

# SCICAN!



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# **The Type of Colour That Will Have the Most Impact on Learning**

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## **I. Abstract:**

The workload in high school is significantly more than elementary schools in Ontario. With the inclusion of final exams, students have to work as hard as usual to memorize all the information taught during the period of exams. However, there is a way to make the lives of the students easier these days and it is a habit developed throughout the year: colour coded notes. This experiment is aimed to determine which colour best memorized by students. By looking at the students' notes, the most common colour that was seen were chosen (grey, black, red, blue, green) and each is used to display a random 20-digit number. The subjects were each given 5 seconds to look at each number and wrote down the number of digits remembered. The results, in average, the colour red had the most digits memorized (average of 7.27 digits) and the colour grey had the least colour memorized (average of 2.73 digits). In the future, if teachers can recommend students to write some essential information in red, the class average will be raised by more than more than just a percentage.

## **II. Introduction:**

Students can find it difficult to transition from elementary school to high school because the workloads are significantly different. This fact is proven by a research ([Tamsin McMahon](#) 2014) done in Canadian secondary schools. The results show that the amount of time Canadian high school students are spending in math class has risen to more than five hours a week, a jump of 90 minutes. Meaning that teachers are giving more and more information to their students, and the students have to memorize all of them. Discovering techniques that can enhance students' work ethic can be the key solution to help them perform a smoother

transition. This is where colour coding comes in. Knowing the right colour that they find the easiest to memorize can reduce a massive time spent amount of repetitive studying. This experiment aims to identify the colour that students memorize the most from within five seconds. If students can develop a habit of writing important information in red, then it would be easier to memorize the content when looking back at it. This is because the colour red is used in many places to represent danger, which means many people have an instinct to recognize this colour before the others and know the importance of it. Also, another similar experiment online (Grace Gilbert 2013) compared the three

colours red, blue, black and concluded that the colour red was the most effective.

### **III. Methods:**

The numbers 47839021569326507814, 25748610393786409152, 79435860128341902567, 01783249651098357246, 86531942706194735820, were chosen to be used to conduct this experiment. Each number was printed in Times New Roman, 20-point form with one of the five common colours that were seen in the subjects' notebooks:

47839021569326507814 in grey,  
25748610393786409152 in black,  
79435860128341902567 in red,  
01783249651098357246 in blue, and  
86531942706194735820 in green (see figure 1).

The subjects were each given 5 seconds to look at each number. Before the subjects were to move on from one number to the next, a pencil and a piece of paper were provided to record the number of digits remembered for that number. Only the colour and the number of digits memorized according to it is recorded. The data was transferred into an excel sheet was used to create bar graphs that clearly displayed the differences in the number of digits memorized for each coloured number. The independent variable in this experiment was the numbers selected for the subjects to memorize. The dependent variable was the number of digits that

were memorized by the subjects. Finally, the controls of this experiment were the number of digits for each number and the font and size of the printed numbers. Subjects who had to memorize a number with more digits could be overwhelmed since only five seconds were given. Also, if the font and size were different for each number, then subjects may memorize more digits out of one number than another since the number printed in that particular font can be more visually appealing than the others. Therefore, the number of digits, font, and size of the numbers must be kept the same for all of the subjects.

### **IV. Results:**

The results of this experiment showed that red was the colour that was memorized the most by the subjects who were being tested on. Out of the 11 subjects, 91% of the subjects found it the easiest to memorize the number that was printed in red (see figure 2). Out of the 20 digits, red had the highest average of 7.27 digits memorized within 5 seconds. In contrast, the colour that represented pencil: gray, had the poorest result of an average of 2.73 digits memorized out of 20 per student (see figure 3). Overall, the results ranked from: red (avg 7.27), green (avg 6.09), black (avg 5), blue (avg 3.82), gray (avg 2.72).

### **V. Discussion & Conclusion:**

The hypothesis was correct as the number printed in colour red had the most digits memorized. According to the data, the red coloured number, on

average has 7.27 digits memorize, whereas no numbers with another colour have exceeded 7 digits. The answer to the initial problem of which colour will be the easiest to memorize is red. An

explanation for this can be that humans have developed an instinct to recognize the colour red before the others. This is because red is usually used in areas to alert the viewers; it can range from small things such as marking errors on a test, to bigger things such as a stop light on the streets. Another explanation can be found in an online article (Oluwakemi Olurinola 2015). The article states that the colour red can alert students to the mistakes they have made and enhance their learning outcomes. An unexpected outcome in this experiment would be how not all students memorized the most digits from the number in red colour, the results only identified the majority of the students. For example, subject number 8, memorized 3 digits for the red coloured number, but more than 3 digits in any other colour; more specifically, 4 digits for gray, 4 digits for black, 4 digits for blue, and 5 digits for green. Further researches can be done on how the colour red can be less visually appealing than other colours to some students. Therefore, it can be concluded that although most students did memorize most from the colour red, the results can be only used to determine the majority of the students but not all. The experiment can be improved by surveying the subjects on their daily practices and colour preferences before taking the test. A possible error that might have occurred during this experiment would be the noise level of the surroundings during the experiment for each subject, which can greatly affect their focus when trying to memorize the numbers.

## **VI. Application**

The results of this experiment can be used in the psychology of education. Knowing the colour that the majority of students find the easiest to memorize can lead to a deeper research to find out why do students behave this way. Not only will this benefit scientist, this can be the solution to significantly increase students' grades and studying habit. Students are taught more and more content as they move through their education stream, it is important for them to realize the importance of the ways they study. If students can identify the colour they find the easiest to memorize and decides to write notes in this colour, massive amounts of time and stress can be reduced when quizzes, tests, and final exams come in their way. In addition, the results of this experiment not only can be applied to the efficiency of learning, it can also be used in other items. This can range from the colour of containers, ranking the importance of the things held inside, to the colour on biking lanes that tells drivers to be aware of bikers. Overall, colours are used on a daily basis, the science that revolves around it can be very interesting and worthwhile to investigate.



figure 1: This is the sheet of paper with the numbers of each colour that is given for the subjects to look at.

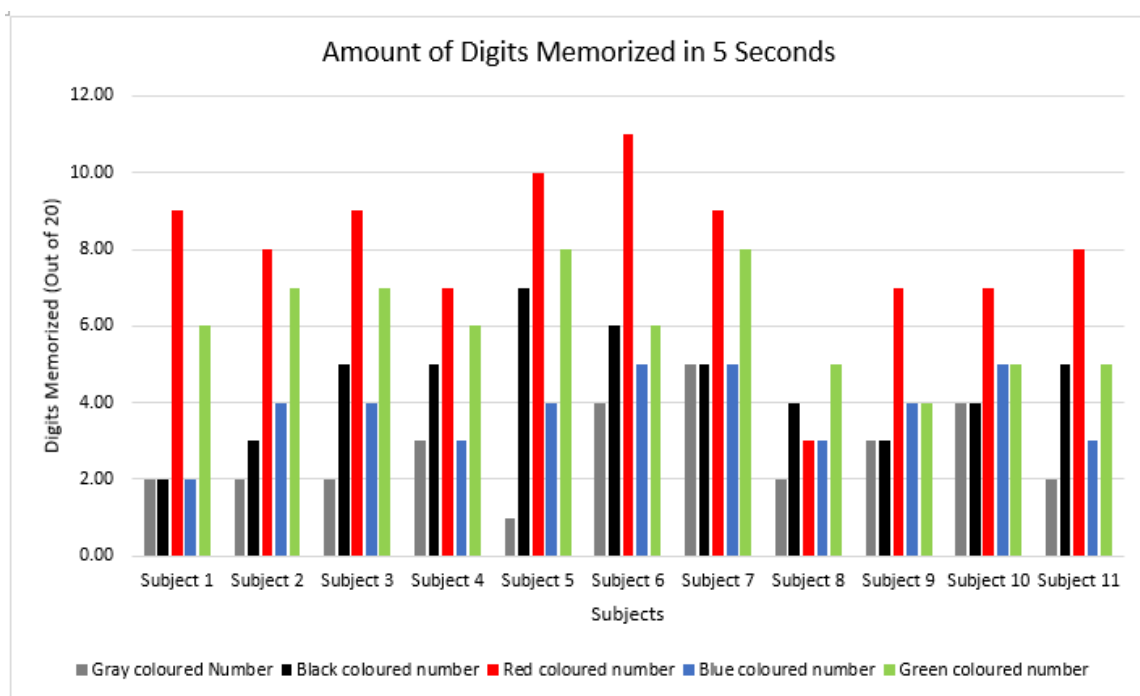


Figure 2: A bar graph that compares the digits memorized for each colour from every subject

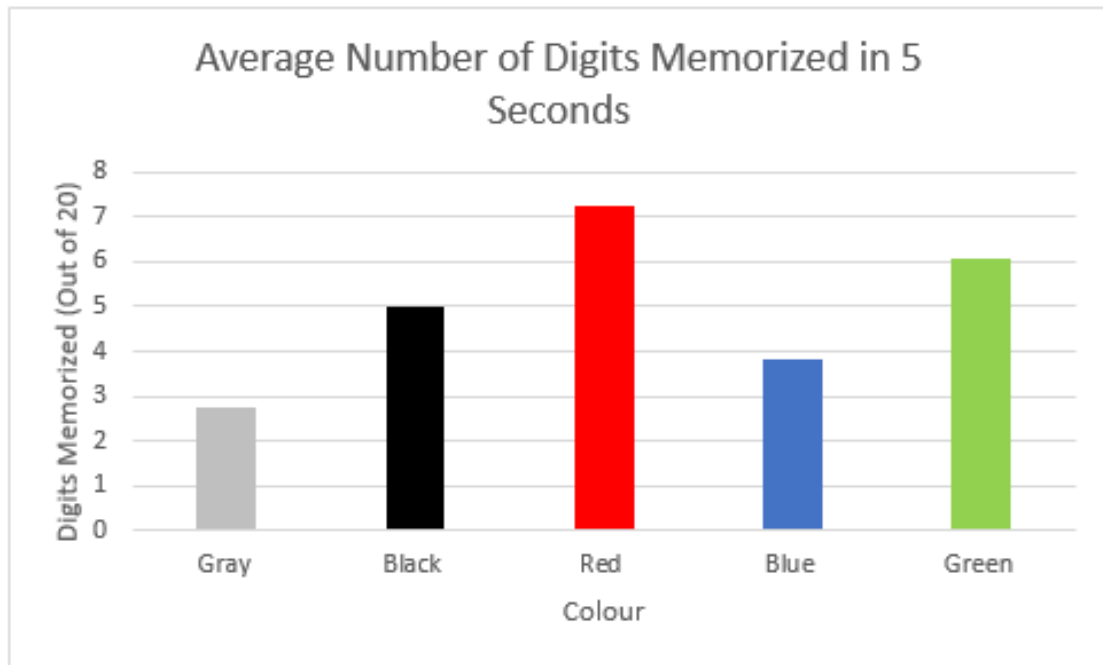


Figure 3: A bar graph that compares the average of the number of digits memorized for each of the colours.

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*Journal of Education and Practice*, 6(14), 1-5.

# **The effect of Aikido on a practitioner's reaction speed**

Andrew

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## **Abstract**

*In modern day society, more people are ignoring the need to question, people don't bother questioning themselves for things. Everything has a purpose, some might even have more than one purpose, martial art is an excellent example. Martial arts teach the students how the way of life should be, how to be respectful, and many other things. One of the most important lessons taught by martial arts is reaction speed, the question investigated was how an Aikido practitioner's reaction speed correlate to their rank. When the subjects got tested on their reaction speed, they were put inside a silent room with nothing but a computer, the subjects had to go to a specific website that tested the subjects' reaction speed. When the subjects had finished the tests and the results had all been compiled, the results were a bit surprising. The data proofed the longer you train in Aikido, the better the student's reaction speed will be. In conclusion, the data imply that learning Aikido can improve the student's reaction speed, the student's reaction speed can be improved more if they learn more about Aikido throughout the years.*

## **Introduction**

Most people in the general population want to learn martial arts just to get in shape and learn how to defend themselves and others when forced into a tight spot. (Eric Daniel, 2005) These people join a martial arts school without acknowledging the other benefits of martial arts. As these new martial arts practitioners' grow up and mature, they begin to notice the other benefits and their lives start to revolve around their martial arts. This experiment will determine if a certain type of martial arts(Aikido) will truly have other benefits other than getting in shape and self-defence. Thus, the question created was does an Aikido practitioner's reaction speed correlate to their rank.

If people practice martial arts(Aikido) daily, then they should have better reaction speed and awareness as they move up in ranks compared to people who do not know any form of martial arts because martial arts require a lot of timing and students need to be aware of their surroundings, so they can know if they're fighting at an advantage or disadvantage. All martial arts require the students to be aware at all times, martial art schools usually do some meditation or breathing exercises to help with the student's awareness, this awareness is called a variety of different things, it is called "Zanshin" in karate, "Chi Gung" in a Chinese martial art called Wushu (Rosendo Lopez, no date). Most students don't realize what the purpose of their training is,



they just blindly go into their training and do whatever the instructor tells them to do. Many martial arts condition their students to help them to keep a clear mind, if the student's mind is bogged, they won't be able to think straight and will be slower than the opponent, most striking martial arts do reaction/combination drills to help with the student's combinations and reaction speed, there are a bunch of drills students do without knowing the purpose of the drills (Evolve MMA, no date). These two are just examples of possible benefits of learning martial arts, there must be other benefits of it, but this experiment will not test the other benefits.

### **Methods**

This experiment was meant to figure out if there is any correlation between reaction speed and Aikido training, in order to conduct this experiment, several Aikido practitioners were needed, along with these people, a device that can connect to the internet is needed so the test subjects can test their reaction speed on an online reaction speed tester.

Prior to starting the experiment, detailed information must be given to the test subjects. The test subjects must know to go to

<https://www.humanbenchmark.com/tests/reactiontime/> after a training session. Have the test subjects test their reaction speed with the website with three minutes intermission in between each attempt. Allow the subjects to have one test run before the actual attempt if they desire so. It's optimal if the subjects were allowed to have a test run because the

subjects might not understand how the tester works and messed up the data completely.

Allow all the subjects to complete the test three times. Gather up all the data and compile them into a chart (Figure 1). Use the data collected and create a bar graph to see if there are any trends in the test subjects' reaction speeds. The independent variable was the subject's level of skill in Aikido, this was different for every subject because if all their skill levels are all the same, the data would be messed up. Ensuring that all the subject's skill levels are all different will lead to a more accurate experiment. The dependent variable was the student's reaction speed. Each subject will have different reaction speeds because of their genetics and time spent training in Aikido. The controlled variables include the dojo the subjects train at, the website used to test, and time allotted between each attempt. The controlled variables were chosen because if these requirements were not made, it could mess up the data collected. Some dojos tend to train their students more intense than other dojos do, this could lead to the students being more disciplined than other students in this experiment. To prevent this from happening, the students will all come from the same dojo (Seikokan Dojo). The website needs to be the same because if all the students used different websites to test the reaction speed, some of the data might not be what they are supposed to be. Some websites are more trustworthy than others, the website that will be used on this experiment is a website dedicated to

test how powerful someone's brain is. The time between each attempt must be controlled because a student might take a 45-minute break between attempt 1 and attempt 2, whereas another student might take 15 seconds break between two attempts. The second student will be more focused on the experiment at hand and will most likely to have better results than usual and the first student will have other thoughts in their heads and will likely do worse. The time when they first attempt it needs to be controlled because the students will all do it after they have attended an Aikido lesson, the students will all still have the night's techniques in their heads and will be in the martial arts mindset, the students will think more like a martial artist at the time and that is when the experiment must be done.

### **Results**

After conducting the experiment, the data showed many things (Figure 2). The data showed a negative trend, as the subject's ranks got higher, their reaction speed was faster (Figure 3). All subjects were tested around the same time (9:30 p.m.) after training, the subjects were all monitored when they were doing the test and didn't attempt to cheat or mess up the data.

### **Discussion & Conclusion**

Yes, the hypothesis to this experiment is correct. The goal of this experiment is to see whether learning a specific type of martial arts(Aikido) will improve one's

reaction speed. As the data collected represents, it can be proven that as you spend more time learning a martial art, one's reaction speed will improve. Not only will the reaction speed improve, in the emails from section five, the scientists have contributed to this experiment by explaining how there are much more benefits other than reaction speed. Since the amount of time spent training in Aikido directly correlates with the subjects' reaction speed, it can be justified that the training provided at the subjects' dojo improve the subjects' reaction speed. The subjects have all devoted their lives to training in this martial art, especially the subjects with more experience. Although martial arts are created so people can protect themselves from harm, they also provide other benefits such as reaction speed and awareness, it is proven that the more time a student spends training in a specific art, it will give them a specific set of skills that the students can apply to life outside the dojo and improve their daily lives.

### **Application**

After the question has been answered, the data gathered can be used in a variety of ways, it can be used in many other researches regarding martial arts and reaction speed. For example, another scientist

could test if learning Judo helps with improving reaction speed, the two sets of data collected could be used to compare to each other to find out which martial art is better for improving the student's reaction speed. Also, a scientist could also research the other benefits of Aikido, the data could be compared to find what the best advantage a student can obtain from learning Aikido.

The information gathered can be extremely useful for the general public, if a person that is interested in martial arts compares the data compared with data from other experiments, the person can use the information to figure out which martial art is best fit and has the most benefits for them.

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# **How the Length of Sleep Relates to the Recognition of Faces, Names and Ages**

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## **I. Abstract**

The question investigated was how the length of sleep related to the recognition of faces, names and ages. Due to studying, students slept for around 5 hours, which was less than the recommended 8 hours per night. However, it was uncertain if that was truly beneficial when it came to remembering information. Four subjects were asked to remember a PowerPoint a day for 4 days which each consisted of 5 names, 5 faces and 5 ages. They slept for 4 different lengths of time. When they woke up, they were asked to recall as many names and ages as they could by answering a Questions PowerPoint. The findings showed that the most names were recalled with either 4 or 12 hours of sleep and the most ages were recalled with 4 hours of sleep. This study did not give a clear answer to the purpose as the results were only 0.25-0.75 off. Although hypothetically, the longer one sleeps the better their memory would be, the data collected from this study did not prove that.

However, research online suggested that by taking naps throughout the day, one's memory could be strengthened, which could be a reason why sleeping for 4 hours has results similar to sleeping for 12 hours.

## **II. Introduction**

Due to studying, students are always sleeping late, but it is unclear as to whether that is truly beneficial. Students normally sleep for around five hours, which is less than the recommended eight hours per night. (How Much Sleep Should a High School Student Get. (n.d.)). Studies show that without adequate sleep, one's brain has a harder time retaining new information. (Sleep Deprivation and Memory Loss. (n.d.)) By answering this question, it will provide more insight as to whether or not the amount of sleep obtained actually affects memory in terms of not only studying, but in everyday life as well such as remembering names, faces, and ages.

The question asks, "how does the length of sleep relate to the recognition of faces, names, and ages?" The hypothesis to this question is if a person sleeps less, then their memory will be worse with remembering faces, names, and ages because sleep involves the brain's hippocampus and neocortex and these areas help make memories last for the long term. Longer periods of sleep mean that there will be more time for these areas to review and process the memory, therefore one's memory will be stronger (Rasch, B., & Born, J. (2013, April). Neurons also do not function as well when a person lacks sleep. It cannot coordinate information properly and the person loses their ability to access

previously learned information. (Sleep, Learning,

and Memory. (n.d.)).

### **III. Methods**

The experiment was conducted on 4 subjects. Each subject had to remember a different PowerPoint for 4 days. Each PowerPoint consisted of 5 faces, 5 names, and 5 ages. They looked at each of the slides for 30 seconds and then went to bed 5 minutes later. For Day 1, they slept for 12 hours, Day 2, 8 hours, Day 3, 4 hours, and Day 4, 2 hours. The 2 and 4 hours were taken as naps. After

sleeping for the required hours, after an hour of awakening, the subjects answered a Questions PowerPoint which had the 5 faces from the PowerPoint they memorized the day before. They had to see how many names and ages they could remember and recorded their results in this table below.

| Day # | Time Slept (hrs) | # of Names Recalled | # of Ages Recalled |
|-------|------------------|---------------------|--------------------|
|       |                  |                     |                    |
|       |                  |                     |                    |
|       |                  |                     |                    |
|       |                  |                     |                    |

The independent variable was the length of sleep. The dependent variable was the number of faces, names and ages the subject would be able to recognize.

The first controlled variable was the level of difficulty for testing, which consisted a mix of males and females, 5 faces, first and last names, and ages from 1-100. This was done to ensure the subject would not have a harder time memorizing one test than another. The second controlled variable was the amount of time to view each slide, which was 30 seconds, as viewing the slides for different lengths of time would affect how well the

subject could memorize the information. The third controlled variable was the location of sleep and the location of where the subject was viewing the slides as how the environment affects sleep and memory was not relevant to this experiment. The fourth controlled variable was to be awake an hour before getting tested. This was done to make sure that the subject had the same amount of time everyday to refresh their brain before testing. The last controlled variable was going to bed 5 minutes after looking at the slides, as this would ensure the subject would not have much extra time to process the information they just viewed before sleeping.

## **IV. Results**

Table 1- Subject #1's results of how many names and ages they were able to recall by sleeping for the different lengths over the course of 4 days

| <b>Day #</b> | <b>Time Slept (hrs)</b> | <b># of Names Recalled</b>                                | <b># of Ages Recalled</b> |
|--------------|-------------------------|-----------------------------------------------------------|---------------------------|
| <b>1</b>     | 12                      | 3- Arial Light<br>Jane Alie<br>Sammy Tabu                 | 3- 41<br>32<br>21         |
| <b>2</b>     | 8                       | 1.5- Hayley<br>Irene Yitva                                | 1-18                      |
| <b>3</b>     | 4                       | 4-Anthony Tong<br>Kita Rima<br>Popgh Van<br>Slire Prime   | 3-7<br>71<br>29           |
| <b>4</b>     | 2                       | 4- George Buska<br>Pippy Nit<br>Eva Ripplie<br>Kalbe West | 3-36<br>24<br>25          |

Table 2- Subject #2's results of how many names and ages they were able to recall by sleeping for the different lengths over the course of 4 days

| <b>Day #</b> | <b>Time Slept (hrs)</b> | <b># of Names Recalled</b>                  | <b># of Ages Recalled</b> |
|--------------|-------------------------|---------------------------------------------|---------------------------|
| <b>1</b>     | 12                      | 3- Jane Alie<br>Elisso Karen<br>Sammy Tabo  | 2-<br>37<br>21            |
| <b>2</b>     | 8                       | 3- Ivan Rewaie<br>Irene Yitva<br>Rina Acide | 3-89<br>34<br>56          |
| <b>3</b>     | 4                       | 0                                           | 3-37<br>71<br>29          |
| <b>4</b>     | 2                       | 1- George Buska                             | 3-36<br>57<br>43          |

Table 3- Subject #3's results of how many names and ages they were able to recall by sleeping for the different lengths over the course of 4 days

| <b>Day #</b> | <b>Time Slept (hrs)</b> | <b># of Names Recalled</b>                  | <b># of Ages Recalled</b> |
|--------------|-------------------------|---------------------------------------------|---------------------------|
| <b>1</b>     | 12                      | 2- Arial Light<br>Jane Alie                 | 2- 41<br>32               |
| <b>2</b>     | 8                       | 2- Ivan Rewaie<br>Steven Ippa               | 2-89<br>51                |
| <b>3</b>     | 4                       | 3-Anthony Tong<br>Kita Rima<br>David Stova  | 3-7<br>37<br>34           |
| <b>4</b>     | 2                       | 3- George Buska<br>Pippy Nit<br>Juliet Iwon | 3-36<br>57<br>43          |

Table 4- Subject #4's results of how many names and ages they were able to recall by sleeping for the different lengths over the course of 4 days

| Day # | Time Slept (hrs) | # of Names Recalled                                                    | # of Ages Recalled          |
|-------|------------------|------------------------------------------------------------------------|-----------------------------|
| 1     | 12               | 4- Arial Light<br>Caily Siwek<br>Elisso Karen<br>Sammy Tabo            | 4- 41<br>19<br>37<br>21     |
| 2     | 8                | 3-Hayley Fira<br>Irene Yitva<br>Steven Ippa                            | 3-18<br>34<br>51            |
| 3     | 4                | 5-Anthony Tong<br>Kita Rima<br>David Stova<br>Popgh Van<br>Slire Prime | 5-7<br>37<br>34<br>71<br>29 |
| 4     | 2                | 3- Eva Ripplie<br>Pippy Nit<br>Juliet Iwon                             | 3-24<br>57<br>43            |

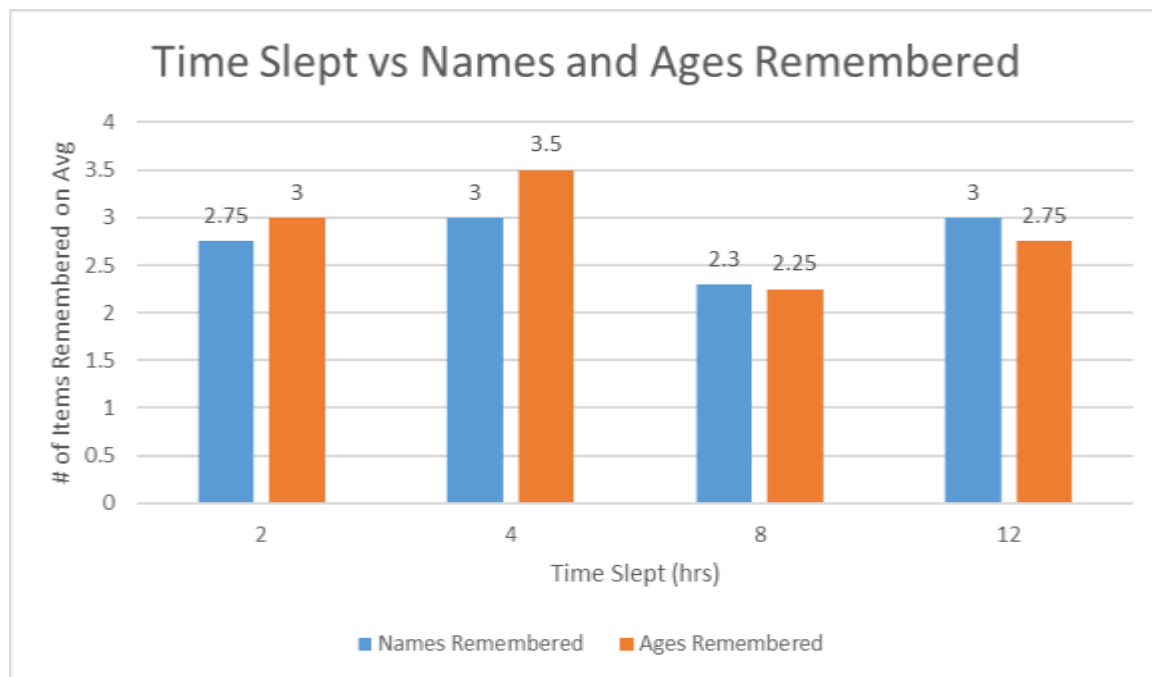


Figure 1- The difference on average in the recognition of names and ages slept for different lengths

## V. Discussion & Conclusion

The hypothesis was that if the subject sleeps for a longer period of time, then they will be able to recall more names and ages. However, it was not correct because this experiment was done on 4

different subjects and on average, the number of names and ages that were remembered were almost the same (between 2-3).

The initial purpose of this experiment was to figure out how the length of sleep relates to the recall of faces, names, and ages. The findings show that the most names will be recalled with either 4 or 12 hours of sleep and the most ages will be recalled with 4 hours of sleep. This study did not give a clear answer to the purpose as the results were only 0.25-0.75 off.

Science states that by sleeping, the brain uses the hippocampus and neocortex, which help make memories last the long term. By sleeping longer, it gives more time for these areas to process and review the information learned, making memory stronger. Hypothetically, the longer one

## **VI. Application**

This information gained from this experiment could be applied to other fields of study such as those who do a lot of research on face perception and face memory. It can help with figuring out why some people have trouble recognizing faces, names and ages and if sleep is a factor that contributes to it. The general public could also use this data to determine how many

sleeps, the better their memory is. However the data collected in this study does not show that. There are research online which suggest that by taking naps throughout the day, one's memory could be strengthened, which could be a reason why sleeping for 4 hours has results similar to sleeping for 12 hours.

Some errors could have affected the result as well. For example, a subject could be used to sleeping for little hours a day, do not sleep for the full time requested, or naturally have problems remembering faces, names and ages. If these errors did not occur, the results would be much more accurate.

hours they want to sleep a night for optimal memory (although the results are similar). The scientific community can use this data to dig deeper and investigate in depth on how exactly sleep affects memory differently between remembering faces, names, and ages and remembering vocabulary and facts.

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# Determining the Best Foundation and Its Effects on the Skin When Worn Regularly Over the Course of a Week

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## I. Abstract

This experiment was to investigate the question, "Are cheaper foundations more or less harmful to the skin than more expensive foundations over the course of a week?". This was an important question to ask because it would inform buyers if it's worth splurging on an expensive cosmetic product for the sake of their skin's health. 4 foundations ranging from \$7.00 to \$56.00 were handed out to 4 subjects who were asked to use the foundation for 10 hours a day for 1 week. They were to record on a chart how their skin looked/felt at the end of each day on a scale of 1-10. It was found that the cheapest foundation (COVERGIRL Ready, Set, Gorgeous foundation; \$7.00) had the steadiest and highest growth in skin improvement, steadily being rated from a 5 to a 9 over the week. This data showed that the cheaper foundation had a better effect on the skin over time, answering the initial question clearly.

## II. Introduction

Users of cosmetics spend an average of \$1 500 on makeup products in their lifetime (<https://www.cheatsheet.com/money-career/how-much-do-we-spend-on-beauty.html/?a=viewall>). A full face of makeup can cost from \$5-\$11.00 on any given day (<https://www.allure.com/story/average-woman-spends-on-makeup>). Pageant-obsessed women and men from Venezuela even spend as much as \$12,500 on foundation in a year, (<https://www.newbeauty.com/blog/dailybeauty/11063-how-much-money-women-spend-on-beauty-products/>). Choosing the right foundation for your skin is important, as failing

to do so may cause breakouts, irritation, dryness, etc. For example, using an thick, oil-based foundation that is heavy and blocks your pores most likely will cause you to breakout (<http://blog.mariobadesco.com/foundation-2/>).

The problem is, not everyone has the money to spend on expensive high-end products. So, does that mean that their cheaper foundations are doing damage to their skin?

How does the price of a cosmetic foundation affect its effects on skin (breakouts, dryness, etc.) when worn for 10 hours daily over the course of 1 week?

The following 4 foundations are tested:

1. COVERGIRL Ready, Set, Gorgeous (\$7.00)

2. L'Oreal Infallible 10HR Pro-Matte (\$17.00)
3. SEPHORA 10HR Wear Perfection (\$26.00)
4. Too Faced Born This Way (\$54.00)

It is hypothesized that if the \$56.00 foundation is worn 10 hours/day for a week and correctly washed off every night, then it will show the most improvement in skin over the week. This is because the ingredients to make the product (such as alpine rose for brightness, hyaluronic acid and coconut water for hydration) are much pricier than the other foundations. All these extra ingredients are expensive because it's supposed to be good for the skin, while still providing the coverage needed in a foundation.

### III. Methods

This experiment began by collecting 4 subjects, aged between 14-20, who are not diagnosed with any skin conditions such as rosacea or cystic acne, etc. Next, the 4 foundations listed in the previous section were purchased and assigned to each subject without telling them the price of the product. The subjects were then given a chart where they recorded their skin reactions daily while using the foundation. They were instructed to wash their face with plain water in the morning and dry off with a clean towel. They were then to dab on a dime-sized amount of their respective foundation, using a clean cosmetic sponge. No other facial products such as concealer or powder were to be applied. After going about their day, 10 hours after

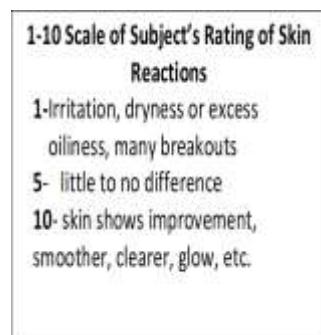
initially putting on the foundation, the subject washed their face using Johnson's baby shampoo to gently remove the foundation. After waiting a couple of minutes (about 10 minutes) to allow their skin to relax after washing it, the subject recorded how their skin looked and felt on their chart. The subject was given a scale of 1-10 (**figure 1**) with which they recorded their results. 1 meant that the skin became very irritated with many new breakouts or unusual dryness or oiliness. 5 meant that there was no noticeable difference in the skin. Lastly, 10 meant that the skin had showed great improvement and was brighter, clearer and smoother.

Once the week was up, the subject's data was collected and put into 5 charts (bar graphs). 1 per subject/brand of foundation, and 1 showing all of the foundations side by side for easy comparison. The foundation that shows growth in the ratings was the foundation which shows the most improvement in the skin.

The independent variable in this experiment was the brand/price of foundation used. The dependent variables were changes in one's skin, such as breakouts, dryness, irritation, etc. whether it is worse or better. The controlled variables include the instructions for the subjects to wash their face with baby shampoo and plain water. This was to make sure that any changes in their skin were due to the foundation and not some other product, like soap or cleanser. The time of wear and amount of

foundation was also controlled (10 hours of wear, dime-sized amount of foundation per day). This was to keep all the results equal. Using a clean beauty sponge was important to make sure that no dirt from fingers or unclean brushes or sponges affected the foundation's results. The ages of the subjects (ages 14-20) was also important to control because as one ages, their skin's sensitivity changes and usually does not break out as much as a teenager's skin. Making sure the subjects did not have any skin conditions was also important because that would have significantly affected the results. This is because any irritation could have been caused by their condition and not the foundation. Lastly, the subjects were not told the price of the product they were assigned. This was to avoid what's known as the placebo effect, a phenomenon where one's expectations of a product will cause them to see changes that would not necessarily be there otherwise.

**Figure 1**



Scale given to subjects.

1. COVERGIRL (\$7.00)
2. Too Faced (\$54.00)
3. L'Oreal (\$17.00)
4. SEPHORA (\$26.00)

#### IV. Results

The data in this experiment showed that the COVERGIRL Ready, Set, Gorgeous foundation showed the steadiest and highest growth in skin improvement. (**Graph 1**) The first 2 days showed no difference but as the days progressed, especially days 4-7, the rating went up all the way to 9. (**Graph 2**) L'Oreal Pro-Matte foundation did not show a specific pattern in skin improvement. Days 3 and 4 were days where the subject's skin became worse and near the end (days 5-7) showed improvement again. These results were inconclusive. (**Graph 3**) Sephora 10Hr Wear foundation showed clear decline in the skin's health over the week, never exceeding past 5 on the chart, and hitting a low 3 at the end of the week. (**Graph 4**) Too Faced Born This Way foundation showed somewhat steady improvement throughout the week, although not as significant as its much cheaper opponent, COVERGIRL. At the end of the week however, it did reach a 9 on the rating scale as well.

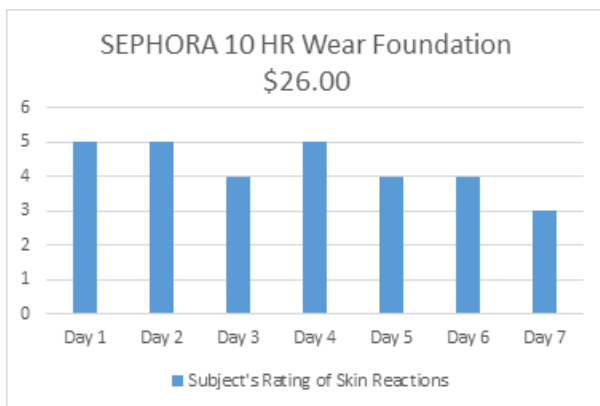
List of best to worst foundations:



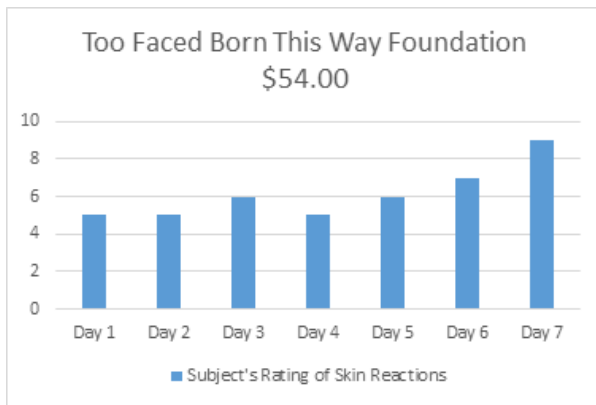
1 Ratings of Subject A's skin reactions to COVERGIRL Ready, Set Gorgeous foundation over 1 week.



2 Ratings of Subject B's skin reactions to L'Oreal Pro-Matte 24HR foundation over 1 week.



3 Ratings of Subject C's skin reactions to SEPHORA 10HR Wear foundation over 1 week.



4 Ratings of Subject D's skin reactions to Too Faced Born

This Way foundation.



5 Ratings of all foundations' results compared to each other

over 1 week.

## V. Discussion & Conclusion

The hypothesis was incorrect. The cheapest foundation, the \$7.00 COVERGIRL foundation showed the greatest and steadiest improvement in skin over the week, with ratings steadily growing from 1 to an impressive 9. No dips in

skin reaction ratings were shown through the 7 days.

The reason this happened is because each foundation has different ingredients. The price of those ingredients does not necessarily define their ability to improve skin quality. As stated in

the hypothesis, Too Faced's coconut oil, alpine rose and hyaluronic acid were in fact helpful to the skin, which is likely why Too Faced came up second, very close behind COVERGIRL. While COVERGIRL does not have any fancy additions to its formula, the ingredients in it form a great product which is good for the skin. The other foundations likely failed on the list due to their matte properties. Matte products do not have as many (if any) hydrating ingredients in them, drying out skin and therefore causing breakouts. The prices of the foundations did not show any pattern. The cheapest was followed by the priciest foundation, then by the second cheapest and lastly by the second priciest. Even though the \$7.00 foundation came in first, it was very close, and does not necessarily mean that all cheap products are better than expensive ones. In this particular set of brands and products, however, "cheaper is better" holds true.

Another way to interpret this data is that it depends on the person and ingredients. The fact that no pattern was shown in the prices and order of best to worst foundations supports that.

Further research on the active ingredients in foundations that make it good or bad for the skin would be necessary to answer questions such as, "Why was there no pattern in the prices of the products and their results?"

A problem with this experiment is the number of subjects. To be able to collect more accurate

data, hundreds of subjects are needed, because then it's possible to find the average results per product. Having one subject per product is not very accurate as every person's skin is different and reacts differently to things. Another problem is not having more brands of foundations from different price points to test out. This would make seeing patterns easier, while the 4 foundations used here could differ because of their different formulas, not their prices. If the money and resources to have more subjects and products were available, the results would be much more accurate, and any outliers wouldn't have affected the data very much.

## **VI. Application**

This information is useful for those who are into makeup or even those who are self-conscious about their skin and want to fake better skin. It's important to take care of the skin as its with you your whole life. There's no point in covering up blemishes with a foundation that will only make them worse. Nobody wants to spend a fortune on a foundation when they could get the same or even better results for 8 times cheaper.

This data could be applied to other studies in the cosmetic field, by analyzing more closely how the makeup of cheaper/more expensive ingredients affect the skin. It could also be retested at a larger scale, getting more accurate results.

The public is easily fooled by media. It's put into their heads that big, expensive brand names are the way to go and that they are better. This causes a lot of wallets to go empty when that money could be spent on something more useful. Knowing that a foundation as cheap as \$7.00 will do good for your skin will allow consumers to make smarter decisions when shopping, allowing shoppers to be confident in their skin while being financially-friendly.

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# Colour's Effect on People's Interpretations and Opinions of Images

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## I. Abstract

The purpose of the investigation was to see how the colours and colour hues used in images impact the way people feel about images. This was important because colour is used in almost every part of daily human life, such as advertisements, clothes, movies, packaging, etc., and it is therefore important to understand colour's relevance in those aspects. The method used to gather data was to show subjects a series of cool-toned images and identical warm-toned images and ask them a series of questions in which the subjects were forced to give a positive, negative response. The subjects were then asked to choose between the identical pairs of images after their previous responses had been recorded. The experiment resulted with the subjects were directly asked to pick between each pair of identical images, the warm-toned images all received the majority of picks. The results concluded that warm-toned images invoke a more positive thought process on people, and cool-toned images do the opposite, implying that colour does affect how people feel or think when viewing an image.

## II. Introduction

Sarah E. Babin (2013) stated that, the relationship between color and the environments [people] live in is one of great dynamics. People should understand these dynamics because color not only affects the way they interpret their environments, but also the images they see. Photos, paintings, and advertisements all use color to convey something and evoke certain feelings in people, which is why it is important to answer the topic and know how they do it.

This is why it is important to answer the question, how do images with different color schemes and hues cause different feelings and/or opinions in people?

The hypothesis is that if an image with bright and warm colors is compared to the same image but with cool and darker colors, then the image with brighter

colors will evoke more positive feelings than the one with the darker and cooler colors because warm and bright colors are associated with positive emotions and meanings. People such as designers and interior decorators have discovered that color sets a mood (Gruson, 1982). And as Goethe's *Theory of Colors* (1810) mentioned, colors like yellow, red and orange are accosted with positive feelings like liveliness, warmth, energy, and cheerfulness, and colors like blue, purple, and green are associated with things like coldness, simplicity, and darkness itself. And it had been proven that colors like blue can help with focus and red can help with athletic performance (Elliot, 2015), due to the emotions and feelings they are associated with.



### III. Methods

Images were gathered along with identical versions of the images that contained opposite colour hues. A subject was then brought into a room that was not densely crowded, and there were little to no distractions in order to gain the subjects full attention. The subject was then shown image 1 from Figure 1 and asked question 1 from Figure 2 for that image.

#### IMAGES:

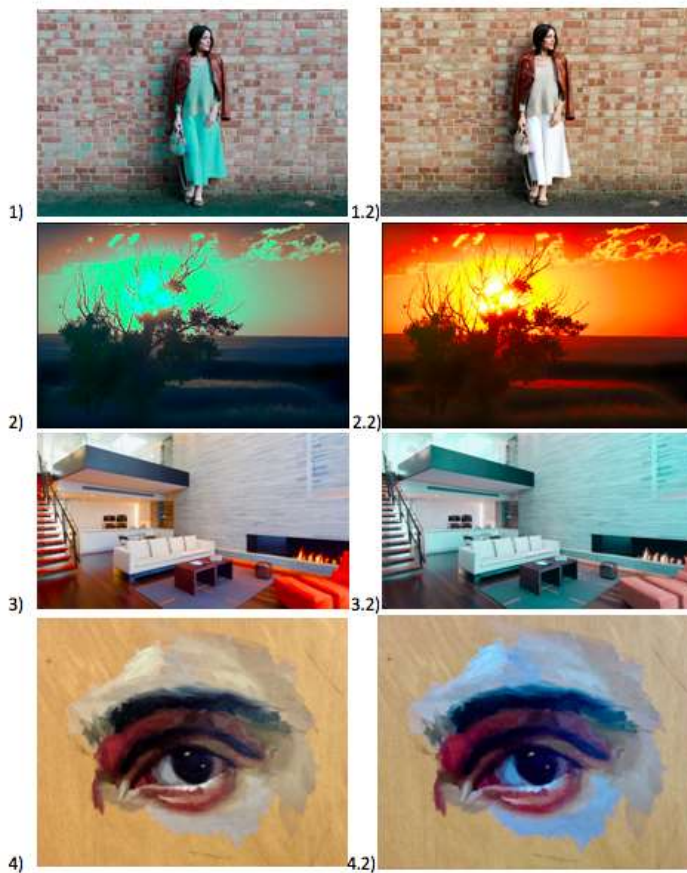


Figure 1: The images shown to the subjects during the experiment.

#### QUESTIONNAIRE:

##### Questions for images 1 and 1.2

- 1- What feelings/tones do you associate with this image?
- 2- What feelings/tones do you associate with this image, now that the hue/color has been changed?
- 3- If this were a clothing ad, which version of the photo would appeal to your interest more and why?

##### Questions for images 2 and 2.2

- 1- What would you assume the weather is like in this image?
- 2- What would you assume the weather is like in this image now that the hue/color has changed?
- 3- If you were to pick one of these to set as a wallpaper for something, which one are you more likely to pick and why?

##### Questions for images 3 and 3.2

- 1- Describe, in your opinion, what kind of personality a person would have to own a house with this kind of interior color scheme?
- 2- Does your opinion change now that the hue has been changed?
- 3- Which version of this room would you feel more warm/comfortable/relaxed in?

##### Questions for images 4 and 4.2

- 1- Which emotion/tones do you think the artist of this painting was trying to convey with this painting?
- 2- Which emotion/tones do you think the artist was trying to convey now that the color has changed?
- 3- If you were to buy this painting, which version are you more likely to buy and why?

Figure 2: The questionnaire used during the experiment.

The subject was given thirty seconds and their response was recorded in an observation table. They were then asked question 2 for image 1.2. They were given thirty seconds and the response was recorded. For question 3, the subject was shown both images 1 and 1.2 at the same time and given thirty seconds. Their answer was recorded. This process was then repeated for images 2 & 2.2, 3 & 3.2, and 4 & 4.2. The same procedure was used on all ten subjects.

The independent variables were the colors of images being shown. The dependent variables were the subject's opinions. The control variables included how many images were shown so that each subject had the same number of images to give responses to; Age group of the subjects (tenth graders) so that any opinions/feelings from the subjects were not different due to large gaps in age. Each subject had the same general knowledge for their age group, and therefore their answers were based off of the same general knowledge; The amount of time

the subjects had to look at the images so that each subject had the same amount of time to look at the images, think about their responses, and answer the questions asked; The questions asked so that responses could be compared for the same questions, and differences and similarities in responses could be

observed; The images shown, so that each subject looked at the same thing and not something else. This allowed for comparisons to be made over their responses due to the colors and hues that were used, and not the objects in the images.

#### IV. Results

The subjects responses (tables 1-10) were categorized as either positive or negative (table 11)

Table 1:

OBSERVATION TABLE - 1

|                 | Response to question 1         | Response to question 2  | Response to question 3                                                                        |
|-----------------|--------------------------------|-------------------------|-----------------------------------------------------------------------------------------------|
| Image 1 and 1.2 | Vibrant<br>Quiet               | Colorful<br>energetic   | I would buy the second one because it looks more natural and realistic.                       |
| Image 2 and 2.2 | Warm<br>Sometime in the spring | Humid<br>Summer         | I would pick the second one because it gives off a relaxing vibe and it is visually appealing |
| Image 3 and 3.2 | Old<br>outgoing                | Young<br>Modern<br>nice | The first one because it looks warmer and more comfortable                                    |
| Image 4 and 4.2 | sad                            | Jubilant<br>Focused     | The first one because the colors go well together more than the second one                    |

Table 2:

OBSERVATION TABLE - 2

|                 | Response to question 1                  | Response to question 2                                            | Response to question 3                                                           |
|-----------------|-----------------------------------------|-------------------------------------------------------------------|----------------------------------------------------------------------------------|
| Image 1 and 1.2 | Calm                                    | Neutral feeling                                                   | The second one appeals more to my interests and looks better IMO                 |
| Image 2 and 2.2 | Clear and cool                          | The same just warmer                                              | The second one because the sunset looks clearer and the colors are warmer        |
| Image 3 and 3.2 | Very welcoming and friendly personality | It seems as if they are hiding something (they are not very open) | First because the colors are warmer and because of the way I perceive the person |
| Image 4 and 4.2 | Misery and desperation                  | Desperation and sadness                                           | The second one because it is more aesthetically pleasing                         |

Subjects 1 and 2's responses.

Table 3:

OBSERVATION TABLE - 3

|                 | Response to question 1                                                                              | Response to question 2         | Response to question 3                                                       |
|-----------------|-----------------------------------------------------------------------------------------------------|--------------------------------|------------------------------------------------------------------------------|
| Image 1 and 1.2 | Adventurous<br>Vibrant<br>Open-minded                                                               | Family<br>Homey<br>Comfortable | The second one: Don't know why                                               |
| Image 2 and 2.2 | The year 2046 when everything is Unnatural<br>No healthy environment                                | Hot 2038 sunset                | Second: Because I like more calming backgrounds                              |
| Image 3 and 3.2 | Modernism (television surgeon) Doesn't socialize well: Self-dependent/reliant Not close with family | No change                      | The first one: Seems like it's more open and has more natural lighting in it |
| Image 4 and 4.2 | Natural<br>Inightful<br>Wise                                                                        | Selfish<br>Biased              | First one because it looks more natural                                      |

Table 4:

OBSERVATION TABLE - 4

|                 | Response to question 1                      | Response to question 2         | Response to question 3                         |
|-----------------|---------------------------------------------|--------------------------------|------------------------------------------------|
| Image 1 and 1.2 | Nice<br>Harmony between colors              | Warm<br>calming                | First one because the colors match better      |
| Image 2 and 2.2 | Cloudy<br>Sunny<br>Warm                     | Warmer<br>Summer               | The second one because it looks more beautiful |
| Image 3 and 3.2 | Neat and organized<br>Someone who is bright | More dull<br>Plain personality | The first one                                  |
| Image 4 and 4.2 | Sadness<br>Sorrow                           | No change                      | The first one because it has more depth        |

Subjects 3 and 4's responses.

Table 5:

**OBSERVATION TABLE - 5**

|                 | Response to question 1                | Response to question 2             | Response to question 3                                        |
|-----------------|---------------------------------------|------------------------------------|---------------------------------------------------------------|
| Image 1 and 1.2 | Artsy<br>Classy                       | Colorful                           | The second one because the filter looks better with the image |
| Image 2 and 2.2 | Sunny<br>Sundown<br>Fall              | Hot weather<br>Summer<br>Africa... | Image 2 because the filter feels warmer                       |
| Image 3 and 3.2 | Classy<br>Fashionable<br><br>Stubborn | Depressed<br>lonely                | The first one because of the filter is more colorful/warmer   |
| Image 4 and 4.2 | Confident<br>strong                   | Not really                         | First one because it looks better                             |

Table 6:

**OBSERVATION TABLE - 6**

|                 | Response to question 1                                                                                       | Response to question 2                                                                                                     | Response to question 3                                                                                |
|-----------------|--------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|
| Image 1 and 1.2 | Conflicting, calm, I feel like the girl is condescending                                                     | Warm, nice, definitely feel better and less confident, girl seems more open and approachable                               | Definitely the second one.                                                                            |
| Image 2 and 2.2 | It looks nice, breezy, but it was probably really hot during the day, probably unknown,                      | It looks hot, desert, savannah like, it's probably sunrise.                                                                | The first one because I like the variation in colors, for example the pink and blue is nice together. |
| Image 3 and 3.2 | Hard working, neat, organized, punctual, talk with poise, confident,                                         | No.                                                                                                                        | Obviously the first one.                                                                              |
| Image 4 and 4.2 | I think she was sad, and wanted people to know that she saw more than she showed to others. She felt lonely. | The author is trying to convey a mischievous feeling, the eye looks more playful and insightful but in a warm and fun way. | The second one, because I feel happier and more fun when I see the second one.                        |

Subjects 5 and 6's responses.

Table 7:

**OBSERVATION TABLE - 7**

|                 | Response to question 1              | Response to question 2                               | Response to question 3                       |
|-----------------|-------------------------------------|------------------------------------------------------|----------------------------------------------|
| Image 1 and 1.2 | Peace                               | Coffee<br>Aesthetic<br>Modern                        | The second one because its more professional |
| Image 2 and 2.2 | Fall, cool, sunset                  | Summer, scorching hot, humid, burning, extremely hot | First one                                    |
| Image 3 and 3.2 | Smart, sleek, poised, professional, | Yes, the person seems like a party person            | The first one; its homier                    |
| Image 4 and 4.2 | Purity                              | Sadness, sorrow, sympathy                            | The first one since its seems more elegant   |

Table 8:

**OBSERVATION TABLE - 8**

|                 | Response to question 1                                                                      | Response to question 2                                                | Response to question 3                                                                                      |
|-----------------|---------------------------------------------------------------------------------------------|-----------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|
| Image 1 and 1.2 | Yellow<br>Calm<br>Pretty and fashionable outfit...makes me want to copy her                 | Fall<br>More modernish                                                | 2 because the color scheme is more matching                                                                 |
| Image 2 and 2.2 | Feels calming and reminds me of summer beaches. Not warm beachy and serene peaceful weather | More not peaceful because red is rage                                 | 1 because I like peace and not rage - more calming and it will help me be calm and focused and study better |
| Image 3 and 3.2 | Calm because not a lot of stuff is crowding and is maybe artsy.                             | Yes. The person is more calm and serene because blue symbolizes peace | 1 because there is more contrast                                                                            |
| Image 4 and 4.2 | Person looking into my soul so he can help me. Reminds me of a therapist analyzing me.      | Gentle eye staring at me less intense                                 | 1 because I like intense things                                                                             |

Subjects 7 and 8's responses.

Table 9:

Table 10:

OBSERVATION TABLE - 9

|                 | Response to question 1                                           | Response to question 2                             | Response to question 3                                               |
|-----------------|------------------------------------------------------------------|----------------------------------------------------|----------------------------------------------------------------------|
| Image 1 and 1.2 | Calm and soothing                                                | Warm, muffins                                      | 2 cuz it seems warmer and inviting and reminds me of the fall        |
| Image 2 and 2.2 | A warm sunny spring day                                          | Summer, hot humid                                  | 2 cuz its brighter                                                   |
| Image 3 and 3.2 | quiet, organized friendly                                        | Calm and put together                              | 1 the colors are more inviting                                       |
| Image 4 and 4.2 | A person looking at something can only see what's on the surface | The person is seeing something that makes them sad | 1 cuz it makes me think more of what the printer is trying to convey |

OBSERVATION TABLE - 10

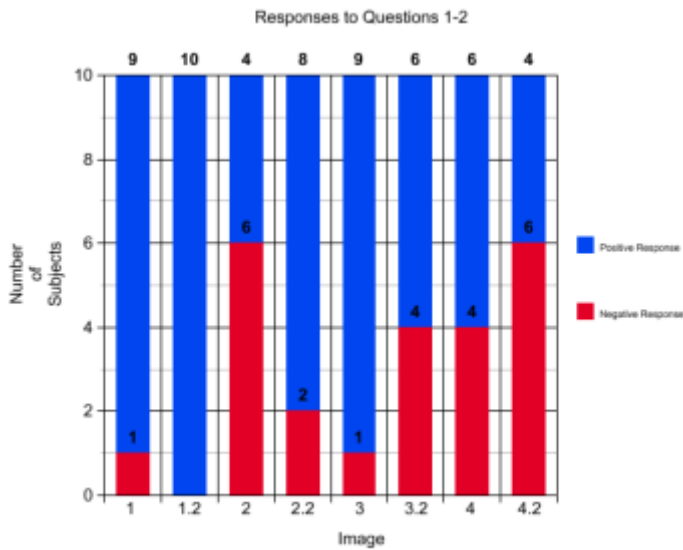
|                 | Response to question 1                              | Response to question 2                                                                                                              | Response to question 3                                                         |
|-----------------|-----------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|
| Image 1 and 1.2 | Serenity, I feel very calm and relaxed              | Fall,                                                                                                                               | 2 <sup>nd</sup> picture                                                        |
| Image 2 and 2.2 | Cold, possibly rain and the water could be freezing | Windy, but warm                                                                                                                     | 1 <sup>st</sup> because it is more colorful and less intense                   |
| Image 3 and 3.2 | Someone who is more reserved and more put together  | No, the color is the only difference, even though the first picture has less color, but the person seems more like she doesn't care | The first one, because it is having more warm color and isn't as dull          |
| Image 4 and 4.2 | Focused, and is just observing something            | It is sadder, because it looks like there are tears in the eye                                                                      | The second one, because it shows more emotion and the colors look more vibrant |

Subjects 9 and 10's responses.

Table 11:

| Words Considered Positive                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Words considered negative                                                                                                                                                                                                                                                                                                                                                                                                                |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>- Vibrant</li> <li>- Warm</li> <li>- Spring</li> <li>- Outgoing</li> <li>- Calm</li> <li>- Welcoming</li> <li>- Friendly</li> <li>- Focused</li> <li>- Put-together</li> <li>- Serenity</li> <li>- Relaxed</li> <li>- Sunny</li> <li>- Summer</li> <li>- Help</li> <li>- Calming</li> <li>- Purity</li> <li>- Smart</li> <li>- Sunset</li> <li>- Comfortable</li> <li>- Homey</li> <li>- Family</li> <li>- Adventure</li> <li>- Inviting</li> </ul> | <ul style="list-style-type: none"> <li>- Sad</li> <li>- Cool</li> <li>- Tears</li> <li>- Dull</li> <li>- Intense</li> <li>- Cold</li> <li>- Fall</li> <li>- Windy</li> <li>- Rain</li> <li>- Freezing</li> <li>- Rage</li> <li>- Sorrow</li> <li>- Sympathy</li> <li>- Lonely</li> <li>- Breezy</li> <li>- Condescending</li> <li>- Misery</li> <li>- Desperation</li> <li>- Depressed</li> <li>- Selfish</li> <li>- Reserved</li> </ul> |

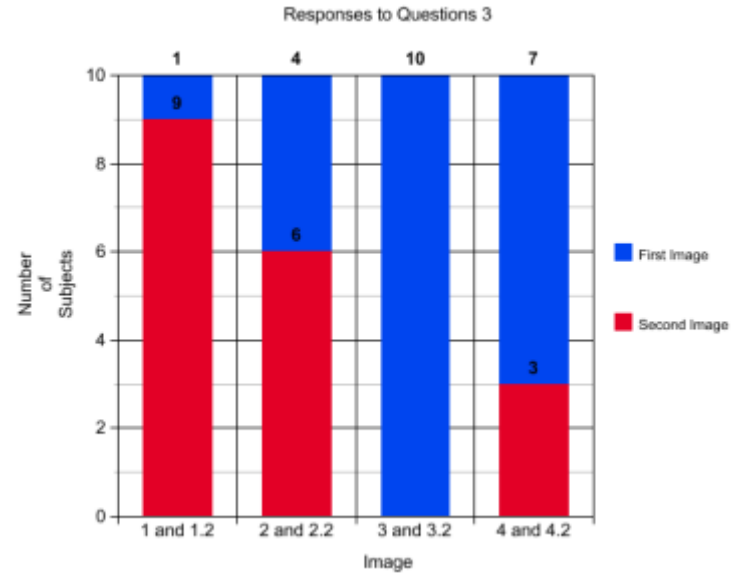
Key words that subjects used in their responses were categorized as either positive or negative responses. This allowed for a numerical count of positive and negative responses used in Figure 3.



**Figure 3:** The subjects responses to the first two questions asked for each pair of images. Responses were considered positive or negative according to where their responses were categorized in table 11.

## V. Discussion & Conclusion

The hypothesis was correct. Images with different color schemes and hues cause different feelings and/or opinions in people because images with warmer hues and colors are associated with more positive feelings and emotions than images with cool hues and colors are. In the data collected, the amount of negative responses to the questions asked for the warmer images was less than the images that had cool hues. Image 1 had a 10% greater negative response than 1.2, image 2 having a 40% greater negative response than 2.2, image 3.2 having a 30% more negative response than 3, and 4.2 having a 20% greater negative response than 4. A total of 6/8 images had a majority of positive responses, however when asked to choose between each pair of images, the majority of the subjects chose the images with warm hues over the images with cold hues, each



**Figure 4:** The subjects responses to the third questions asked for each pair of images. Results were organized by which image they chose.

result having 6/10 or higher number of picks for the warmer images because it appealed to them more.

When gathering the data, it was noted that male subjects had a harder time interpreting images or associating them with emotions than female subjects did. This could be because the male stereotype does not show and/or feel as much emotion than the female stereotype, therefore making it harder for them to associate other things, like images, with emotions. Also, in the subject's answers for question 1-2 for each image, the responses were more open-minded than the answers for question 3 for each image where the subjects did not hesitate to pick between images. For example, subject 6 responded positively about question one for image 3, using words such as hard-working, confident, poise, etc., and stated that their opinion did not change for image 3.2 when the color hue was changed to a cooler hue. However, when



asked which image out of 3 and 3.2 they would feel more warm/comfortable/relaxed in, they responded with “obviously the first one”, leaving no room for doubt, even though the images were of the same exact room aside from the different hues. This pattern occurred in 6/10 of the subject’s responses and may have occurred because the subjects were not aware they would have to choose between images until they were asked to, meaning they did not have a preference between images while answering questions 1 and 2 and thought of them in the same way.

There were no obvious errors in the results, however errors may have occurred. If any of the subjects received knowledge about the experiment prior to participating, their answers could have been affected. For example, if a subject knew that the purpose of the experiment was to find negative and positive words in the responses, they may have made their answers more obvious or they may have said something they wouldn’t have if they didn’t have knowledge of what was being looked at. If all of the subjects had zero prior knowledge, then it is possible that it would have been a little harder to identify negative or positive responses, or the differences of negative and positive responses for each image would decrease.

## **VI. Application**

Colour is everywhere around humans every day. Which is why this information could be applied to any

field of study in which colour is an important factor. Artists can use it when looking for ways to add more of an emotional impact on their art. Fashion designers can use it when considering what kind of attitude they want their clothes to have, like red for boldness or grey for subtleness. Even school environments can use colour to keep students in an engaging mood with bright, vibrant colours that will make the students feel more lively.

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# **The Effects of Citric Acid, Acetic Acid, and Hydrochloric Acid on 100% Cotton Garments for Recycling**

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## **I. Abstract**

The question investigated was ‘how could cotton be changed chemically using acids for better recycling?’. This question is important because in the modern world of fast fashion, current cotton recycling is inefficient and if it could be improved to become a cheaper, more universal manufacturing process, the clothing industry would become more sustainable. The cotton was submerged in various acids (hydrochloric acid, citric acid, and acetic acid) over approximately three weeks, and then the cotton fibers were pulled with tweezers to test the acid’s effect on the cotton’s structure. Of the three acids, the citric acid was the most effective at making cotton fibers easy to pull apart. The implication of these results is citric acid could be useful in the process of recycling cotton garments, and more research into the usefulness of acids in recycling cotton should be done.

## **II. Introduction**

It is important to look for materials that can be recycled or are biodegradable, because today’s clothes are meant to have a short lifespan, so the consumers will buy more (Joy A, Sherry J Jr, Venkatesh A, Wang J & Chan R, 2012). In fact, the vast majority of clothes in the US are not recycled or reused, and rather end up in landfills (Gunther M, 2016). It’s not just important to factor how these clothes are disposed of, but to find sustainable ways to make such a large volume of clothing. One single policy, material, or brand will not be enough to solve this problem, but rather a solution involving all aspects of clothing design, manufacturing and disposal (Khan M. R & Islam M, 2015).

How can cotton be recycled more efficiently and therefore cheaper than the industry standard?

If cotton can be broken down partially using acids, then it will be more efficient to recycle because mechanically breaking down cotton is extremely ineffective.

## **III. Methods**

100% cotton from a used garment was submerged in three different acids (acetic acid (36%), citric acid (15%), and hydrochloric acid (1.5 mole).

Observations were recorded whenever a change in the look of the cotton was seen, and pictures were taken. After three weeks of submersion, the cotton was pulled with tweezers to test the effects of the acids.

The independent variable was the type of acid, which differed in the three different trials, and the dependant variable was the effects of the cotton. The control variables were the amount of time the cotton was submerged, the amount of acid the cotton was submerged in, and the pieces of cotton themselves were uniform.

#### IV. Results

The results from the trials suggested that citric acid was the most effective of the acids used. These results were collected from three cotton samples (see figure one), and then observations were made in a chart (see table two) to describe the change in physical qualities of the cotton samples. These results were measured qualitatively.



Figure One: Labelled Samples of Cotton in the Acids During Week One

|                     | Citric Acid (15%)                                                     | Acetic Acid (36%)                          | Hydrochloric Acid (0.5M)                   |
|---------------------|-----------------------------------------------------------------------|--------------------------------------------|--------------------------------------------|
| Start of week one   | Cotton submerged, no difference in texture                            | Cotton submerged, no difference in texture | Cotton submerged, no difference in texture |
| Start of week two   | Bits of cotton at bottom of acid solution, cotton is more see-through | Cotton appears see-through                 | Cotton appears see-through                 |
| Start of week three | Cotton able to be pulled apart to the point of a change in texture    | Cotton is more see-through                 | Cotton is more see-through                 |

#### Cotton Sample Qualities Over Time

Table Two



The citric acid was the best dissolver, which was evidenced by how the cotton was able to be pulled apart with a changed consistency, (see figure two).

Figure Two: cotton sample taken during week three from the citric acid trial.

The results were unable to go any further or answer questions about how the cotton would be reused, as due to lack of materials there was no way to make the cotton free of the acids.

However, these results implied that more research into recycling cotton chemically should be done, as the results shown were promising. If the results can be replicated, it may make it easier and more efficient to recycle cotton.

These results were also contrary to the research done prior to the trials, because many sources



quotes acetic acid to be the best at breaking down cotton, while in this trial, citric acid at just 15% was a better dissolving agent than acetic acid at 36%.

**V. Discussion & Conclusion** These results support the original hypothesis of *If cotton can be broken down partially using acids, then it will be more efficient to recycle because mechanically breaking down cotton is extremely ineffective*, because the cotton was showed to be broken down partially with citric acid, and therefore broken down efficiently.

These results could be explained by the way that the cotton is structured. Its structure allows for it to be broken apart not just physically through machines as is used in most factories, but also through chemical processes involving acids.

The fact that cotton's structure allows it to be broken by acids also means that other acids should be tested for usefulness in the process of recycling. These futures test could include both the processes of mechanical and physical breaking of cotton fibers to find the most efficient process.

The cottons structure could also play a role in making cotton easier to recycle, as if companies started weaving cotton in structures where the fibers had more surface area on the outside, and less on the inside, it would be able to be recycled chemically a lot more efficiently. Additionally, if the dyes added into cotton were all made to not preserve the cotton or stop it from being dissolved, chemical recycling of cotton may become easier.

The biggest obstacle to getting more clear results was a lack of ways to use quantitative measurements in the trials, as the cotton must be handled with proper safety precautions due to harmful acids still being in the cotton fibers.

Some possible sources of error that could have occurred in the experiment were:

- No quantitative observations were made, which can lead to subjective or biased results
- The dye in the cotton is another chemical that could have influenced the rate at which each cotton sample broke down
- The cut of the cotton could have influenced the structure of the cotton fibers, causing them to be broken down faster in some places than in others
- The cotton samples taken were from an old shirt, and the degree to which they broke down may not be able to be modelled on a newer, less worn cotton garment.

Despite many possible sources of errors, the results shown are still promising and support the original hypothesis of *If cotton can be broken down partially using acids, then it will be more efficient to recycle because mechanically breaking down cotton is extremely ineffective* through the qualitative data observed over three weeks.

**VI. Application** The application of these findings are quite broad and varied; from the fields of

material science, chemistry, and even non-science industries like textile manufacturing, fast fashion, and retail. The scientific community can respond to these results by building onto the originally

presented hypothesis and performing more tests to further study of textile recycling. These results fit into the big picture by providing a more sustainable method of reacting to the overproduction of clothes.

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# **The Effect an Audience Has on the Performance of Test Subjects in Both an Intellectual and Physical Manner**

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## **I. Abstract:**

An audience was deemed to have a large impact on the performance of those being spectated. As such, further research was done on this topic. This was done by recording the performance of test subjects with and without an audience in both an athletic and an intellectual environment. The results of the subjects in the athletic portion of the experiment revealed that an audience was fairly substantial to their increased rates of success. On the contrary, the subjects taking part in the intellectual portion of the experiment proved the detrimental effect an audience can have on those completing a written test. It is concluded that an audience will positively affect athletic based activities, all the while being detrimental towards intellectual based activities.

## **II. Introduction:**

Many competitive athletes know how it feels to be spectated by a group of people, and most intellectuals know how it feels to have a teacher or mentor look at their exam as they write it. This tends to be a factor that plays a significant role in the mental state of an athlete or intellectual because of its bold presence. Therefore, the effects of this factor must be further researched.

The main question of this experiment is: is an athlete or intellectual's performance affected by spectators? If a competition is held between athletes or a test is written by intellectuals was to take place both with and without spectators. Then, it is believed that there will be an inferior performance

when there are spectators. This is because of a thorough experiment done by (Moore, James C. and Brylisnky, Jody A., 1993) in which two college basketball teams competed against each other. In the first few games, which had spectators, team A scored an average of 76.25 points and team B scored an average of 64.29 points, but due to an outbreak in measles that same year, both teams faced off on multiple occasions with no spectators. In this setting, team A scored an average of 86.2 points, and team B scored an average of 71.25.

## **III. Methods:**

For the intellectual experiment, begin by choosing two education related rooms. Of those two rooms, one must have the capacity to support five

spectators as well as the subject. Then, provide the subject with a simple arithmetic test in the empty room. Then allow the subject to write the test. While the subject writes the test, be sure to time the

subject. When finished, send the subject to the room with the audience and allow the subject to write a similar test. Then time the subject once again.

*Pictures 1 and 2: subjects were given the first test when an audience was not present, and the second test when an audience was present*

Name :
Teacher :

Score :
Date :

|    |    |    |    |    |    |
|----|----|----|----|----|----|
| 16 | 7  | 19 | 1  | 2  | 14 |
| +8 | +2 | +5 | +4 | +8 | +3 |

|    |    |     |     |     |    |
|----|----|-----|-----|-----|----|
| 10 | 16 | 0   | 8   | 4   | 9  |
| +6 | +6 | +24 | +13 | +16 | +8 |

|    |     |    |    |    |    |
|----|-----|----|----|----|----|
| 12 | 1   | 4  | 22 | 23 | 17 |
| +3 | +23 | +8 | +0 | +1 | +4 |

|     |    |     |    |    |    |
|-----|----|-----|----|----|----|
| 9   | 18 | 2   | 20 | 13 | 18 |
| +11 | +0 | +12 | +0 | +3 | +4 |

|    |    |     |     |     |    |
|----|----|-----|-----|-----|----|
| 7  | 13 | 14  | 0   | 12  | 20 |
| +0 | +2 | +10 | +11 | +12 | +3 |

|    |    |    |   |   |    |
|----|----|----|---|---|----|
| 13 | 17 | 21 | 9 | 7 | 17 |
| +1 | 0  | 0  | 0 | 4 | 5  |

|    |    |    |     |    |    |
|----|----|----|-----|----|----|
| 15 | 18 | 22 | 9   | 20 | 6  |
| +7 | +6 | +2 | +12 | +1 | +1 |

|    |    |     |    |    |    |
|----|----|-----|----|----|----|
| 22 | 8  | 2   | 19 | 23 | 14 |
| +0 | +5 | +13 | +1 | +1 | +1 |

|    |     |     |     |    |    |
|----|-----|-----|-----|----|----|
| 17 | 12  | 3   | 4   | 6  | 11 |
| +0 | +10 | +17 | +16 | +4 | +7 |

|     |     |     |    |    |     |
|-----|-----|-----|----|----|-----|
| 7   | 0   | 0   | 15 | 3  | 10  |
| +13 | +19 | +11 | +5 | +2 | +14 |

As for the athletic experiment, begin by choosing a location in which there is only one thousandth, or

less, of a centimeter slope extending for a distance of fifty meters. This will serve as a proper runway

for the subjects. Then, set up the pole vault mats, crossbar, and crossbar holders. Afterwards, allow each subject two practice jumps without an audience present. Then, allow subjects to jump for an hour and record each subject’s best jump in centimeters. On a different day allow each subject two practice jumps with an audience present. Once again, allow the subjects to proceed jumping until the subjects are eliminated from competition. Record the subject’s best jump. The control variables of the athletic-based experiment are the runway, the pole being used, and the subject’s footwear. These variables were controlled in order to leave a single independent variable, the presence

**IV. Results:**

The athlete-based experiment showed an increase in performance when an audience was present (Table 1, 2 and Graph 1.)

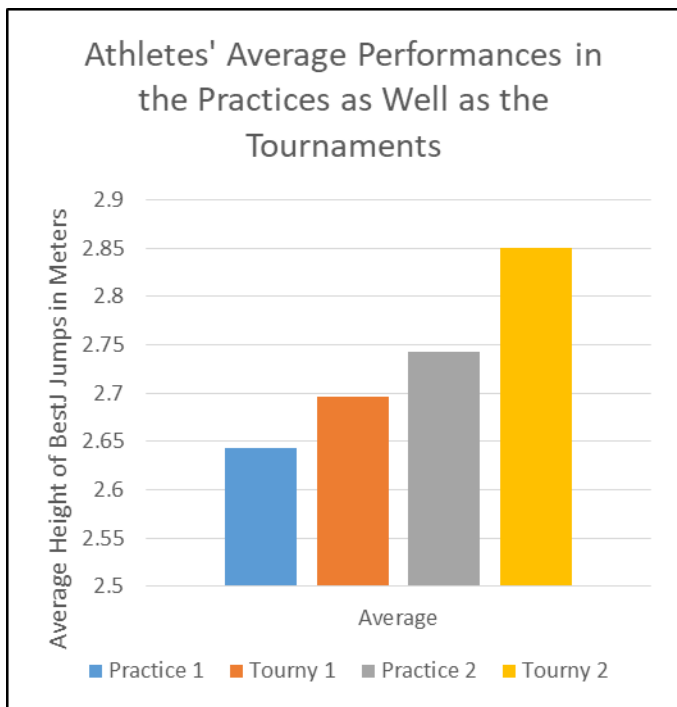
| Name of Athlete | Performance Without an Audience (Practice 1) | Performance with an Audience (Tournament 1) |
|-----------------|----------------------------------------------|---------------------------------------------|
| Subject A       | 2.65 meters                                  | 2.75 meters                                 |
| Subject B       | 2.45 meters                                  | 2.45 meters                                 |
| Subject C       | 2.90 meters                                  | 3.20 meters                                 |
| Subject D       | 2.30 meters                                  | 2.45 meters                                 |
| Subject E       | 2.45 meters                                  | 2.30 meters                                 |
| Subject F       | 2.45 meters                                  | 2.60 meters                                 |
| Subject G       | 2.60 meters                                  | 2.75 meters                                 |
| Subject H       | 2.40 meters                                  | 2.45 meters                                 |
| Subject I       | 2.50 meters                                  | 2.20 meters                                 |
| Subject J       | 2.20 meters                                  | Failed to clear 2.00 meters                 |
| Subject K       | 3.00 meters                                  | 3.20 meters                                 |

of an audience, to determine the change in the dependent variable, the performance of the subjects. Those three specific control variables are the ones that most affect the jump itself. As such, they were controlled. The control variables for the intellectual-based experiment are the location, the type of pen used, and the desk and chair in which the test was written. Those three are the most vital variables to control in order to best allow the presence of an audience to be the only source that influences the performance of the subjects.

|           |             |             |
|-----------|-------------|-------------|
| Subject L | 4.10 meters | 3.80 meters |
| Subject M | 3.00 meters | 3.20 meters |
| Subject N | 2.00 meters | 2.20 meters |

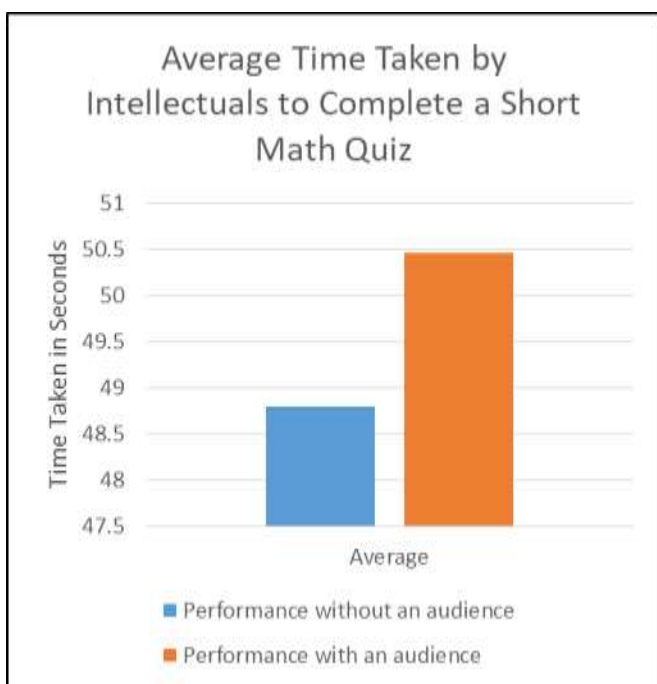
| Name of Athlete | Performance Without an Audience (Practice 2) | Performance with an Audience (Tournament 2) |
|-----------------|----------------------------------------------|---------------------------------------------|
| Subject A       | 2.80 meters                                  | 2.90 meters                                 |
| Subject B       | 2.45 meters                                  | 2.60 meters                                 |
| Subject C       | 2.90 meters                                  | 3.35 meters                                 |
| Subject D       | 2.45 meters                                  | 2.60 meters                                 |
| Subject E       | 2.45 meters                                  | 2.60 meters                                 |
| Subject F       | 2.75 meters                                  | 2.75 meters                                 |
| Subject G       | 2.60 meters                                  | 2.75 meters                                 |
| Subject H       | 2.60 meters                                  | 2.45 meters                                 |
| Subject I       | 2.50 meters                                  | 2.60 meters                                 |
| Subject J       | 2.20 meters                                  | 2.20 meters                                 |
| Subject K       | 3.05 meters                                  | 3.20 meters                                 |
| Subject L       | 4.10 meters                                  | 4.15 meters                                 |
| Subject M       | 3.15 meters                                  | 3.35 meters                                 |
| Subject N       | 2.40 meters                                  | Did not participate                         |

Graph 1: subjects were much more successful when writing without an audience. They performed around 3.6% better.



Graph 1: subjects were much more successful when jumping in front of an audience. They performed around 3% better.

In the intellectual based experiment, the results were the opposite of those seen in the athletic based experiment (Graph 2.)



## V. Discussion & Conclusion:

The hypothesis was partially correct; the athlete-based experiment's portion was incorrect, this was mostly because subjects felt more inclined to perform during competition due to the much more competitive environment provided by the competition and were performing on a lower level during practices thanks to the laid-back environment provided by the practices. On the contrary, the intellectual-based experiment's portion was fully correct, this was primarily due to the element of discomfort; while the subjects were writing the tests in the audience-free room, they experienced the familiar sensation of writing a practice test at home in which they are isolated and focused. When writing the test in the room with the audience, the subjects felt high levels of discomfort due to the several sets of eyes looking down upon them. This data fully answers the question imposed at the beginning of this experiment. Yet, this data is not similar to other data determined by previous researchers. This is due to the uniqueness of this experiment; as it has never been done before in terms of pole vault. This means that further research is needed in order to provide a solid base for this specific topic. As such, the data concluded from this experiment is simply a supplement to previous research. As for the possible errors in the experimentation, the accuracy of the results is not optimal due to the small number of subjects participating and trials conducted. Another issue is the lack of variety in terms of subjects; all subjects

were between the ages of fifteen and eighteen and were from similar ethnic backgrounds, spare one outlier. It is believed that there would have been different results when testing for different age groups as well as ethnic backgrounds due to the different views regarding an audience perceived by those who are older in age in comparison to the younger subjects. The perception of performing in front of an audience is also very different based on ethnic backgrounds as stated by (Saylor Academy, 2012.)

## **VI. Application:**

This information can be applied into several fields of study, some of which include: psychology, in which the brain patterns of the subjects can be observed to provide useful information. Kinesiology, in which the bodily movements of the subjects taking place in the athletic-based experiment can be monitored to provide information. And the science of brain and bodily hormones, in which specific hormones like dopamine and adrenaline can be observed to provide useful information. Those who can manipulate the concluded data in their day-to-day lives include: athletes, who could ask the audience to attend practices. Coaches, who could provide the right environment for their trainees. And Intellectuals, who could try to practice for tests in a slightly more crowded area rather than the comfort of their homes to better prepare for the actual,

supervised, test. These results will help both athletes and intellectuals succeed in their respective tasks. The results will also allow more accurate research to take place in the future.

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# **Comparing the Creative and Mathematical Abilities between Left and Right-Handed People**

Imaya

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## **Abstract**

The purpose of this project was to evaluate and analyze the differences between the performance of a left-handed person compared to a right-handed person during the completion of various experiments that tested their mathematical and creative abilities. Participants were given three tests—one that tested their hand dominance, one that tested their drawing and interpretation abilities, and lastly one that tested their mathematical skills. All participants were given the same test as the other, with the same procedures and questions. Both left handed and right-handed participants were able to conduct all procedures similarly to each other in terms of accuracy, considering each participant had their own strengths and weaknesses. Each participant had varying levels of knowledge in the given task, specifically the mathematical task, which challenged all participants, despite coming off as more easy or difficult to one person more than the other. No matter which hand the participants used, all were capable of completing the given task both accurately and to their best efforts.

## **I. INTRODUCTION**

The purpose of this project is to analyze and compare the differences in between a left-handed person and a right-handed person by examining the way each person can complete a given task. These tasks are meant to test their creative and mathematical abilities. Understanding these differences is important since left handed people only make up 10% of our world's population, yet they are said to be more creative and even more intelligent than right handed people, despite scientific research producing mixed results on the matter.

A psychology professor by the name of Chris McManus states that left-handed people do not have a higher IQ than those who are right dominant, but that left-hander's brains allow them to process language, spatial relations, and emotions in more creative ways (Olsen, S. (2013, August 13)). This scientific research opens up many opportunities to find a solution to this project's initial question: how are the creative and mathematical abilities of a left-handed person different from those of a right-handed person?



If a left-handed person and a right-handed person are compared based on their performances of completing creative tasks, then the left-hander would most likely perform better, because they have the advantage of using both hemispheres in the brain, which initially allows them to perform the task in numerous creative ways (Porac 2016). The increased abilities of the hemispheres to communicate through the corpus callosum in the brain gives left-handed people the greater ability to recruit and associate networks that store different types of information (Abel, 2017), which gives them a significant advantage.

## II. METHODS

To begin the first experiment which tested for the dominant hand of the participant, start by handing each participant the questionnaire that contained fourteen basic everyday questions regarding their skills, with the participant having to check off if they prefer to use their left handed, right hand, or either hand to perform the skill. For example, some of the questions were: what hand do you use to write? What hand do you usually eat

Figure 1a shows the first part of the questionnaire. It includes a title 'Handedness Test' and a list of 14 questions. Each question has three checkboxes: 'Left', 'Right', and 'Either'. The questions are: 1. Which hand do you use to write? 2. Which hand do you use to hold a pen or pencil? 3. Which hand do you use to hold a glass or cup? 4. Which hand do you use to hold a spoon or fork? 5. Which hand do you use to hold a knife? 6. Which hand do you use to hold a book? 7. Which hand do you use to hold a bag or suitcase? 8. Which hand do you use to hold a camera? 9. Which hand do you use to hold a telephone? 10. Which hand do you use to hold a remote control? 11. Which hand do you use to hold a computer mouse? 12. Which hand do you use to hold a computer keyboard? 13. Which hand do you use to hold a video game controller? 14. Which hand do you use to hold a steering wheel?

Figure 1a -- This is the first part of the test

Figure 1b shows the continuation of the questionnaire. It includes a title 'Handedness Test' and a list of 14 questions. Each question has three checkboxes: 'Left', 'Right', and 'Either'. The questions are: 15. Which hand do you use to hold a hammer? 16. Which hand do you use to hold a saw? 17. Which hand do you use to hold a drill? 18. Which hand do you use to hold a screwdriver? 19. Which hand do you use to hold a wrench? 20. Which hand do you use to hold a pliers? 21. Which hand do you use to hold a pair of scissors? 22. Which hand do you use to hold a pair of gloves? 23. Which hand do you use to hold a pair of shoes? 24. Which hand do you use to hold a pair of socks? 25. Which hand do you use to hold a pair of pants? 26. Which hand do you use to hold a pair of underwear? 27. Which hand do you use to hold a pair of pajamas? 28. Which hand do you use to hold a pair of shorts? 29. Which hand do you use to hold a pair of swim trunks? 30. Which hand do you use to hold a pair of swimwear?

Figure 1b -- This is the continuation of the test

with? The most amount of checks in a category determined the participant's dominant hand.

For the second experiment which tested a person's mathematical abilities, present each participant with a set of mathematical problems, and start a timer for each participant. All participants were given the same test. Participants were not allowed calculators and therefore had to show their work to get full marks. Once a participant finishes their set of questions, stop the timer, and collect the questions paper.

To start off the third experiment which tested a person's creative abilities, begin by giving each participant a pencil and a blank sheet of paper. A description of a pre-existing image was given to each participant, who then had to re-draw the image to the best of their ability in one minute. Once the minute is finished, collect the drawings from each participant and write what hand they used to complete this task.

The independent variable of all these experiments was the participant completing the experiment based on what their dominant hand was. The dependent variable was how effectively and efficiently a participant completed the task based on how well they performed. The

controlled variables were the amount of time taken to complete a task, the test that is given to each participant, the level of difficulty

of the experiments, and the lengths of the tests. If these measures are not taken, the results of each test would not be accurate. For instance, in the third test where the participants draw an image, if one participant gets more than a minute to complete their drawing, they get a chance to draw their picture with more detail and precision, which ruins the purpose of this experiment. If one participant receives a different test than another, not all the participants will have an equal chance of performing well, since the description or the questions may differ in difficulty or in

length on one test compared to another. To avoid this, the test given to every participant is identical to ensure everyone has an equal chance in completing the test efficiently. If the difficulty and length of the mathematical test differed for each participant, some participants might have more of an advantage if their test is shorter and easier compared to the others, whose test might be more difficult and longer in terms of the amount of questions. To make sure all the results are accurate, the test is made to be completed, with a challenge, by all participants.

### III. RESULTS

The following figures represent the results from Experiment 1.

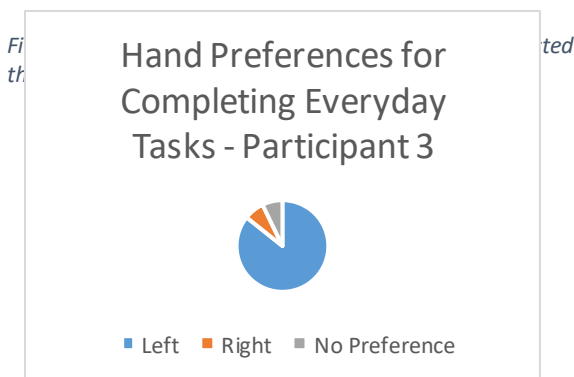
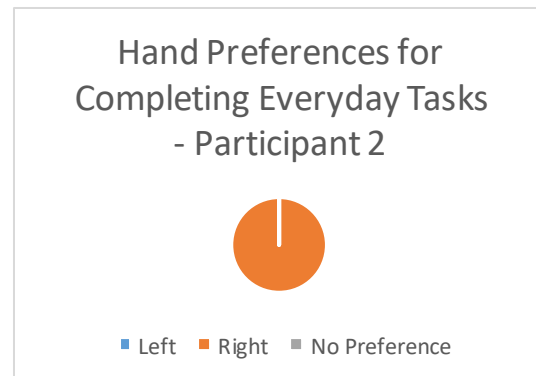


Figure 5 -- Results from the first experiment which depicted the dominant hand for Participant 4 (Ambidextrous)

Figure 4 - Results from the first experiment which depicted the dominant hand for Participant 3 (Left Hand)

The following figures represent the results from Experiment 2.

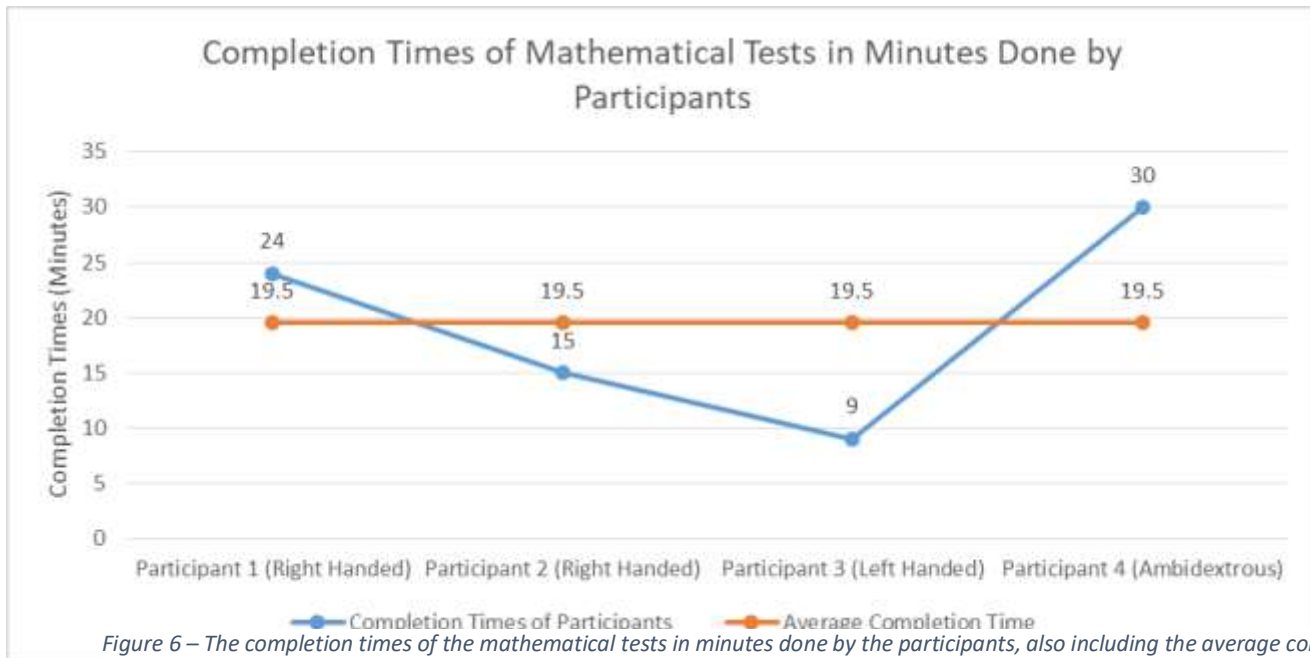


Figure 6 – The completion times of the mathematical tests in minutes done by the participants, also including the average completion time among the participants

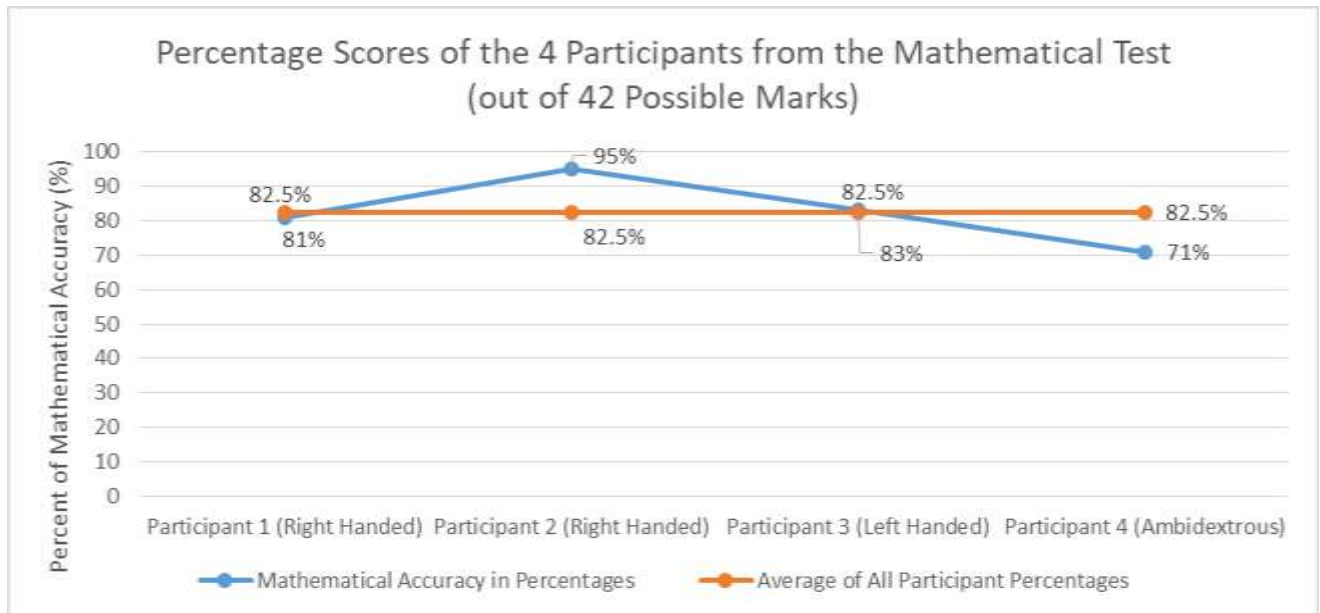


Figure 7 – Results from the Mathematical Test done by Participants presented in Percentages out of 42 possible marks

The following table can be referred to as **Table 1**.

**Table 1:** Results and Performances of Participants in Experiment 2: Determining the Creative Abilities of a Person

| Components to Ensure Accuracy |      |       |         | Overall Performance | Hand Dominance/Preference |
|-------------------------------|------|-------|---------|---------------------|---------------------------|
| Lightbulb                     | Fish | Water | Bubbles |                     |                           |
| ✓                             | ✓    | ✓     | ✓       | 9/10 accuracy       | Right Hand                |
| ✓                             | ✓    | ✓     | ✓       | 10/10 accuracy      | Right Hand                |
| ✓                             | ✓    | ✓     | ✓       | 10/10 accuracy      | Left Hand                 |
| ✓                             | ✓    | ✓     | ✓       | 8/10 accuracy       | Ambidextrous              |

#### IV. DISCUSSION/CONCLUSION

The hypothesis was incorrect. Throughout the completion of the three experiments, more specifically the two experiments that tested the participants on their mathematical and creative abilities, the overall results show that the performances between a left handed and right-handed person were fairly similar. In the mathematical experiment, all participants did well, but the left-handed participant 3 got a lower score than participant 2, who was right handed. Despite participant 3 taking nine minutes to complete all twenty problems, participant 2 completed the same problems in around fifteen minutes and was able to remain as accurate as possible. In terms of the drawing experiment, all the participants were able to comprehend the main elements in the description, which were the lightbulb, the water in the lightbulb, the fish, and the bubbles, as specified. Despite a left-handed person having the ability to use both hemispheres of their brain which makes them more creative, the third experiment shows that all

participants, whether right or left handed, were able to accurately depict an image from the description given to them.

Scientifically, a left-handed person is said to use both hemispheres of the brain when completing various tasks in their day, which initially gives them an advantage. Despite right-handed people using one hemisphere of their brain more frequently than the other, they are just as capable of completing the same tasks similarly to, or even better than a left-handed person. Having access to both brain hemispheres might enhance the way a left-handed person regards a task to figure out various problem-solving strategies, and creative ways to complete a task. For example, a left-handed person might interpret a certain description of an image differently than a right-handed person based on the way that they choose to understand and imagine the words. Dr. Lorin Elias, a psychology professor, stated that left-handers are usually over represented in the fields of creativity, and that they are often associated with artists and musicians,

which links them to the field of creativity. Through the results, it is seen that right- and computing equations as a left-handed person, despite the left-handed person having the ability to use both hemispheres.

handed people are just as capable of drawing

This is similar to many other aspects of research done by scientists, as the topic of handedness has always brought up mixed results regarding the differences of the intelligence levels in a left and right-handed individual. The results of experiments 2 and 3 related with this research, as they did not necessarily lean in a direction where it supported the hypothesis but rather produced mixed results in terms of the performances of each right handed and left-handed participant in the experiments.

A potential source of error would be if a participant was already skilled in achieving the requirements for that experiment. For instance, if a participant, whether left or right-handed, was particularly skilled at art, or was known for being an artist, they would be able to conduct the second experiment of drawing an image with much greater ease than a participant who did not have as much experience. This would affect the overall results of the experiment, as one participant had an advantage compared to the others, which would place an inaccurate standard on whichever hand the participant was dominant in. This also applies to how the performance of the participants in the third experiment, as one participant could have an enhanced understanding and knowledge than another participant, initially giving them an advantage in receiving better results which then reflect to what hand that person was dominant in. The overall results will not be as definite and accurate in terms of the performances of the participants, which affects the initial purpose of the experiment.

## **V. APPLICATION**

Many scientists can use this information as a basis for much broader and branched out topics, which might aid in the making of a conclusion regarding left and right-handedness. This might bring more awareness on this topic of handedness to the public eye and educate more people about the similarities and differences between a left-handed person and a right-handed person that are faced by each person in various day-to-day activities. The general public will develop a greater understanding about how handedness varies and changes from person to person, and the challenges and new obstacles that they have to face in their lives because of being left-handed, right-handed, or ambidextrous. The results reflected a minor aspect of a much broader topic that delves deeper into the origins of handedness and what it is in relevance to how the brain works and how the hemispheres control the body's movement. Overall, the results showcased a discovery that when expanded and examined, opens up a whole other set of topics that lead into more complex levels of analysis and understanding.

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# **Effect of Gradually Increasing Aerobic Exercise on Short Term Memory**

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## **I. ABSTRACT**

The purpose of this study is to determine if gradually increasing the intensity of an aerobic exercise performed daily has any effects on short term memory. This experiment was conducted to improve short term memory and to prevent severe memory loss such as dementia and Alzheimer's disease. Throughout the course of a week, subjects performed an aerobic activity such as jump-roping and increased the number of jumps per day. Subjects were asked to complete a series of cognitive mnemonic tests to observe the changes in memory retention. The results showed improvement in short term memory by an average of 13% over 7 days.

## **II. INTRODUCTION**

Short-term memory is a concept of storing limited amount of information in a short period of time. (Godman, 2016). Staying healthy and maintaining short term memory is important because many people as they age suffer from mild cognitive impairment, the state between normal and severe loss of memory (Wells, 2015). In 1956, George Miller tested short-term memory for how much information someone can hold; the result of his experiment averaged to seven items (McLeod, 2009). Finding ways to improve short-term memory can benefit others with everyday tasks. This experiment will focus on daily physical exercise. What are the effects of gradually increasing aerobic exercise on short term memory?

If physical exercise is done regularly everyday then short-term memory can be improved because it increases the size of the hippocampus (Godman,

2016). The hippocampus is an area of the brain that is involved with memory. Blood flowing in the areas of the brain that controls memory will increase the size of the hippocampus (Godman, 2016). This experiment focuses on the progress and observing the changes of memory development after physical exercise.

## **III. METHODS**

This experiment was conducted for one week and consisted of four different tests the subjects completed after finishing an aerobic workout.

The subjects chose a specific time in the day to perform the exercise throughout the course of the experiment. The first day, the subject skipped rope for one minute. Each day was increased by one minute with 30 seconds of rest in between. Each memory test was completed five minutes after



completing the exercise. The scores for each memory test were recorded.

The first memory test (Test A) is matching memory cards. 24 matching cards with 12 pairs are placed in a random order facing down in front of the subjects. The subject flipped the cards to find a matching pair. The number of flips was recorded by an experimenter. A different set of matching cards was given to the subject for each different day.

The second memory test (Test B) is memorizing a list of words. The subjects listened to a list of 10 unrelated words spoken by an experimenter. After all the words have been said, the subject wrote down as many words they can remember. One point was added for each correct word. The score was recorded by an experimenter. A different list of words was given to the subject for each different day.

The third memory test (Test C) is memorizing objects. The subjects observed 15 objects placed before them by an experimenter for one minute. After one minute, the subject faced away from the objects and wrote down as many objects they can remember. One point was added for each correct object. The score was recorded.

The fourth memory test (Test D) is recreating sequences. The subject analyzed a random order of index cards with different colored shapes for three seconds. After three seconds, the subject faced away and recreated the sequence with the same set of index cards. One point was added for each correct

card and order in the sequence. The score was recorded. The number of items in the sequence increased by 1 each time the subject recreated the previous sequence correctly.

The independent variable was the amount of exercise. The dependent variable was the score on the memory tests. The control variables are the age of the subjects, the difficulty of the memory tests, the type of physical activity, the time in the day, and the time between exercising and test taking. The ages of the subjects are high school students. The memory of different age groups may be different so controlling the age of the subjects can ensure accurate results. The difficulty of the memory tests can guarantee that the subjects will not have certain advantages that other subjects may not have. The type of cardio is skipping rope. The same activity will eliminate any inaccurate results if different types of activities were performed. Completing the workout throughout the experiment on the same days and time will provide consistency to the results. The time between exercising and the test taking will remain the same so no other factors between that times may alter the results.

#### IV. RESULTS

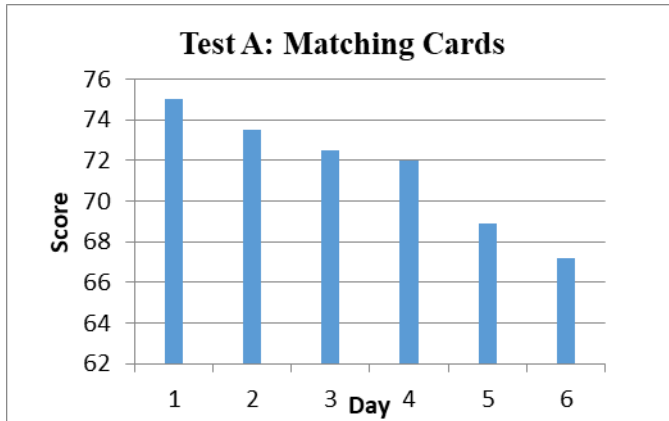


Figure 1: The Subjects' Average Number of Flips for Matching Cards Over the Course of 6 Days After Performing Aerobic Exercise

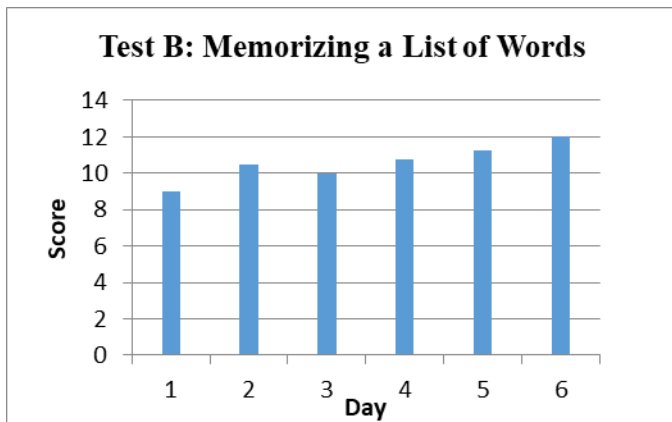


Figure 2: The Subjects' Average Score for Memorizing a List of Words over the Course of 6 Days after Performing Aerobic Exercise

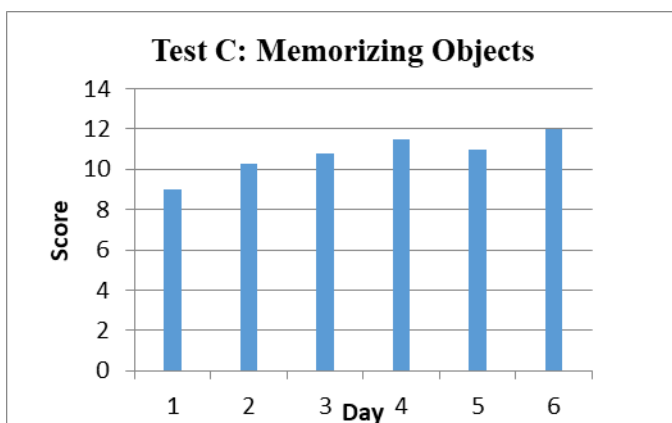


Figure 3: The Subjects' Average Score for Memorizing Objects Over the Course of 6 Days After Performing Aerobic Exercise

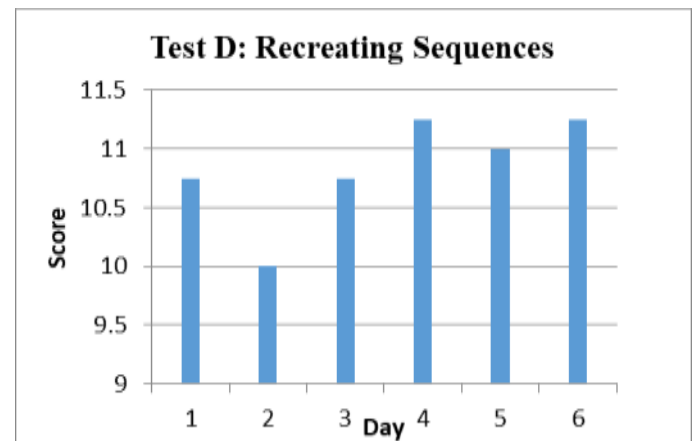


Figure 4: The Subjects' Average Score for Recreating Sequences Over the Course of 6 Days After Performing Aerobic Exercise

The data showed that the subjects' average scores for each memory test improved over the course of the experiment. The data collected showed an increasing trend except for test A. A lower number of flips for matching cards in test A shows improvement in memory. The test that showed the most improvement was test A. Based on the results, the number of flips decreased by 7.8%. The test that showed the least improvement was test D. The data from Test D (Recreating Sequences) showed that the subjects' scores increased by 0.5%.

#### V. DISCUSSION/CONCLUSION

The hypothesis was correct. The subject's short term memory improved throughout a short amount

of time after gradually intensifying the workout. Through the experiments, the subject's short term memory improved by an average of 13% after 6 days of gradually increasing daily aerobic exercise. Exercising can help improve memory because there is an increase in growth factors (2017). The development in proteins will improve and strengthen memory. For the future, a way of performing the investigation differently is conducting the experiment for a longer period of time to show if the improvement of memory is more significant, no change or decreased. Errors that may have occurred are external factors that may have altered the results from the subjects' memory tests. Different variables such as the amount of sleep or type of foods/drinks taken before the tests may stimulate or decrease memory on that day. In the future, more controlled variables should be set to ensure that the results are accurate.

## VI. APPLICATION

Information gathered from this experiment can be used to determine how to improve short term memory and overall health. The results from the experiment can inform the general public about the positive effects of aerobic exercise on short term memory. The scientific community can take this experiment and perform it on an older demographic to observe the correlation between exercising and mild cognitive impairment.

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## **How Ballet, Hip Hop and lyrical can positively or negatively affects emotions.**

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### **I. Abstract**

The question investigated is how ballet, hip hop and lyrical affected emotion. With all the stress and anxiety the people in the world experience now, dance is a perfect way to allow the body not to be controlled by the mind. This experiment is very beneficial to people with mental health problems as dance could be a form of therapy. It also benefits dancers because it gives them a great understanding of the physical and mental effects of dance.

Ten subjects were asked to dance three forms of dance (ballet, hip hop and lyrical). Before and after every dance quizzes were taken to determine what their emotion were and if they had changed throughout the activity. As the subjects danced, almost all of them ended up with different emotions by the end then what they started with. The results of the data collection showed that dance indeed affects emotion in many ways by allowing the subjects to express themselves, this was proven when seven out of the ten subjects before Hip Hop had a positive emotion. Then by the end of it nine out of ten felt happier, only one of them was tired. It was concluded that dance affects emotions and its proven to increase creativity, reduce depression and reduce stress.

### **II. Introduction**

While exercise is good for you and keeps you in good shape, dancing was proven to have the biggest effect on reducing feelings of depression. (Arthur Murray, 2016). Answering this problem is important because many people tend to think dance is just another sport and it doesn't do anything except give people better posture; that's only one of the many things dance offers. Dancing is a very fun activity and it's important to experiment if it actually affects emotions and can have bonus to helping people feeling better as well as making them fall in love with a sport.

The question selected is how does ballet, hip hop and lyrical affect emotion positively or negatively. The purpose of this experiment is to find a way to lower the rate of mental health problems as using dancing to express feelings and thoughts.

If a person is feeling energetic and that person dances ballet for a couple minutes that the person will feel a little calmer because no matter how long the time period of dancing ballet; the act of using the body to communicate, create art and completely giving their body to each move provides that human with an unbelievable feeling (Hayley Page, 2013). If a person

is sad when they dance Hip Hop for a couple of minutes that person will feel happier because just moving to the highest capability anywhere can lift anyone's spirit (Viva Fifty, 2016) sending signals to the brain allowing the person to feel more energetic and cheerful. Lastly, It is thought if a human is feeling stressed then when that person dances lyrical for a couple of minutes that person will feel a little less stressed because dancing lyrical focuses on the expression of strong emotion. This style of dance focuses more on individual approach rather than the precision of the movements contrary to ballet and hip hop.

### **III. Methods**

The study conducted was completed in a quiet area with enough room to move around. Ten subjects were all registered by writing down their name on a piece of paper with their age. Each subjects name was written down in the data table to keep track of information for before and after. Each applicant was asked to have a seat on the ground and was asked to complete the quiz that was passed around. This quiz was the "before dancing ballet quiz", the applicants were given five minute to complete every single quiz. When finished the quizzes were collected and the song "Disney Classic Ballet Songs" was played. The candidates were taught a little combo (1-2 minute little dance) and when the combo was perfected the candidates then danced the full thing out. When ballet was complete the "after dancing ballet quiz" was passed around and five minutes were given to complete and have a drink of water. The same steps

were then done with hip hop and jazz. The song for hip hop was "The Middle" and for jazz "Purpose". When all three combos were completed the dancers were thanked for all their hard work and every emotion was then recorded in the data table provided on the sheet.

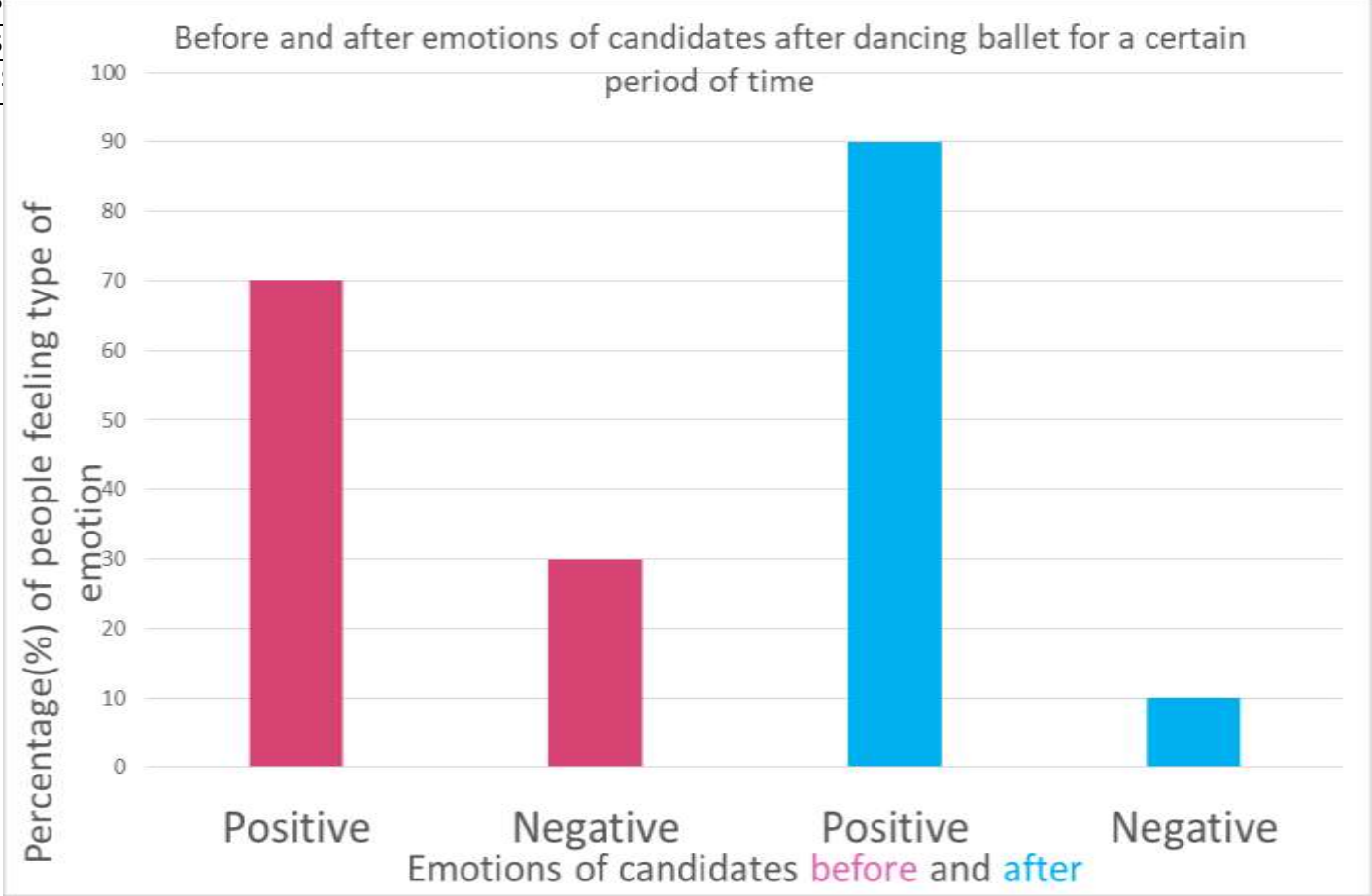
The independent variable in this experiment was the type of the dance performed by the subjects (ballet, hip hop and lyrical). Investigating these certain types of dance were needed to answer the question and compile the data. The dependent variable was the emotions of the subjects after every round of dancing. Every form of dance would have gotten a different type of emotion being felt. Finally, there are a couple of controlled variables the first one being the age of the candidates. Subjects needed to be from the ages of 8-20. This needed to be controlled or else there wouldn't be an even correlation. If candidates were older than 20 subjects wouldn't be as motivated as teenagers. The second one being the time to dance; dancing hip hop longer than ballet may change the subjects' emotions by making them exhausted. The type of music is equally important as well. If the music was both negative and positive, it would be considered another dependent variable but there can only be one. In this experiment, the music was positive for all three types of dances. In addition, the environment should be a quiet place where the subjects can express themselves and not be distracted. Last but not least, the quizzes that every subject needed to complete to be able to compile the data. The quizzes needed to be the same or else the data would be inaccurate.

IV. Results

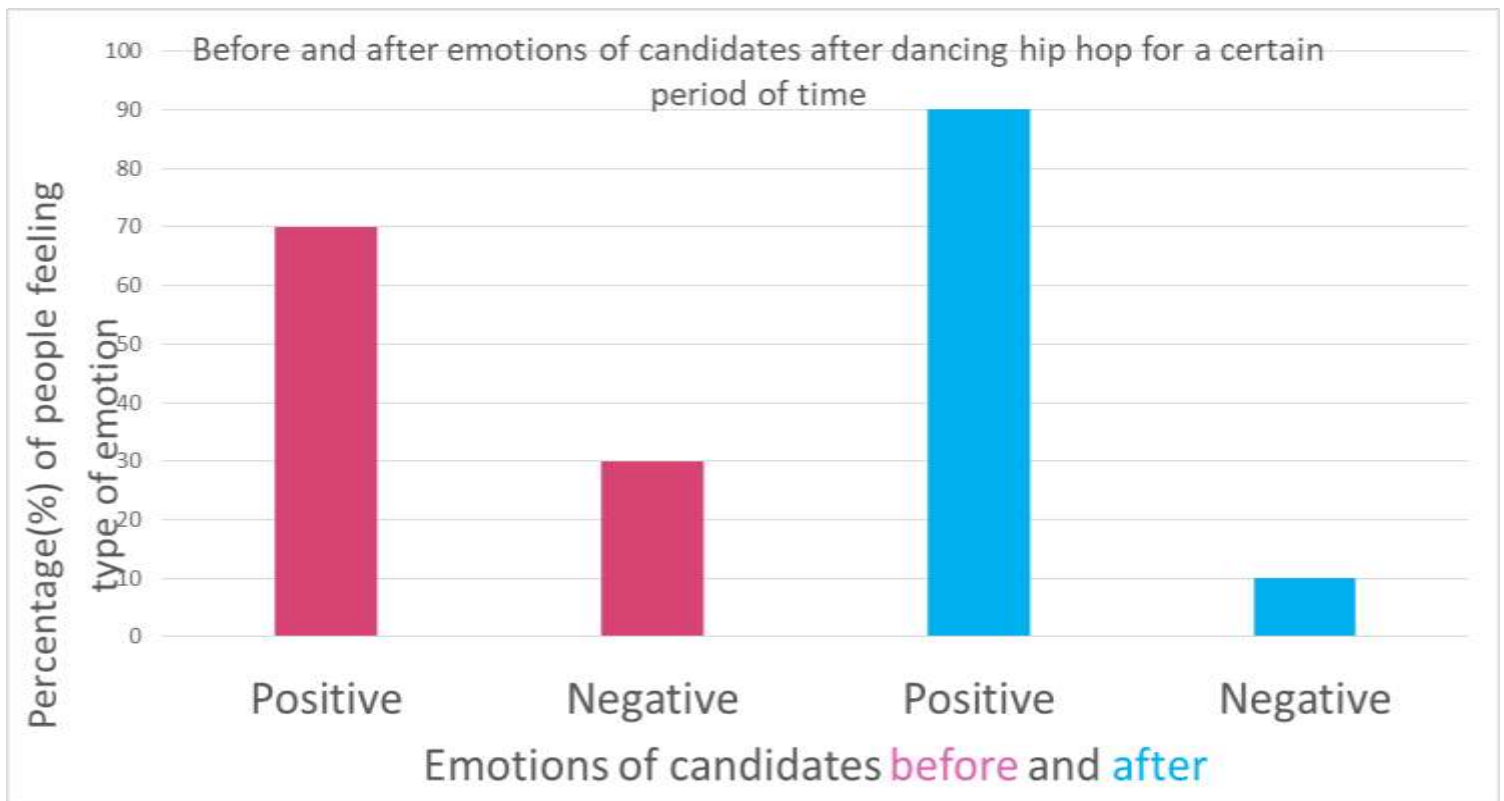
Table 1 – Data from the subject from the experimented conducted identifying the emotion (pink for positive and green for negative).

Graph 1 – This graph is comparing the positive and negative emotions of candidates before and after dancing ballet.

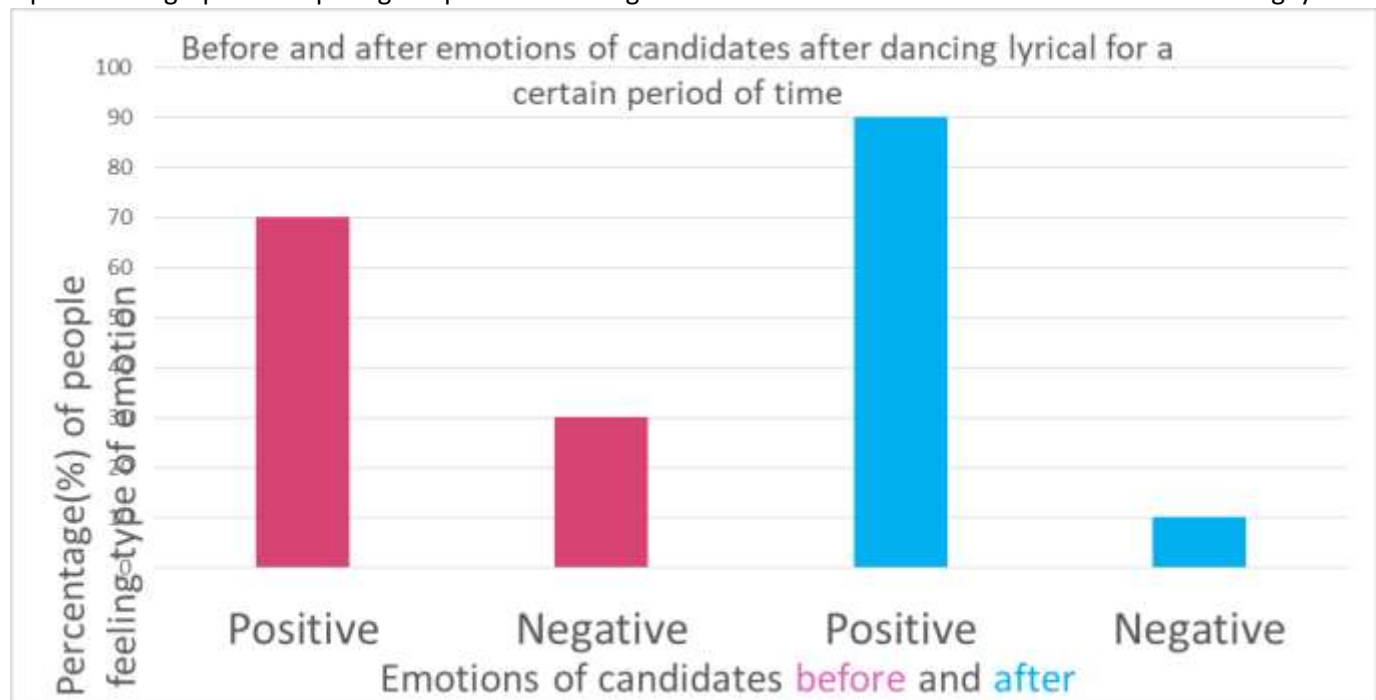
| Candidates-Name | Ballet Before | Ballet After         | Hip Hop Before | Hip Hop After | Lyrical Before | Lyrical After |
|-----------------|---------------|----------------------|----------------|---------------|----------------|---------------|
| Subject 1:      | Happy         | Calm                 | Calm           | Energetic     | Excited        | Calm          |
| Subject 2:      | Sad           | Calm                 | Calm           | Happy         | Happy          | Calm          |
| Subject 3:      | Stressed      | Little less stressed | Calm           | Energetic     | Happy          | Calm          |
| Subject 4:      | Calm          | Amused               | Calm           | Happy         | Excited        | Calm          |
| Subject 5:      | Angry         | Calm                 | Calm           | Enthusiastic  | Sad            | Calm          |
| Subject 6:      | Calm          | Sad                  | Sad            | Happy         | Tired          | Happy         |
| Subject 7:      | Stressed      | Calm                 | Calm           | Amused        | Tired          | Calm          |
| Subject 8:      | Happy         | Happy                | Happy          | Excited       | Excited        | Tired         |
| Subject 9:      | Happy         | Happy                | Happy          | Excited       | Excited        | Happy         |
| Subject 10:     | Happy         | Happy                | Happy          | Excited       | Excited        | Calm          |



Graph 2 – This graph is comparing the positive and negative emotions of candidates before and after dancing hip hop for a certain period of time



Graph 3 – This graph is comparing the positive and negative emotions of candidates before and after dancing lyrical



## **V. Discussion and conclusion**

The hypothesis for this experiment was correct. As it is stated in the hypothesis that dance will affect emotion by allowing people to express themselves. It is correct because almost every single person felt differently by the end of each little dance. From graph 2 above the subjects 2 & 3 were not in the positive section of the bar graphs but when they danced ballet and hip hop they felt better and regained positive emotions. As well as with subject 5 who was angry through the beginning of the experiment and after expressing that anger became calmer and happier. The overall increase in happiness percentage after hip hop went up 40%. The emotions that were considered as positive are happy, calm, amused and energetic. The negative emotions are sad, stressed, angry and tired.

An explanation for the results of this question is that dance can lift your spirits. That's why in that data subject 7 was feeling stressed before starting to dance, after ballet the candidate released some of the stress and became calmer. Also, dance has many emotional and physical affects. If a subject has fun while dancing it will send signals to the brain allowing the candidate to gain more energy and be happier. This was shown when all the candidates after dancing hip hop and jumping around became more energetic and ecstatic.

A problem did occur during this experiment being that subject 1 & 4 both have had experience with dancing. The entire time throughout the experiment

they never had a negative emotion because those subjects are used to dancing that much and the subjects love it. If those subjects have never danced before they would've felt a negative emotion (tired) and it would've proven the hypothesis to be correct

## **VI. Application**

The information gained from this experiment can be useful to many but mostly dancers and anyone facing mental health problems. Dance is more than just memorizing moves, it is a way of using the body as an instrument of expression and communication. For anyone who is having a hard time, either struggling with stress or depression, dance is a perfect form of therapy but should not be a replacement for seeking out for help from a professional. Dance is a tool to help people stay mentally happy and in a good shape. Dance has a reputation of having physical and mental affects such as being in a good shape and living a happier life.

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# **Effectively Determining a Studying Strategy for a Specific Individual Through a Computer Program**

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## **I. Abstract**

The question investigated was how can a studying strategy for a specific individual be analyzed effectively and determined efficiently? The relevance of this question lead to having a nurturing learning environment not just in school but also at home (Rall 2018), and leads to the importance of students developing good studying habits while demonstrating responsibility when completing tasks. In order to have found a possible solution to the question, 50 surveys were given to grade 9 and grade 10 students inquiring studying strategy, while an additional 10 students were given interviews where their math and science marks were recorded; in grade 9 and grade 10. According to the data, 80% of students who improved in science marks had more elaborate studying strategy. There was also correlation where 56% of students who do work at the last moment do not like their studying strategy. After gathering all data, a computer program was made in the Python programming language which asked questions to the user. It then used the answers to calculate a strategy; for example, people who are more focused on getting good grades were told to rewrite notes, reread, and do practice questions. There are many possible implications that could affect the data, however, the one that was most prominent was motivation. It was shown that most people who had mindsets towards academic success were more likely to study more and devise creative studying strategies to maintain their mark. By driving motivation into students, more time will be put into studying which will no doubt improve their averages.

## **II. Introduction**

This experiment is important to figure out because learning how to study is essential for succeeding in life, and to be able to have a nurturing learning environment not just in school but also at home is very beneficial (Rall 2018). Students with majors in architecture and chemical engineering have higher study hours (Statista 2011) than the average high school student who studies, and this becomes a problem because studying can take up a large chunk of time. By learning how to study effectively,

students can leave more room for extracurriculars and free time, develop good habits and responsibility when completing tasks, and can make the content of what they're studying much easier to learn. This goes to the question, which is how can a studying strategy for a specific individual be analyzed effectively and determined efficiently?

If a studying/learning strategy for a specific individual can be identified through their marks and their habits, the individual's performance will

improve overall in marks and mental health because the individual will apply that strategy and will learn more if the method of studying is more suitable for them (Monteiro 2016). Typically, in academics, common teaching and studying methods are near identical twins of each other - copy down notes and at home, read over notes. This method of learning can be very uninteresting for students since not every student learns and studies the same way. By identifying a strategy for a student to study with at home and at the same time invoking a deeper feeling of meaning for the material (Oxford 2017), everyone can learn effectively regardless of what the teacher teaches at school.

### **III. Methods**

A survey was given to 20 grade nines and 30 grade tens. (See below)

#### **SURVEY**

1. What grade are you in?
  - a. 9
  - b. 10
2. Do you do homework when you get home, or last minute?
  - a. When I get home
  - b. Last minute; night before
  - c. I do my homework consistently throughout the day
3. What is your mindset towards school?
  - a. Grades are the most important
  - b. Just trying to survive
  - c. School is chill

- d. School sucks
4. What's your studying strategy for tests?
  - a. \_\_\_\_\_
5. How long do you study for?
  - a. I don't study
  - b. Less than an hour
  - c. More than an hour
6. When you're studying, do you get distracted by social media, games, etc?
  - a. Often
  - b. Sometimes
  - c. Never
7. Personally, is this studying strategy is working out for you?
  - a. Yes, it's amazing
  - b. It's okay
  - c. No, not very well
8. Briefly describe what type of person you are in one sentence:
  - a. \_\_\_\_\_
9. What are some hobbies you enjoy?
  - a. \_\_\_\_\_

An interview was given to 10 grade tens. (See below)

#### **INTERVIEW**

1. What was your math mark in grade 9 versus grade 10? Do you feel like you've improved or degraded?
2. What was your science mark in grade 9 versus grade 10? Do you feel like you've improved or degraded?
3. Could you tell me what studying strategy you use in depth?

4. Did you change the way you study from grade 9 to 10? Did studying stay the same? Why?
5. Which do you prefer: Flashcards, Quizlets, or just rewriting your notes?
6. When you're studying, do you focus on understanding the general topic, or do you go further and memorize terms and definitions?
7. Would you rather study alone, or in a group?
8. Do you study daily, or just a few days before the test?

## PROGRAM

1. What grade are you in? (Grade 9, Grade 10)
2. What type of grades do you usually get? (50-60, 61-70, 81-90, 91-100)
3. Choose one: (Math, Science)
4. How long can you concentrate on studying for? (More than 2 hours, 1-2 hours, less than an hour)
5. Choose one: (Technology, Good Old Books)
6. Choose one: (Squad, Solo)
7. Choose one: (Speech, Read, Both)
8. How important is school to you? (Very Important, It's okay, Not my top priority)

50 students were randomly selected in the cafeteria, hallways, stairways, classrooms for the survey. The data was collected and filled in on Excel, and the data of grade 10s versus grade 9s were separated. The data was filtered for determining further correlations, and a circle graph was generated for each question.

10 different grade 10 students were selected for the interview. The data was collected and filled in on Excel. The data was also filtered for determining further correlations, and a circle graph was generated for each question.

Once completed, an evaluation program programmed in the Python programming language. The program took parts of studying strategies from answers the user gave and compiled it all on one screen. After 100 user feedback responses, the program used the Scikit module and used the feedback responses as testing data for machine learning. (See below)



```

simulation.py - D:\Science\Scikit\simulation.py (3.6.5)
File Edit Format Run Options Window Help

"""TRY using Quizlets and Flashcards. Study using with textbooks or
Work better in a group. Work better independently."""

"""Section 1"""

def draw_o(self, g):
    p = 0
    g.blit(self.back, (0,0))
    draw_rect(g, (139, 195, 74), (1000, 600, 100, 100))
    g.blit(self.textFont.render("Back", True, (255, 255, 255)), (1000, 630))

    for i in range(len(self.answers)):
        g.blit(self.textFont.render(self.strat[i][self.answers[i].index(self.answers[i])
        p=i)

def readData(self):
    data = open("data.txt", "r").read()
    features = []
    answers = []
    if len(data) > 100:
        for question in questions:
            for answer in data:
                features.append([answer])

    clf = tree.DecisionTreeClassifier()
    clf = clf.fit(features, answers) #find patterns
    print(clf.predict([[]]))

#studying strategies:

#Plan everything out, then work. Use computer program
#Rewrite notes/Rephrase notes
#Memorize notes - Flash cards, quizlets
#Read notes with friends
#Practice sample questions/Write worksheets
#Choose code notes when reading

g.mainloop()

while g.running:
    mx, my = mouse.get_pos()
    g.clicked = (mx, my)
    mb = mouse.get_pressed()
    if mb[0] > 0:
        if e.type == QUIT:
            g.running = False
        if e.type == MOUSEBUTTONDOWN:
            if e.button == 1:
                g.buttonPressed(mx, my)

    g.checkState(mx, my)
    if mb[0] > 0:
        #print(mx, my)
        pass
    display.flip()
#Time: 1:10:10
quit()

```

In this experiment, the independent variable was the studying strategy. The whole experiment was organized by studying strategies to be able to gather relevant data and information. By changing

studying strategies, data like interest and traits will change according to that.

In this experiment, dependent variables were personal traits, interests, math and science marks and hobbies. Since the independent variable was studying strategy, the dependent variables changed according to the independent variable. Another dependent variable was students' mindset towards school.

In this experiment, one of the controlled variables was grade level and school since data from Assumption Highschool or from grade 12s may be different. For example, grade 9s will be separated and grade 10s will also be separated with students only in Massey. Another controlled variable was the survey and interview because every student regardless of who they are was given the same material. Other controlled variables were the environment of the interview and simulations which was calm and quiet. The survey's environment was also controlled but, it was made sure the student was filling it in alone to prevent influence from peers and to make sure the student was focusing on completing the survey.

## IV. Results

|   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |     |
|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|-----|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 |
|   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |     |

|                                                       | 1        | 2                                                                                              | 3                                                             | 4                                                                 | 5                            | 6                                                                 | 7                                         | 8 |
|-------------------------------------------------------|----------|------------------------------------------------------------------------------------------------|---------------------------------------------------------------|-------------------------------------------------------------------|------------------------------|-------------------------------------------------------------------|-------------------------------------------|---|
| Improved                                              | Improved | Plan out (risky notes), know exactly what to study. Procrastinate a few hours, then work hard. | Started using computer programs                               | Flash cards                                                       | Main concept, key terms      | alone for intense projects                                        | As long as I understand, a few days study |   |
| Improved                                              | Degraded | Rewrite notes, then memorize                                                                   | No                                                            | Rewrite notes                                                     | Further and memorize         | study alone                                                       | Important - daily, other tests, before    |   |
| Improved                                              | Degraded | I study with friends, writes notes out                                                         | NO                                                            | rewrite notes                                                     | memorize terms               | study in a group                                                  | study just a few days before the test     |   |
| degraded                                              | degraded | rephrase them (info), reread                                                                   | quantity of studying - improved reading has become rephrasing | rewrite notes (flashcards for memorization)                       | the general topics           | group for large test, alone for small tests                       | a few days before the test                |   |
| improved even though mark dropped a bit               | improved | read notes, do practice questions                                                              | same                                                          | flash cards, repetition                                           | both                         | alone                                                             | few days before test                      |   |
| even though mark increased, feels like didn't improve | improved | notes, practice sample questions, friends studying together                                    | Same since cannot think of any other way to study             | Flash cards to confirm understanding, quizzes for covering things | memorize terms               | group, but 3 max                                                  | few days before test                      |   |
| Improved                                              | Improved | Colour coding notes, review info multiple times, practice                                      | Gr 9 - Read over then in Gr 10 - Rewrite notes                | Quizzes because more questions and you can see mistakes           | memorize terms               | study alone                                                       | study a few days before test              |   |
| Improved                                              | Degraded | Rewrite notes, flashcards, quizzes                                                             | Same                                                          | Rewriting notes                                                   | General topics               | study alone since you become more focused, groups get a bit silly | a few days before the test                |   |
| Same                                                  | Same     | Make notes, practice questions, go over information                                            | A lot of more practice questions (math)                       | quizzes                                                           | Understanding general topics | Group (stay more on task)                                         | few days before test                      |   |
| improved                                              | improved | read through notes                                                                             | no                                                            | quizlet                                                           | General topics               | alone                                                             | few days before test                      |   |

Figure 2: Results of the interview. Each column is a different question, each row is a different person.

## Survey Graphed Result Summary:

Grade 9s:

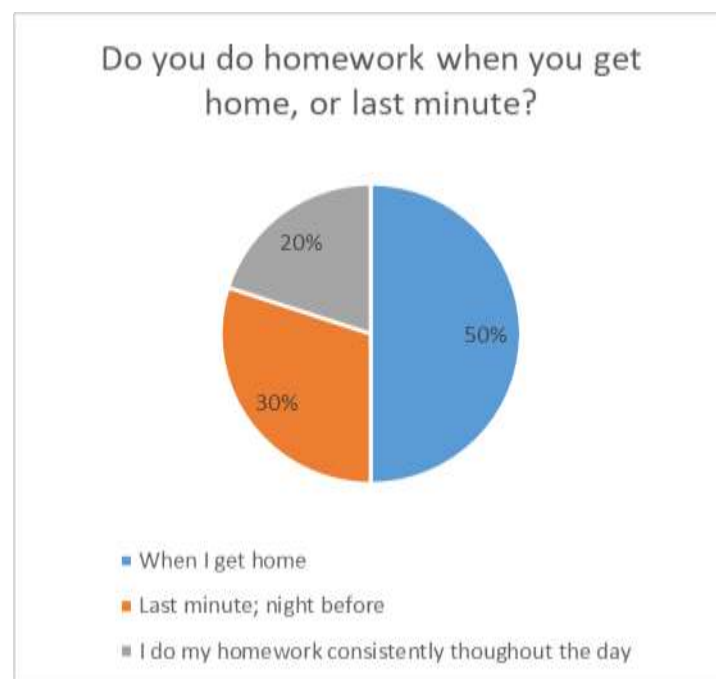


Figure 3: Percentage of students who do homework at set times. (Grade 9)

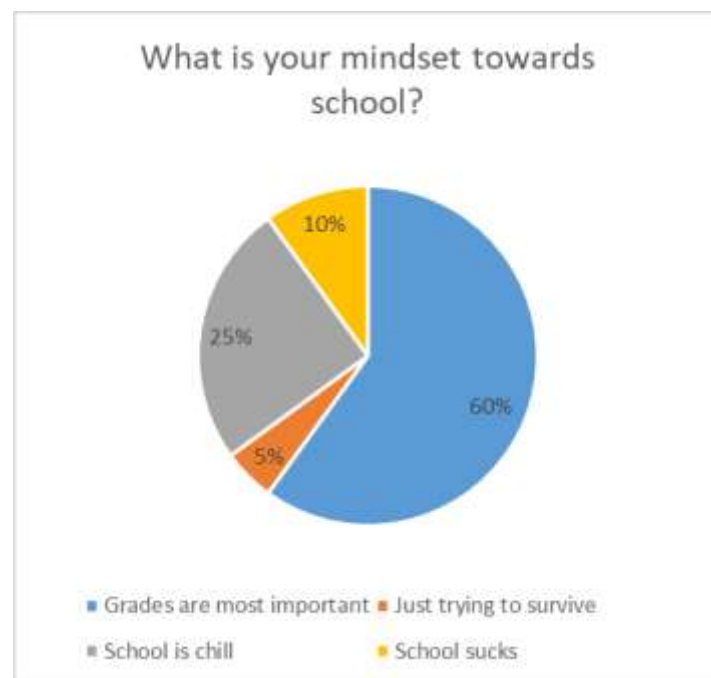


Figure 4: Percentage of students' mindsets towards school. (Grade 9)

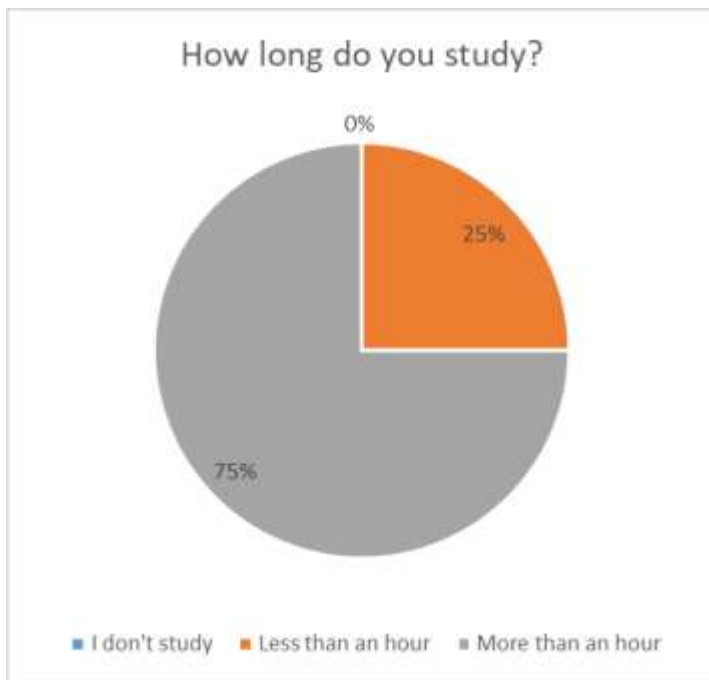


Figure 5: Percentage of students' study hours. (Grade 9)

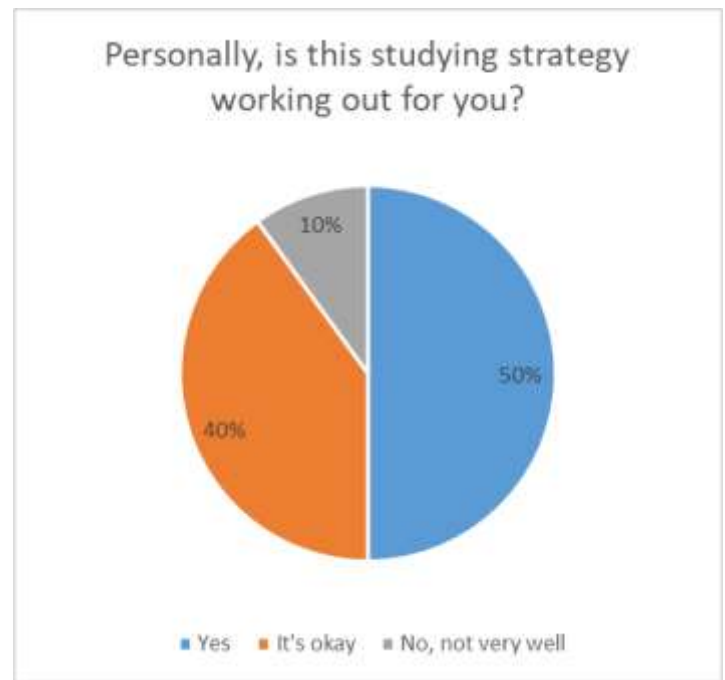


Figure 7: Percentage of students' studying strategies that are effective. (Grade 9)

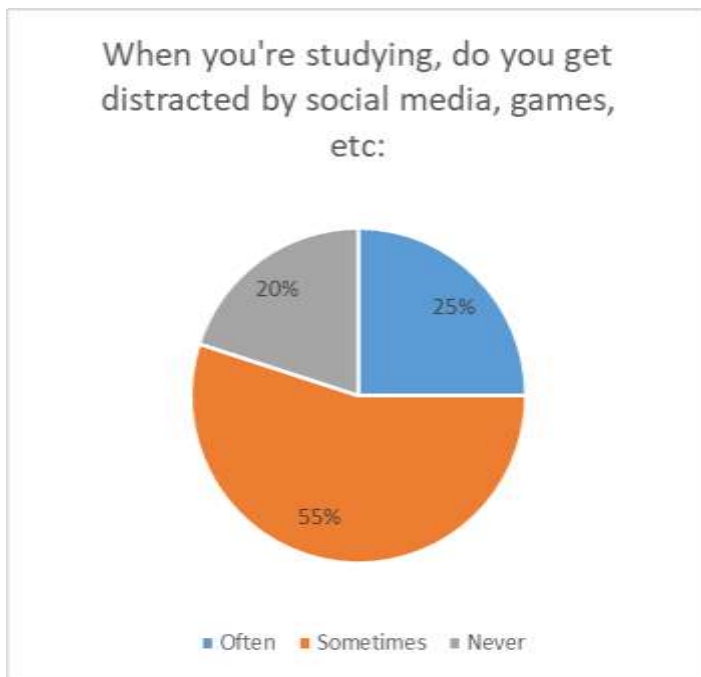


Figure 6: Percentage of students getting distracted by social media, games, etc. (Grade 9)

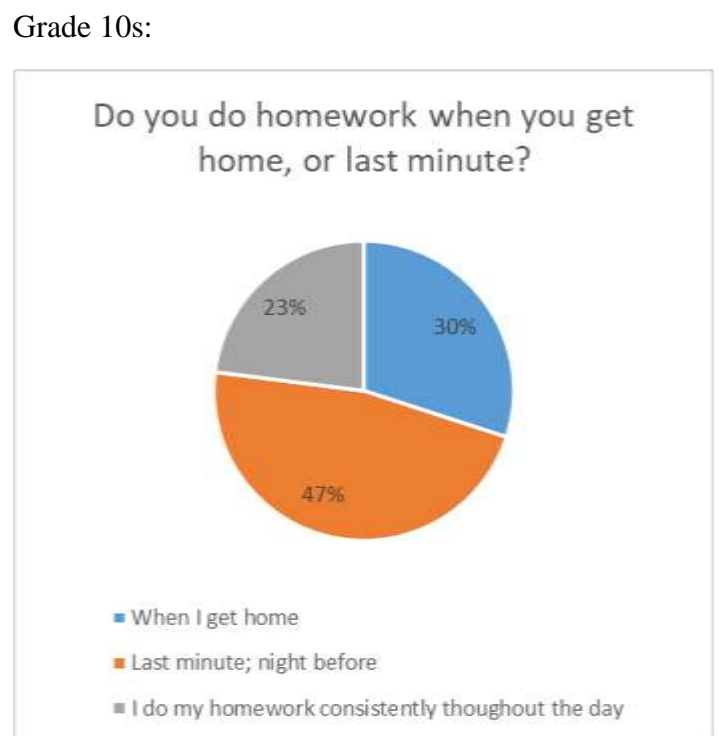


Figure 8: Percentage of students who do homework at set times. (Grade 10)

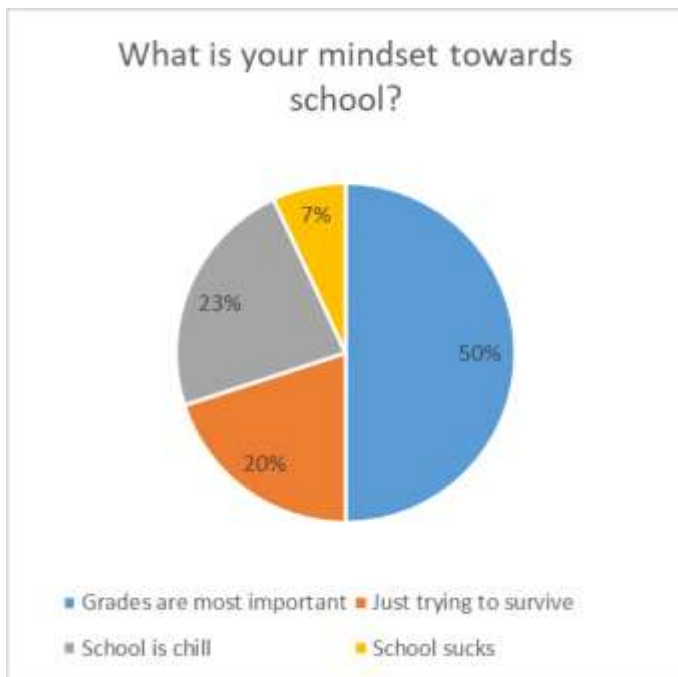


Figure 9: Percentage of students' mindsets towards school. (Grade 10)

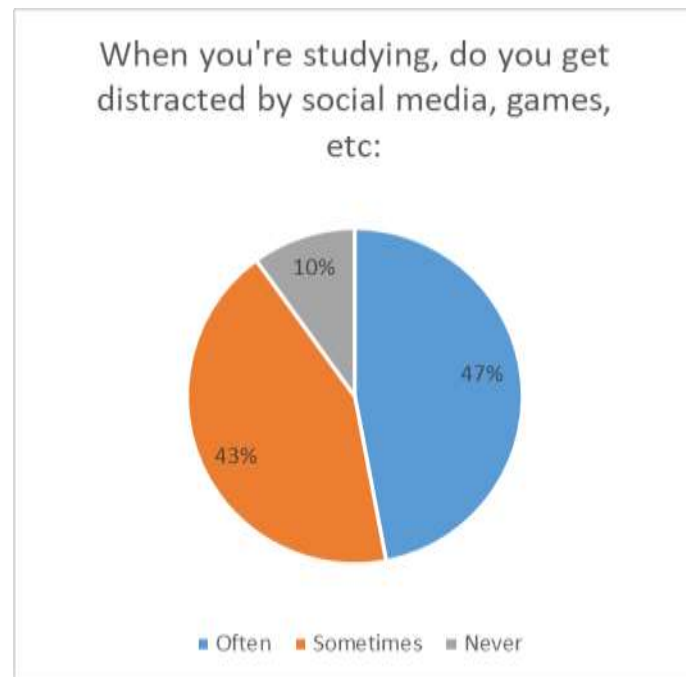


Figure 11: Percentage of students getting distracted by social media, games, etc. (Grade 10)

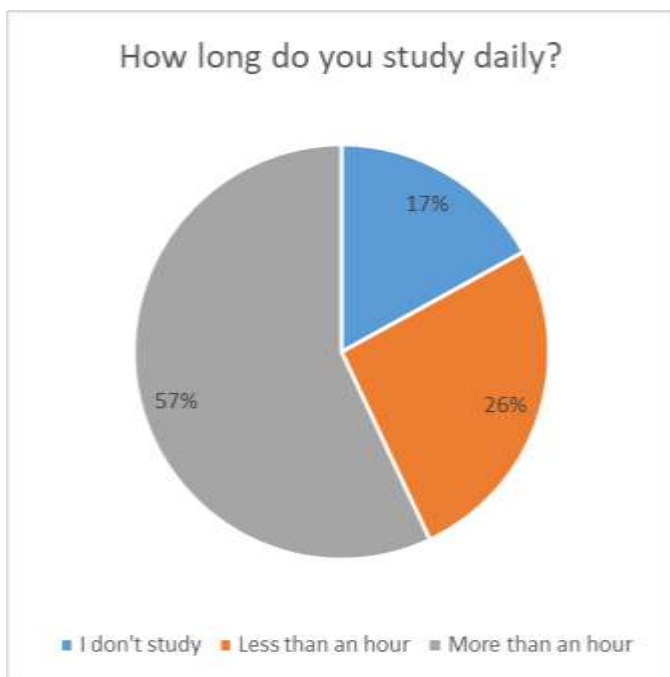


Figure 10: Percentage of students' study hours. (Grade 10)

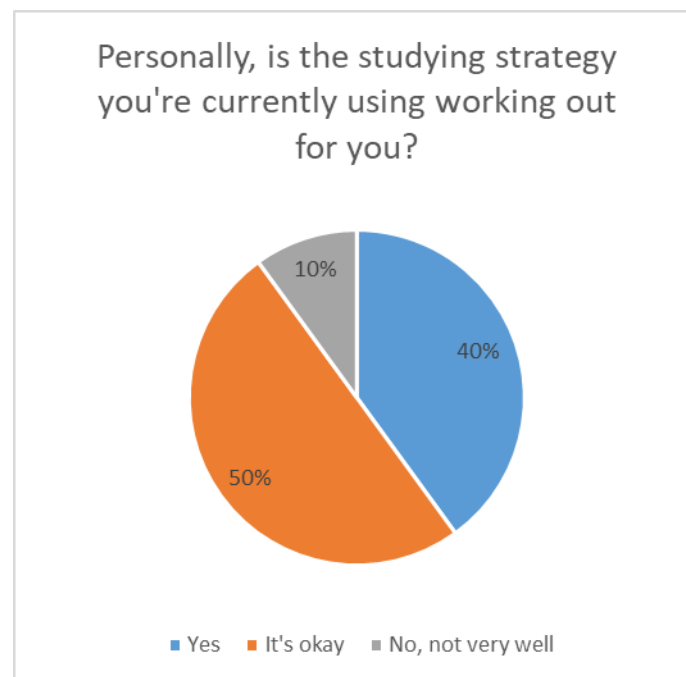


Figure 12: Percentage of students' studying strategies that are effective. (Grade 10)

YouTube Link to Program:

<https://youtu.be/3NbXvktFToQ>



## **V. Discussion and Conclusion**

If a studying strategy for a specific individual can be identified through correlations in data pertaining to their habits and personality, then the individual's performance in marks and mental health will improve overall. Through Figure 1, of all the students that loved their studying strategy, 55% do the work the moment they get home while on the other side, of all the students that aren't sure or don't like their strategy, 56% do their work at the last moment, which shows a correlation between doing homework early versus late at night where it can affect how they feel about their strategy. Figure 1 also showed that there was a 17.1% difference in procrastination and getting less distracted by social media and games where students who loved their strategy had less procrastination. This proves that there are correlations in data that can improve their mental health of how they view their studying strategy. Due to the python program created to identify studying strategies based on correlations from the survey and interview, it was able to procure a studying strategy and provide specific details on that studying strategy such as the study time, method, and visuals (see video and code). It was hypothesized that if a studying strategy could be identified for an individual, marks and mental health will improve. From the experiment portion, it was proven that correlations could be identified and that students improved in mental health and marks,

and from the combination portion, it was proven that the strategy could be implemented.

The more efficient a studying strategy is for the student, their memorization and understanding of the content for subjects increase, which boosts their mark and in turn boosts their mental health since their grades are improving. However, there is much more to this than overall academic improvement. Studies have shown that good habits begin at home, and having good study habits can carry onto college, university, and even later in a job. One possible error in the SciCan experiment involves the unequal distribution of surveys and interviews since students are selected in school, and this could alter the reliability of the data since there could be a group of students that are missing such as people outside playing basketball or the people in the gym. One other possible error is during surveys, participants are given the survey on the spot, and depending on the environment they're in, it can influence their responses which alters the survey data. Some improvements to this SciCan would be changing the survey to online in order to make gathering survey data easier and quicker, doing interviews for grade nines to gather separate and specific grade nine data, and adding more features to the python program such as simulating the studying strategy given in order for them to experience it.

## **VI. Application**

The information from this experiment shows that the more compatible a studying strategy is to a



student, the more successful they are on academic assessments such as tests and homework. This information can help students develop good habits in the future; stopping procrastination and finishing homework as soon as possible to prevent all-nighters. These good habits developed straight from a studying strategy can carry onto university and into the workforce, where many assignments and tasks are worth much more than a simple mark. By developing good habits early on, it prepares students for the future. If students are doing well academically, then their mental health improves, which benefits their lifestyle, and eventually helps physical health as well. This information can be used in areas like high school guidance or the Kids Help Phone where finding a studying strategy for an individual can de-stress them and help them perform better in school. This information not only helps students, but also benefits teachers too. By using the techniques of the program, teachers can figure out the studying strategies of most students, and they can tailor lessons to fit learning styles of most students as studying strategies are very much

hand in hand with learning strategies. In summary, both the experiment and innovation portions contribute significantly to education by developing students and increasing efficiency for teachers and staff.

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# **Effects of Stress Versus Encouragement on the Ability to play “Perfection”**

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## **Abstract:**

This purpose of this study was to determine how encouragement versus acute stress affects one’s ability to complete a game like “Perfection”. Subjects were brought into a noiseless room and were given one minute to correctly place all the shapes into their correct slots. The subjects are given two attempts to complete the game, once while being stressed and the other while being encouraged. During the first attempt, a person stands beside the subject and makes comments to stress them out and during the second attempt, the same person stands beside the subject and gives them words of encouragement. All comments stay consistent through out the experiment. Majority of test subjects performed better when given words of encouragement as opposed to stress. This information proves that encouragement and having a positive attitude towards stress allows a person to excel in their ability to perform stressful tasks, in this case “Perfection”.

## **Introduction**

Stress is a normal and unavoidable part of life that everyone eventually deals with. Based on a recent survey, studies show that approximately %73 of people regularly experience psychological symptoms caused by stress and %77 of people regularly experience physical symptoms caused by stress (Daily Life 2018). People everywhere deal with stress and it is important to find ways to reduce it. Stress can be positive or negative and it is important to be able to distinguish the point where stress has crossed its boundaries and has become dangerous.

The question is, how does encouragement versus acute stress/pressure affect a person’s ability to complete various stressful tasks?

It is hypothesised that if a person is under the pressure of time or by others then he/she will perform worse in a stressful task because stress is a chain reaction of signals that makes its way out into your body and then induces all the responses that is associated with stress (Chess Stetson 2015).

Stress also causes the brain to go in a stress state, releasing adrenaline and cortisol; hormones that decrease our short-term memory (Jason Silva 2015). On the other hand, if a person is encouraged and motivated then it is hypothesized that he/she will do better in the same task because when faced with a stressful task, a little positive reinforcement will give much better results

## **Methods**

This experiment was conducted using the game perfection. The game was placed at the center of the table and the subjects were asked to enter the room along with the stressor/encourager. The test subjects were told that they have sixty seconds to place all the pieces of the game into their corresponding slots. The subjects started the game while the stressor made comments that would stress the person while they are playing the game. The results were recorded based on the number of shapes the subject was able to fit into correct slot before the timer rang. Results were recorded in the table provided. The independent variable was the stressor/encourager alternating between stressing or encouraging the person. The

dependent variable is if the subject was able to or unable to complete the game in the time given. The controlled variables were that the game must be the same game throughout, the stressor/encourager must be the same person throughout making the

same comments, and finally the number of times each subject completes the game, under stress or encouragement, should be the same to ensure that the game is fair.

### Results:

Table 1: Table 1 shows that's majority of subjects fit more shapes into their correct slots when encourage as opposed to stressed/pressured.

| Ages 6-17 | Ages 18-30 | Ages 31-49 | Ages 50+ | Encouraged or Stressed | Number of shapes that were put in (out of 25) |
|-----------|------------|------------|----------|------------------------|-----------------------------------------------|
| X         |            |            |          | Stressed               | 14/25                                         |
| X         |            |            |          | Encouraged             | 20/25                                         |
|           | X          |            |          | Stressed               | 11/25                                         |
|           | X          |            |          | Encouraged             | 17/25                                         |
|           |            | X          |          | Stressed               | 13/25                                         |
|           |            | X          |          | Encouraged             | 16/25                                         |
|           | X          |            |          | Stressed               | 18/25                                         |
|           | X          |            |          | Encouraged             | 25/25                                         |
|           |            |            | X        | Stressed               | 8/25                                          |
|           |            |            | X        | Encouraged             | 11/25                                         |
| X         |            |            |          | Stressed               | 19/25                                         |
| X         |            |            |          | Encouraged             | 14/25                                         |
|           |            | X          |          | Stressed               | 13/25                                         |
|           |            | X          |          | Encouraged             | 15/25                                         |
|           |            |            | X        | Stressed               | 7/25                                          |
|           |            |            | X        | Encouraged             | 10/25                                         |
|           | X          |            |          | Stressed               | 19/25                                         |
|           | X          |            |          | Encouraged             | 23/25                                         |
| X         |            |            |          | Stressed               | 11/25                                         |
| X         |            |            |          | Encouraged             | 17/25                                         |

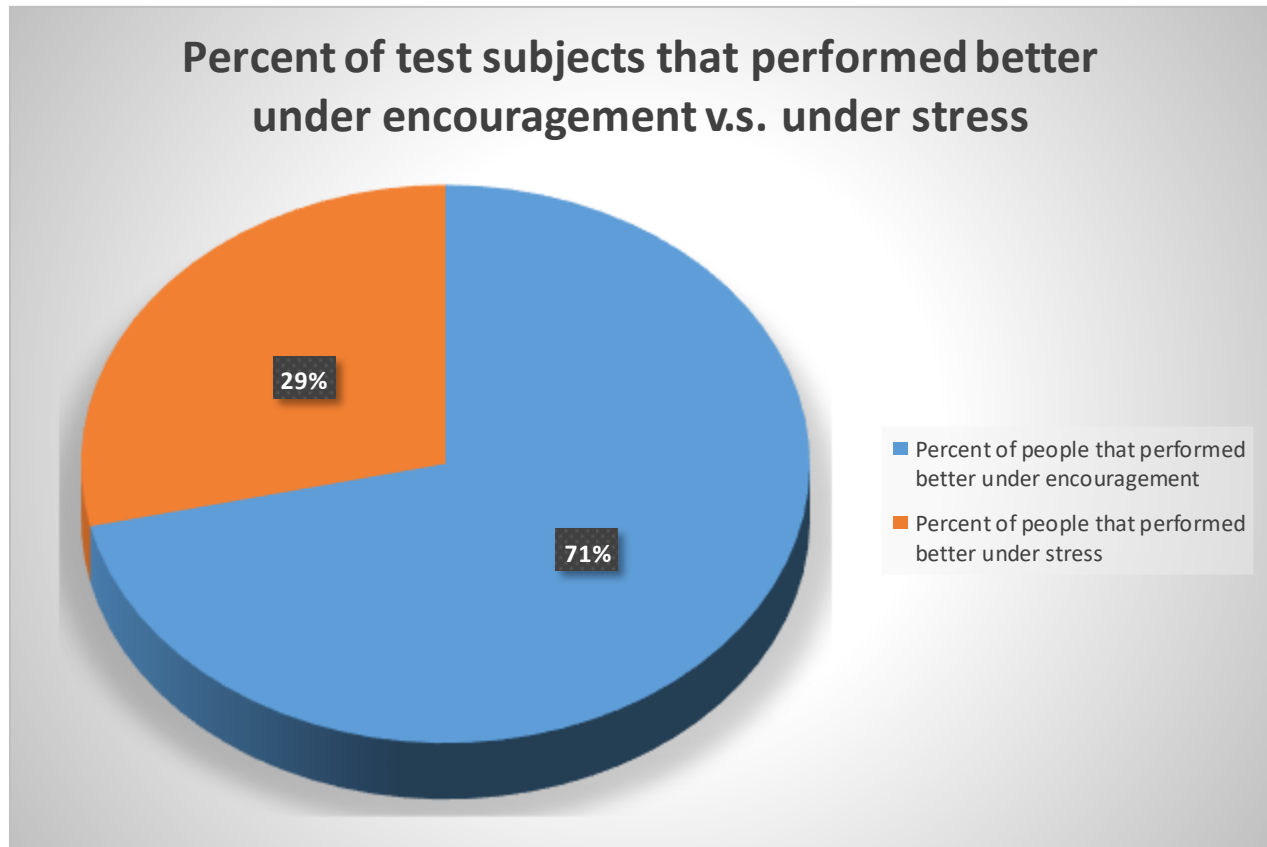


Figure 1: Figure 1 shows the percent of test subjects that performed better under encouragement as opposed to stress.

### **Discussion and Conclusion:**

The hypothesis was correct. Stress does indeed affect a person's ability to complete a stressful game. Based on the results, one will perform worse in the game "Perfection" when they are under pressure. Seventy-one percent of the test subjects performed better under encouragement than under stress. This comes to prove that stress does affect one's ability to complete a game. In addition, the age group with the highest scores both under stress and under encouragement was ages 18-30. The younger half of the subjects performed much better both under stress and under encouragement bringing into light that younger minds are better at handling stress than elder minds.

Stress does in fact affect one's ability to perform tasks such as school work, sports, or games. Stress activates a process in our bodies called the fight or flight response.

The last step of the fight or flight response is the release of a hormone into our blood stream called "cortisol". Studies show that sometimes, depending on how stressed one is, cortisol can affect one's concentration, focus, memory, attention, and planning and organizing ability just as much as alcohol does! Not only that, but stress negatively affects one's immune system. When one is under stress, they are more likely to get sick, which makes it harder to concentrate and focus on tasks like school, sports, or games. This explains why subjects under stress performed more poorly than those

under encouragement. Some problems that I faced were regarding the comments. The stressor/encourager had a challenging time on making the same comments with the same enthusiasm or expressions. This slight difference in the way of commenting could possibly have affected the results. Had this problem not been there, the results would have likely been the same because the overall feel of encouragement o stress was met, despite the change of tone or enthusiasm by the stressor/ encourager.

### **Application:**

The results of this experiment can be used to help not only the medical field, but also many others. These results and information can be applied to fields like Phycology, Neurology, Criminology, and basically any field that is related to stress or studies of the brain. Not only are these field affected but almost every field or stressful occupation can use this data. The general population can also use this data to help them view stress in a new perspective that is better and healthier for them. Overall, this

data can help almost everyone. From people who experience stress daily to people who are very calm and collected, this data gives an insight on a new positive perspective towards stress.

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# **Similar or Contrasting Emotions Based on the Same Song Played in Key Signatures containing Flats and Key Signatures containing Sharps.**

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## **I. Abstract**

Music is everywhere, and associating the right music with any type of media could influence emotional connections and biasing. It was hypothesized that if the same song was played in multiple keys that contain sharps in the key signature, similar emotions would be invoked that contrasted the similar emotions invoked if the song was played in multiple keys with flats in the key signature. Subjects listened to four different recordings of the same song, each time played in a different key: two sharp keys and two flat keys. Subjects recorded the emotions felt after each recording, and answered other questions based on pitch, preference, and visual representation as well. Both flat recording stimulated many similar emotions within subjects. Both sharp songs also stimulated similar emotions within subjects, but the number of occurrences was much smaller. 45% of subjects felt contrasting emotions between sharp recordings and flat recordings. There was no direct conclusion; according to this experiment, there is no set contrasting emotions that are invoked when a song is played in a key with flats and a key with sharps.

## **II. Introduction**

According to the findings of 3 experiments Mr. Bhattacharya (2016) conducted, musical emotions plays a big role in biasing judgement, and this bias is based off the concepts of good and evil, bright and dark, respectively. Following that, according to the findings of multiple researchers from the US National Library of Medicine (2011), the acoustic features of a song with and without lyrics differ and has something to do with perceptual brightness, but sad music with lyrics and happy music without may not differ. This shows the possibility of music

influencing bias and therefore judgement, eliminating the possibility of linguistic content influencing the findings. Learning about what specific musical factors (flats vs sharps) can influence bias which is important for marketing, musical therapy, and possibly emotional and physical changes.

Knowing how much of an impact music has on society today, the question that demands to be answered is the following: what emotional variant

can be invoked if the same song is played in a key with flats versus in a key with sharps?

It is hypothesized that if the same song is played in keys with flats in the key signature versus in a key hypothesized that the emotions invoked within sharp versions will be the same or similar emotions, and that the emotions invoked within the flat

III. Methods

Subjects were given a digital survey to complete before listening to the recordings (Figure 1). A short, simple, and emotional song was composed to eliminate any possible prior emotional connection to the song. That song was played on the piano, four times, in four different key signatures. The keys used were E-flat major, D-flat major, E major, and D major, in that order. After listening to the first recording, subjects were asked to fill out another digital survey (Figure 2), and yet a different one after listening to recordings 2, 3, and 4 (Figure 3). After listening to the final recording, subjects were required to fill out a post-experiment survey (Figure 4). The independent variable was the change in keys. The dependent variable was the emotions experienced. The controlled variables were the (same) song, the tempo, the (same) survey questions, and the atmosphere. The same song was used to limit the range of emotions that could be experienced, and to collect data that specifically analyzed the different key’s affects. The same tempo reduced bias since fast tempos are associated with joy whilst slow tempos are associated with melancholy and sadness. The survey questions were

with sharps in the key signature, contrasting emotions are to be invoked. However, it is also

versions of the song will also be similar or the same.

the same to effectively compare the data collected, and the same atmosphere was used to limit the influence of other factors (e.g., noise levels, surrounding visuals) on the experiment.

|                                                                                      |
|--------------------------------------------------------------------------------------|
| How do you feel, before taking the test?<br>(Explore your emotions and moods)        |
| What did you do before taking the test?                                              |
| Do you play a musical instrument? If yes, which one, and for how many years?         |
| Do you have perfect pitch? (Yes, no, sometimes, it depends on the instrument, other) |

Figure 1: survey for before listening to recordings.

|                                                                                                                                                      |
|------------------------------------------------------------------------------------------------------------------------------------------------------|
| Use 3-6 words/phrases to describe how you feel.                                                                                                      |
| Choose one image you imagined as you were listening. Describe the image.                                                                             |
| What kind of movie or video do you think this song could be played with? (think about genres and/or examples of movies or videos you've seen before) |

Figure 2: survey for after listening to 1<sup>st</sup> recording.

|                                                                                                             |
|-------------------------------------------------------------------------------------------------------------|
| Use 3-6 words/phrases to describe how you feel. If you don't feel differently, type "Same".                 |
| Choose one image you imagined as you were listening. Describe the image if it was different from the first. |
| What do you think made the image/words change from the first? If not different, type "Same".                |

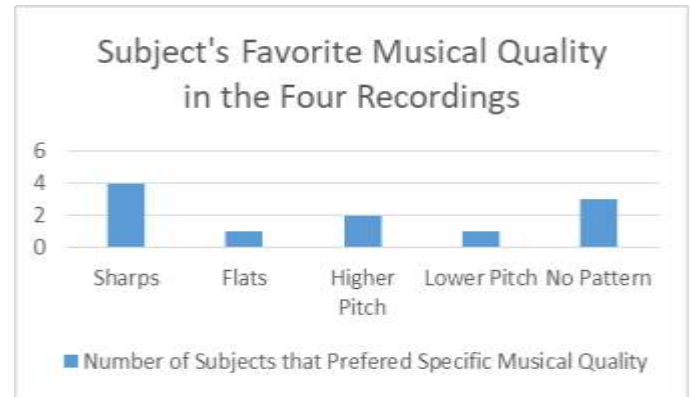
**Figure 3:** survey for after 2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup> recordings.

|                                                                                                           |
|-----------------------------------------------------------------------------------------------------------|
| Were you annoyed by the repetition of songs? If not, choose another description on how you felt about it. |
| Did you realize what was being changed throughout the recordings? If yes, what was being changed?         |
| Try to rank the songs from favorite to least                                                              |

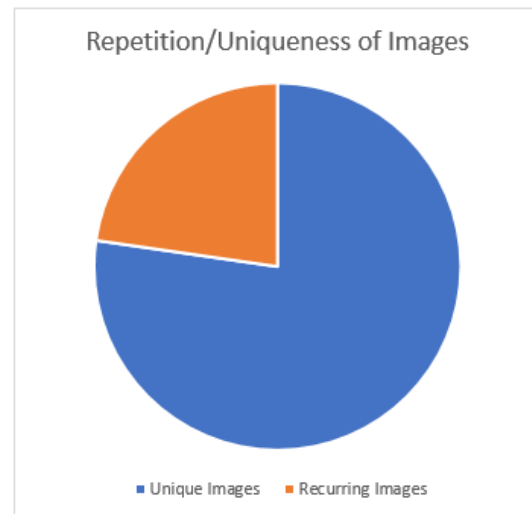
**Figure 4:** survey for after all recordings.

#### IV. Results

**Graph 1:** this graph was created after collecting data from the third question in Figure 4. For example, a subject that preferred “higher pitch” would have ranked the recordings as E major, then E-flat major, then D major, then D-flat major. The subjects that fell under the “No Pattern” category had a certain preference, but with pattern under musical terms.



**Graph 2:** this chart was compiled after collecting data from the second question of Figures 2 & 3. Of the 44 images that were imagined, 34 images were unique for that person. There were 10 occurrences where a person saw the same image for a different recording. However, not a single person saw the same image for all 4 recordings.



**Table 1:** this table was compiled from the data from the first question of Figures 2 & 3.



| Subjects  | 1. Emotional Summary: E-flat Recording (flat) | 2. Emotional Summary: D-flat Recording (flat) | 3. Emotional Summary: E Recording (sharp) | 4. Emotional Summary: D Recording (sharp) |
|-----------|-----------------------------------------------|-----------------------------------------------|-------------------------------------------|-------------------------------------------|
| Subject A | Nostalgic, happy                              | Sad, lonely                                   | Happy, festive                            | Same as 1                                 |
| Subject B | Calm                                          | Sadder                                        | Happier, fulfilled                        | Sadder than 2                             |
| Subject C | Energetic, happier                            | Same as 1                                     | More energized                            | Lot less tired                            |
| Subject D | Reflecting, nostalgic                         | Same as 1                                     | More tense, less carefree                 | More mellow                               |
| Subject E | At ease, breezy                               | Same as 1, calmer                             | Light, delicate                           | Same as 2                                 |
| Subject F | Calm, peace                                   | Same as 1                                     | Joy, cheer, bright                        | Most peaceful                             |
| Subject G | Relaxed, calm, happy                          | Same as 1                                     | Less happy, sad                           | Sad, hopeful at end                       |
| Subject H | Calm, pleased                                 | Same as 1                                     | Joy, happy                                | Sadness                                   |
| Subject I | Loved, optimistic, peace                      | Same as 1, more resolution                    | Same as 2                                 | Same as all                               |
| Subject J | Annoyed (affected by distaste for genre)      | Heartwarming                                  | Bittersweet, happy                        | Same as 3, but stronger                   |
| Subject K | Relaxed, excited, calm                        | Same as 1                                     | Optimistic, happy                         | Same as 3                                 |

According to the findings, 8 subjects had the same emotions for both flat songs, and 3 subjects had the same emotions for both sharp recordings. 4 subjects had the same emotions in sharp and flat recordings. 3 subjects had contrasting or different emotions in both flat recordings, and even though 8 subjects had different emotions in both sharp recordings, only 3 subjects felt contrasting emotions in both flat recordings. 2 subjects had the same emotions for recordings that started on notes a semitone apart, and 2 subjects had the same emotions regardless of any musical quality: not flats nor sharps nor pitch. Only 1 subject proved the hypothesis directly.

## V. Discussion & Conclusion

The hypothesis was not 100% correct, but it was directly supported by 1 subject and half-supported 11 out of 22 times, making it partially correct. The initial question was, “What emotional variant can be invoked if the same song is played in a key with flats versus in a key with sharps”? This question can be answered in different ways, one by comparing different emotions between flats vs. sharps, and two by comparing what emotions were the same in sharp songs and the same in flat songs. 73% of

subjects felt the same emotions for both Flat recordings, and 27% of subjects felt the same emotions for both Sharp recordings. This means that oppositely, 27% of subjects felt differently in both flat versions, and that 73% felt differently in both sharp versions, which shows a partial emotional variant between flats and sharps. It was found that emotions can be categorized based on the pitch of the tonic note – the starting note; songs that had tonic notes only a semi-tone apart invoked similar or same emotions in 2/11 of the subjects. Also, when asked for preference, another 2 subjects ordered their favorites in order of highest to lowest pitch, or vice versa. This side-observation says something about how higher or lower pitches can affect emotions as well.

There was no special mathematical connection that separated flats and sharps (using the hertz measurement), so also finding no definitive scientific connection is predictable as well. However, since musicians from the past have associated keys to emotions and since changing a song with flats to sharps changes the key, it made sense to find more than a few connections that were the same between the recordings with flats and separately between the recordings with sharps. It also made sense to find a small connection between emotions and pitch (higher vs. lower) since studies have already been made to show a bigger emotional jump when a same song is played with a tonal center that’s further apart rather than closer together.

Errors occurred because it's really hard for a human to play the same song multiple times in the same way without playing it like a robot, because pianists feel different emotions constantly. Also, holding a single note too long or playing two notes too loud can change the mood of the song entirely. What this means for this experiment is that each recording most likely had different moods due to the pianist's different emotions, and that most likely had an impact on the emotions the subjects felt.

## **VI. Application**

Since the hypothesis wasn't correct, and there was no other direct correlation between emotions and flats, or sharps, or pitch, therefore it cannot be applied to any other fields of study. People should take this experiment, and know that good music, music that invokes emotions, are not an exact science. There is no scientific formula that can help musicians manipulate the listener's emotions. A part of being a good musician is feeling those

emotions themselves and trying their best to convey those emotions to the audience every time they perform.

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# **The Impact Various Types of Artificially Colored Incandescent Lights Have on Plant Growth**

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## **Abstract**

The question investigated was how do distinct types of artificially colored incandescent lights impact plant growth. Finding the results for the proposed question is important because if artificial lights can provide sufficient energy like sunlight, farmers in Canada can grow plants indoors during the long winter periods with minimal sunlight. During the experimental process, 4 mint plants were separated into 4 different locations, with each location having a different light source, the 4 different light sources were a red colored light bulb, purple colored light bulb, normal incandescent light bulb, and sunlight. 3 of the plants were grown indoors and were exposed to artificial colored incandescent light bulbs, whereas the 4<sup>th</sup> plant grew outside while being exposed to sunlight. The results of the experiment were that the plant growing in sunlight grew the most since it was exposed to the full spectrum of different lights that the sun provides, this was followed by the purple light bulb which has the highest energy on the visible light spectrum, next was a normal incandescent bulb which had some frequencies of light but lacked certain frequencies only available in sunlight, and finally was the red light which had minimum energy and longer wave lengths which did not provide sufficient energy for plant growth. These results can be used by farmers to bypass harsh outdoor conditions especially in the winters of Canada.

## **Introduction**

As the growing season in Canada is very short, farmers and commercial producers are forced to grow crops indoors using artificial light. They need to know what type of light, and how much of it is required for optimal growth. According to Bonnie L. Grant (2016), Cold freezes the cells in a plant, causing damage and interrupts the pathways for nutrients and

water to flow. Therefore, farmers need to know the affects of artificial light on the plant growth, as compared to natural sunlight to get optimal growth.

How do distinct types of artificially colored incandescent lights impact plant growth?

If artificial light helps plants grow the same way as sunlight, then distinct types of artificial light sources should result in

different amounts of growth, because the light emitted from various sources look different in intensity, colour, and brightness. According to Lee Reich (2016, January 19), “Fluorescent light is rich in blue and the shorter wavelengths of red light, important for healthy foliage; incandescent light is rich in “far-red” — the longer wavelengths of red light — and is important for flowering.” Furthermore, according to Tom Wagner, “While plants generally do not utilize green-spectrum light, blue light is essential for plant growth and development and red light promotes flowering. Many artificial lights provide both spectrums, though to varying degrees, so you must decide what you wish to grow before choosing an artificial light source.”

### **Methods**

Took 4 pots and filled with 1 litre of topsoil to use for the experiment. Made a hole in the center of the potted soil with a radius of approximately 2 centimetres and a depth of 6 centimetres. Then placed 1 sapling in each of the potted soil pots, the hole was then covered up with the surrounding soil to ensure that the sapling was firmly held by the soil. Put all 4 of the plants in their appropriate locations with the corresponding light sources. Kept each sapling under the same light source for 14 days which was the length of experiment. During these 14 days, all 4 pots were

watered with approximately 150mL of water daily, also for 14 days. Measured and recorded the initial height of all saplings, from the soil to the top. Ensured that the artificial lights were only on from sunrise to sunset and then must be turned off at sunset. Procedure was repeated everyday for 14 days, and recorded height changes every 2 days.

The independent variable in this experiment was the color of the lights which was being used to compare the height of all 4 plants. The dependent variable was the height of the mint plants which was being affected and measured throughout the duration of the experiment. Lastly, the controlled variables were the soil, temperature, water quantity, and exposure to light. Since the purpose of the experiment was to study the affect distinct types of lights have on plant growth, the other factors affecting plant growth must be controlled. That is why soil, temperature, water quantity, and exposure hours to light have been kept controlled.

### **Results**

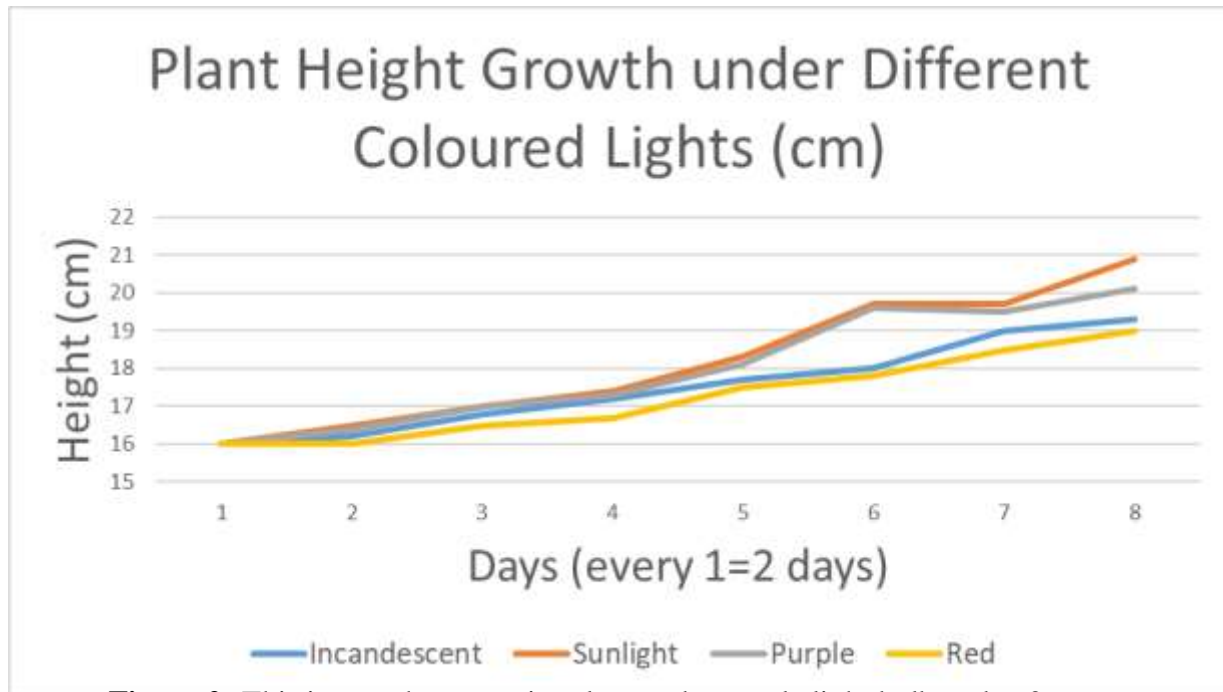
**Table 1:** This table compares height growth of the 4 plants when exposed to different sources over a period of 14 days

| Time | Plant Height (cm) |                   |                |                               |
|------|-------------------|-------------------|----------------|-------------------------------|
|      | Sunlight Plant    | Purple Light Bulb | Red Light Bulb | Incandescent Light Bulb Plant |

|       |      | Plant | Plant |      |
|-------|------|-------|-------|------|
| Day 0 | 16.0 | 16.0  | 16.0  | 16.0 |
| Day 2 | 16.5 | 16.5  | 16.0  | 16.2 |
| Day 4 |      |       |       |      |
| Day 6 |      |       |       |      |
| Day 8 |      |       |       |      |

|        |  |  |  |  |
|--------|--|--|--|--|
| Day 9  |  |  |  |  |
| Day 10 |  |  |  |  |
| Day 11 |  |  |  |  |
| Day 12 |  |  |  |  |
| Day 13 |  |  |  |  |
| Day 14 |  |  |  |  |

**Figure 1:** This graph shows the gradual increase of height over 14 days for all 4 plants



**Figure 2:** This image shows a mint plant under purple light bulb at day 0



**Figure 3:** This image shows a mint plant under red light bulb at day 0



**Figure 4:** This image shows a mint plant under incandescent light bulb at day 0



### **Discussion & Conclusion:**

The hypothesis that distinct colors of artificial light and sunlight would result in different amounts of growth in plants, was correct.

Different colors and types of light affect the growth of plants. In the experiment conducted, it was observed that the sunlight produced a maximum growth in height of 30.625% more than the initial height followed by the purple light producing 27.5% increased growth compared to initial height. The lowest growth percentage was produced by the red light equal to 26.25% greater than initial height. The incandescent light produced 20.625% growth compared to initial height that was better than the red light but lesser than the other two.

Therefore, it can be concluded that the sunlight is the best for plant growth, followed by high energy lights such as purple and incandescent light.

These results also showed that there are other viable sources of light energy available for plants rather than sunlight which may not be present always, especially depending on the geological location for some places such as Canada. Since it's evident that certain artificially colored light

bulbs can almost produce the same amount of a plant growth rate as compared to that of sunlight, these light sources can replace sunlight especially for indoor environments such as greenhouses. The data recorded supports the hypothesis as it proved that there is an actual difference in plant growth rate and heights compared to initial height depending on the different light sources they're exposed to, and the energy these lights provided.

A factor that may have impacted the overall outcome of the experiment could have been the daily outdoor sunlight exposure time during the time in which the experiment was being conducted. If it was mostly cloudy outdoors for even a couple days, this would significantly reduce the amount of energy the plant could intake and thus reduce its overall growth rate compared to what it may have been had it been continuously exposed to sunlight.

Furthermore, another source of error could have been the specific individual light bulbs that were used. The incandescent light bulbs provided both heat and light energy for the plants but these both could have been reduced if the light bulbs were nearly the end of their use period which would have then reduced the energy outputted from these bulbs, altering the outcome for the plant growth rates.

### **Application**

The results of the experiment being that artificial sources of light can almost reduce sunlight for a cheap cost can go a long way for farming both locally here in Canada and even globally for other countries that have long periods of winter or reduced sunlight hours due to geological locations. Since a farmer's total amount of produce would be limited by lack of sunlight in the cold winter temperature's as well as snow/ice, greenhouses and artificially colored lights can be used to replace sunlight and grow plants indoors for much longer time periods. Doing this can also almost completely replicate the total energy spectrum provided by sunlight. Another significant benefit for using artificial light sources instead of sunlight is that these artificial light sources can run continuously the entire day without even turning off once whereas sunlight is already limited during the day, and then is even further limited depending on if there are any clouds in the sky.

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# **The Effects of The Self-Serving Bias on the Performance of a Group During a Group Task**

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## **I. Abstract**

The purpose of the experiment was to see the effects of the self-serving bias on how a group performs when presented with a task where the group must work together. This is relevant as the self-serving bias affects many aspects of everyday life, primarily in schools, the workplace, and social interactions, and understanding the bias will improve the ways interactions occur in these situations. The study was conducted by selecting ten participants and determining their self-serving score using surveys and a diagnostic activity, which indicated how much they were affected by the self-serving bias. If a participant had a higher self-serving score, it showed that they were more affected by the self-serving bias and had a greater tendency to blame others or external factors for mistakes. Participants were separated into two groups based on self-serving score, with participants with the lowest scores in one group and participants with the highest scores in the other. The two groups then competed in a spaghetti tower construction competition, where the goal was to build the tallest tower with the materials provided. It was found that the group with the higher average self-serving score was more successful at the task and was able to create a taller structure. This group produced a 73 cm tall tower with an average self-serving score of 26.4, while the other group with a lower self-serving score produced a 71 cm tall tower with an average self-serving score of 14.8. The data shows that groups whose members that are more greatly affected by the self-serving bias do not perform worse than groups whose members are not as affected by the bias. An explanation for this finding is that participants with higher self-serving scores often vocalized and discussed ideas more effectively, and thus were able to come up with better ideas and were ultimately more successful.

## **II. Introduction**

This question is important because self-serving bias is prevalent in everyday society and as a result, impacts many aspects of everyday life, such as in the workplace or interpersonal relations (Campbell, W. K, 2000). By having a greater understanding of this bias, such as by understanding the causes and effects of it, there will be more information for analyzing human behaviors in places such as the

workplace. This will allow for greater cooperation with one another, if human behaviors are better understood and issues caused by the self-serving bias can be resolved more effectively.

What are the effects of the self-serving bias on the performance of a group in a team situation, such as a spaghetti tower construction competition? If those who are more susceptible to the self-serving bias are put together in a team situation, then that group will



suffer from disorganization and uncooperative group members, resulting in the downfall of the group, because those who tend to blame others tend to be more uncooperative individuals, and demand to do things "their way." The self-serving bias causes people to be egotistical about themselves and take credit for successes and blame others for failures (Boyles, A. 2013). They form beliefs that their methods and ideas are superior to other people's ideas, and as a result, they force their ideas onto other people. This results in arguments and non-cooperation between group members, as each group member is fighting to defend their ideas and attacking other ideas. Ultimately, the group with many members that are influenced by self-serving bias will be unsuccessful at the task.

### **III. Methods**

This project was an experiment with the purpose of observing the effects of the self-serving bias on the performance of a group in a spaghetti tower construction competition. First, ten participants were selected and given a written survey. The survey was used to determine self-serving score and contains eight multiple choice questions and one short answer. The questions asked are as follows, with questions 1-8 being multiple choice questions and question 9 being a short answer question:

1. During group projects and activities, I find that my group members are the ones making most of the mistakes.

2. I usually take credit for successes during group activities but am not so vocal for failures.
3. I often attribute shortcomings to external factors rather than my own ability.
4. When I get into disagreements with friends or classmates, it is usually because they are the ones being unreasonable.
5. If I perform poorly on a test, it is at least partially because the questions were bad, or the teacher taught the material poorly.
6. I am concerned about the way other people view me.
7. I am reluctant to admit to mistakes in fear of appearing weak or incompetent.
8. I often make excuses whenever something goes wrong.
9. Consider the following scenario: you and Abby (placeholder name) are doing a group project. Abby overall has not paid very much attention or put much effort into the project. You tell Abby to complete a task to a certain specification. You hand in the project but get a bad mark. You find that Abby did not complete the task to your specifications and blame her, as she did not put much effort in the project, but she says that your work had errors in it that prevented her from doing the work properly, and that you failed to explain the task properly. What would you do and who is responsible for the bad mark?

Each multiple-choice question had five options: strongly disagree (SD), disagree (D), neutral (N), agree (A), and strongly agree (SA). The short answer question asked participants to identify who was at fault in the hypothetical scenario, and to provide justification for their answer. The survey was marked with a response of “strongly disagree” giving a mark of -2, “disagree” giving a mark of -1, “neutral” giving a mark of 0, “agree” giving a mark of 2, and “strongly agree” giving a mark of 4. The short answer question was marked on a scale of 1-10, where the more a person blamed the other group member, the higher their mark was for that question. The preliminary self-serving score was determined by summing up scores from the 9 questions. After the first survey was completed, the participants were randomly put into two groups, group A and group B. The two groups participated in the diagnostic competition round with the following rules:

1. The tower must be freestanding, i.e. not suspended from the ceiling, wall, or other higher structures. Holding the structure in place at the time of measuring is not allowed.
2. The height of the tower is measured from the table to the lowest point of the marshmallow.
3. Each group can only use the materials that provided to them: 20 strands uncooked spaghetti, 1m of string, 1m of masking tape, and a large marshmallow.

4. The whole marshmallow must be on the tower. Splitting the marshmallow is not allowed.
5. The materials provided may be manipulated in any way to create the structure, and any strategy is acceptable, except for splitting the marshmallow.
6. 2 minutes of discussion time before construction is given to discuss tower building strategies. During this time no handling of materials is allowed.
7. 18 minutes of construction time are given. At the end of these 18 minutes, participants must step away from the structure and cannot work on it anymore.

After the competition was completed, a second written survey was given to participants to further determine self-serving score. This survey consisted of three short answer questions, and two yes/no questions. The questions are as follows, with questions 3 and 4 being yes/no questions, and the rest being short answer questions:

1. What was the cause of your group’s successes?
2. What was the cause of your group’s failures?
3. Do you feel your group would have performed better if they listened to your ideas more or if you were in charge? ( Y / N )

4. Do you feel that external factors were the main cause of your group's failures? ( Y / N )
5. What would you do differently next time?

Questions 1 and 5 were not used to determine self-serving score. Question 2 was marked on a scale of 1-10, where the more blame the respondent placed on external factors or other group members, the higher the score would be. Questions 3 and 4 were marked so if a "yes" response was given the participant would receive 5 marks and if a "no" response was given the respondent would receive 0 marks.

Based off the self-serving score of participants from the two surveys, they were separated into two groups, with participants with the lowest self-serving scores put into group C, and participants with the highest self-serving scores put into group

D. The two groups were again put into the competition, with the same rules. After the competition was completed, the heights of the towers and the self-serving scores from the teams were compared and the behavior of group members from each team was observed.

There were three types of variables to keep in mind for the experiment. The independent variable was the systematic arrangement of participants into groups based on self-serving score, with participants with higher scores being placed in one group and ones with lower scores placed in the

other. This was the independent variable because it was being changed to get the results. Participants were arranged in this fashion to maximize the observable effects of the bias, and to allow for more accurate observations. The dependent variables were the heights of each structure at the end of the second round of competing, and the level of cooperation or lack thereof between group members. This was a dependent variable because the height of the structure and the level of cooperation changes based on how the self-serving bias affects the group. The controlled variables included the rules and materials given for the competition. These aspects are kept constant between both groups to accurately and reliably measure the performances of each group.

## IV. Results

Table 1: Responses to the first survey multiple choice questions.

| Question # | SD | D | N | A | SA |
|------------|----|---|---|---|----|
| 1          | 0  | 2 | 4 | 2 | 2  |
| 2          | 1  | 6 | 2 | 0 | 1  |
| 3          | 2  | 0 | 5 | 2 | 1  |
| 4          | 0  | 2 | 2 | 4 | 2  |
| 5          | 0  | 7 | 0 | 3 | 0  |
| 6          | 2  | 1 | 2 | 5 | 0  |
| 7          | 2  | 4 | 1 | 2 | 1  |
| 8          | 0  | 4 | 1 | 4 | 1  |

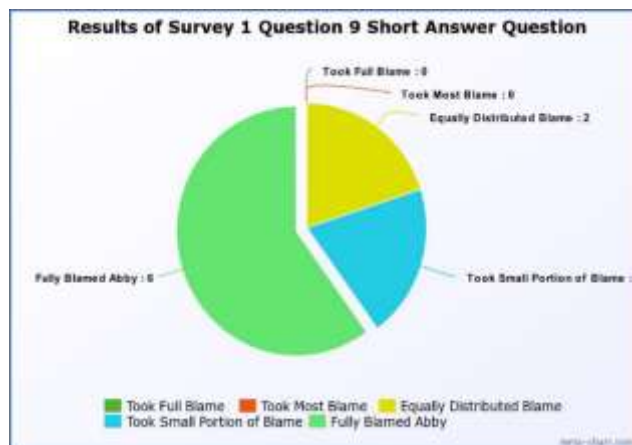


Figure 1: Responses of the short answer question (question 9) for the first survey. The responses received from participants were categorized into 5 categories.

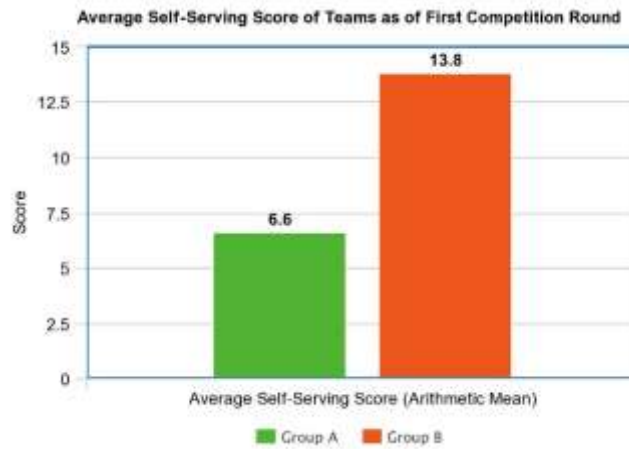


Figure 2: Average self-serving scores of members in groups A and B during the first competition round.

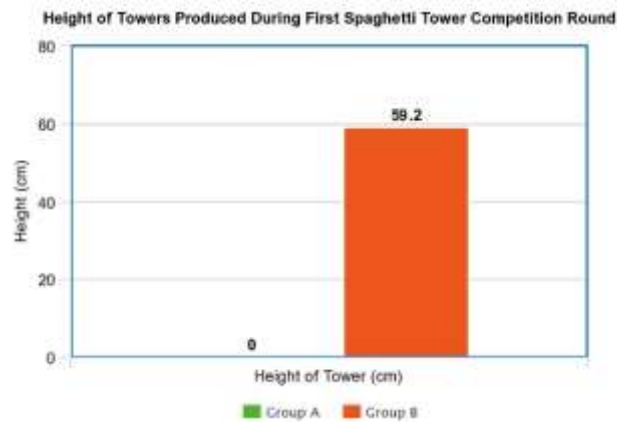


Figure 3: Heights of towers produced by each team after the first competition round.

Table 2: Responses to questions 3 and 4 (yes/no questions) on the second survey.

|                             | Answered "Yes" | Answered "No" |
|-----------------------------|----------------|---------------|
| Question 3 (# of responses) | 3              | 7             |
| Question 4 (# of responses) | 2              | 8             |

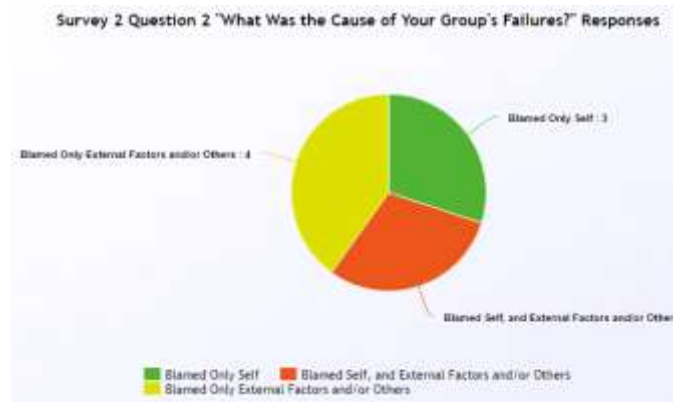


Figure 4: Responses to question 2 “what was the cause of your group’s failures?” for the second survey. Responses received were categorized into 3 categories: blamed only self,

Table 3: Self-Serving Scores of Participants

| Participant # | Score first survey | Score second survey | Total score |
|---------------|--------------------|---------------------|-------------|
| 1             | 0                  | 16                  | 16          |
| 2             | 16                 | 11                  | 27          |
| 3             | 11                 | 3                   | 14          |
| 4             | 8                  | 5                   | 13          |
| 5             | 2                  | 14                  | 16          |
| 6             | 19                 | 5                   | 24          |
| 7             | 7                  | 22                  | 29          |
| 8             | 16                 | 10                  | 26          |
| 9             | 7                  | 8                   | 15          |
| 10            | 16                 | 10                  | 26          |

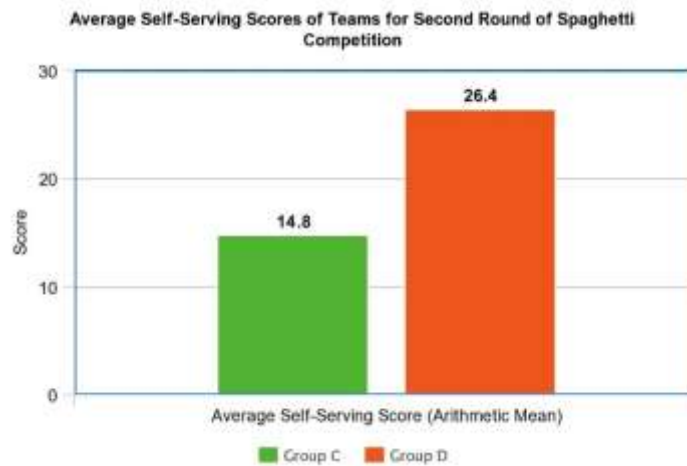


Figure 5: Average self-serving scores of groups C and D during the second competition round

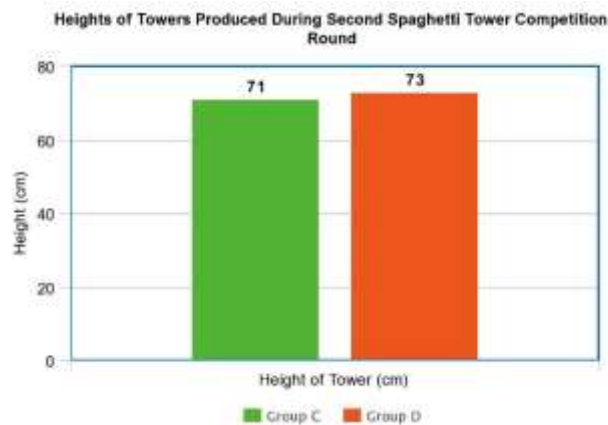


Figure 6: Heights of towers produced by each team after the second competition round.

## **V. Discussion and Conclusion**

The hypothesis was incorrect. In the hypothesis, it was predicted that if people who are more susceptible to the self-serving bias are put together in a group to complete a task, the group will be unsuccessful due to a high level of non-cooperation between group members. However, during both rounds of the spaghetti construction competition, the team with the higher self-serving

scores was more successful as they had built the higher tower. During the first round, group B had a tower with a height of 59.2 cm and an average self-serving score of 13.8 compared to a height of 0 cm and an average self-serving score of 6.6 for group A. During the second round, group D had a tower with a height of 73.0 cm and an average self-serving score of 26.4 compared to a height of 71.0 cm and an average self-serving score of 14.8 for group C. Additionally, it was found that the level of non-cooperation between group members was roughly

the same for all groups during both rounds regardless of self-serving score. The teams all had very little disagreements between group members, except for some arguing towards the end of the rounds. From the data, it can be concluded that when people who are more susceptible to the self-serving bias are put together in a group to complete the task, they are not any less successful than a group with its members not being as susceptible to the bias.

A possible explanation for the results could be that participants with higher self-serving scores are more willing and able to make their ideas heard and put into action, and thus can produce a better structure. Many of the participants in group D (participants 2, 8, 10), who had high self-serving scores, often vocalized their ideas and gave orders to group members to carry out these ideas. These participants also gave insight and criticisms to ideas presented by group members. As people who are more susceptible to the self-serving bias believe their own ideas to be better, they vocalize and force their ideas onto other people (Boyles, A. 2013). On the other hand, many participants in group C (participants 4, 9) with lower self-serving scores did not vocalize their ideas or present criticisms to proposed ideas, and rather just accepted what the more vocal group members proposed. As a result, group D was able to produce more and better ideas, and thus a taller structure. Factors in the experiment that may have affected the result include the sample size as there were only 10 participants, the fact that

all participants were familiar with one another, and the differences in skill between various group members. The small sample size may not produce accurate data that is representative of the population, which affects the conclusion. The fact that all participants were familiar with one another may have affected their behavior, as this would cause the participants to be more cooperative, reducing the effects of the self-serving bias. The differences in skill of the participants may also have affected the data, as it is possible that people with higher skill were put in the winning teams, and the data was not caused by the self-serving bias. If the experiment was repeated, it could be improved upon by increasing the sample size by performing the experiment multiple times, finding participants that do not know each other, and conducting an additional survey to determine each participant's skill level.

## **VI. Application**

The results of this experiment can be applied to human resource departments in companies, as they can use this data in both the hiring of employees and for workplace conflict resolution. This data can be applied to hiring criteria, as being self-serving be a good trait rather than a harmful trait when selecting new employees and can also be used to better understand employees when resolving conflicts, making the resolution more effective. This experiment can also be a stepping stone for other psychological experiments that are directly related, such as investigating why those who are more self-



serving are more vocal, which can further understandings of psychology and human behavior.

These HR departments can further use data collected from related experiments to enhance their jobs. Overall, the data collected from this experiment is useful in both practical and scientific applications.

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# **Sleep is More Valuable Than Practice the Night Before a Math Contest**

Noor

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## **I. Abstract**

The question at hand was “What is the best ratio of sleep to practice the day before a math contest is to be taken?”. For previous math contests, many students considered practicing through the night instead of sleeping, and this project was made to help those students know when it is best to sleep, if at all. The answer was found through an experiment and explained using a survey and an interview with a professional in this topic. The experiment tested how subjects performed when told to practice beyond their regular bedtime in comparison to sleeping at that bedtime. The experiment proved that there was no correlation between practicing more the day before the contest and doing well in that contest in comparison to usual. Both the experiment and the survey showed a correlation between overtime experience and high contest scores. This was because the brain needs time to develop, making it nearly irrelevant to practice the day before the contest. Therefore, it is best to sleep at your regular bedtime to feel comfortable writing the contest.

## **II. Introduction**

Answering this question is important because it affects all students in the world that are seeking outstanding achievements. Hard working students must often decide between sleep and preparation. This is currently an issue, as (Richer, 2015) over 87% of high school students already do not get the recommended hours of sleep, which would only get worse on important days like math contests. The students often decide to prepare rather than sleep without knowing if this decision helps them or not. This raised the question; “What is the best ratio of sleep to preparation the night before a math contest?”. In other words, when is it best to stop practicing and go to sleep?

If the student cannot focus due to fatigue or feels confident enough to write the assessment, then it would be best to sleep because loss of sleep lowers performance, but not as much as being unprepared. (Markman, 2013) Grade 9 students slept an average of 7.6 hours a night, while grade 12 students slept an average of 6.9 hours a night. However, the average grade 12 has a higher average. The decrease of 0.7 hours of sleep on average was mostly due to the students working more for school. This tells us that although they slept less, they still achieved more as they spent that extra time on the subjects, proving that extra preparation at the cost of sleep could be effective.

Not having enough sleep can directly affect someone's short term memory and causes learning problems. (Loria, 2017) To give students more time to sleep, school start times were delayed by an hour and standardized test scores in math increased by 2%. Although there is no way to verify if those students slept in that hour, there was a correlation between the amount of sleep the students could obtain and an increase in math scores.

In conclusion, preparation at the cost of sleep is effective to gain higher scores, until the method of preparation is ineffective, which would make it best to sleep. Preparation would be ineffective once the student is confident enough that their practice will not help them, or when they cannot focus enough to study due to sleep deprivation.

### **III. Methods**

To answer this question, both a survey and an experiment took place. The experiment tested how students performed on math contests the days after preparation in comparison to the days sleeping at their regular bedtime. The survey was then used to explain the results, made to get a good understanding of how students felt towards this subject and any interesting correlations.

To conduct the experiment, a group of test subjects that agreed to spend a minimum of seven and a half hours over a period of six days had to be found. For each day, they were given a different Cayley contest with an hour to work on the contest and had their

scores recorded. However, every other day, they were required to prepare for a minimum of half an hour past their regular bedtime. The results were placed in a chart to be graphed for analysis.

In this experiment, the contest difficulty, the amount of time they had to write the contests, the time in which they wrote the contest, and the environment in which they wrote the contest had to be controlled for the test subjects. This is due to the need of consistency for the data to be valid.

They wrote a standard grade ten contest every time with an equal amount of time to write the contest to reduce the risk of varying contest difficulty, as that would sway the results. The subjects had to write the contest at the same time every day (the time is up to the individual subjects) because the time of day in which you do something correlates with the amount of energy you have while doing it. Finally, the environment had to be consistent, so the subjects were asked to write the contest in the same place every time.

The independent variables being changed in this experiment were the amount of preparation and sleep that the subjects have. The result in which was dependant on those variables (dependant variable) was the performance on the math contest.

As for the survey, forty students had to be found. They were each required to fill out the following survey:

How often do you write math contests?

A) All the time    B) Most of the time    C) Sometimes    D) Never

How well do you think you do on those contests?

A) Very well    B) Well    C) Decent    D) Mediocre    E) Bad

Do you think that preparing for contests the day before is useful?

A) Yes, Always    B) Most of the time    C) Sometimes    D) Never

How much sleep is required for a math contest?

A) 8+ Hours    B) 6-8 Hours    C) 3-6 Hours    D) Sleep Is irrelevant

When is it time to stop practicing and go to sleep?

A) Right away    B) When you're tired    C) When you cannot focus    D) Never

The results were inserted into a computer program to find the largest correlations for analysis.

In this survey, the survey, time given to write the survey, and the environment had to be controlled to reduce the number of independent variables to what was being tested.

All subjects were given the same survey (the one shown above) and had no more than five minutes to complete the survey. That is because if the survey was switched, the data could not be compared directly. If they had varying amounts of time to complete the survey, they would vary in intimidation while writing it. Finally, all the subjects were given the survey in the morning to keep the time of day consistent for the same reason as the experiment, but also all wrote the surveys in classroom environments. Changing the environment in which the subjects write the survey may alter their perspectives.

The independent variables were the subject's work ethics and their performance on math contests. The dependant variable that raised from those is the correlation between practice/sleep times and high contest results.

## IV. Results

The experiment results were modeled using a line graph (Figure 1). Overall, there was a trend of improvement but there was no correlation between high contest scores and the contest being written before extra preparation or extra sleep. The test subjects were asked how they felt about staying up to practice for those contests (Figure 2) and 80% of the subjects agreed that it was harmful.

As for the survey, the results were modeled using a bar graph (Figure 3). However, the bar graph alone did not explain much except that most students believe it is best to sleep when you could no longer focus.

The program found an interesting correlation between how students that write contests place on those contests (Figure 4) in comparison to how students that don't write contests as often do on the contests (Figure 5). There was a huge correlation between year long experience and high contest performance. Out of the students that write contests more frequently, 69% of them do well on contests, while only 22% of students that don't write contests so often do well on them.

(Figure 1)

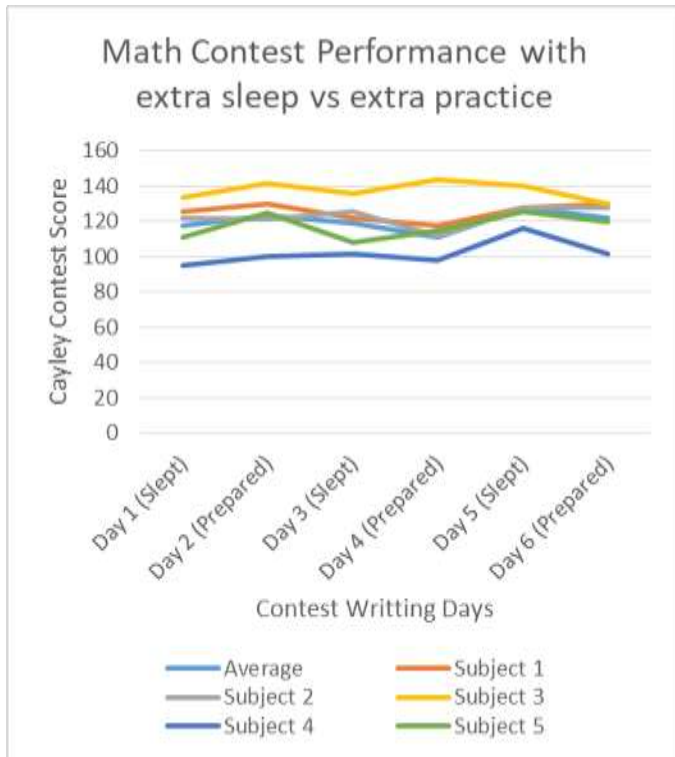


Figure 2: The graph models how students that participated in the experiment in Figure 1 felt about preparing at the cost of sleep.

(Figure 3)

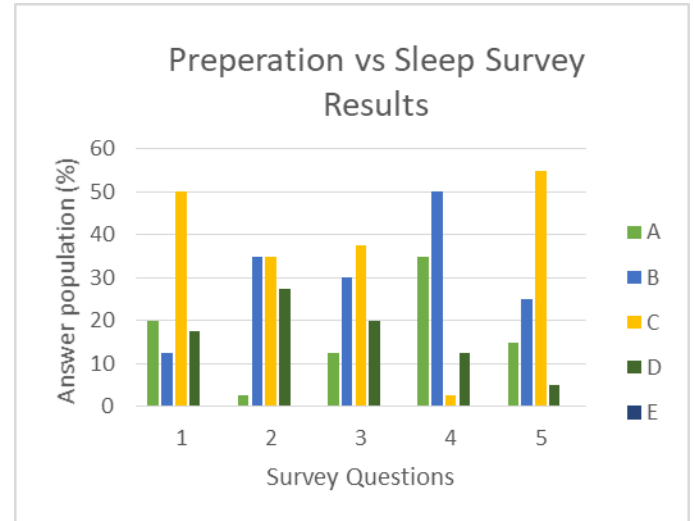


Figure 3: The graph models how students responded to the following multiple choice survey:

### Math & Sleep Survey

Noor Nasri

Applicant Name: \_\_\_\_\_

May 5<sup>th</sup>, 2018.

Date of Application: \_\_\_\_\_

Circle the letter that corresponds with your answer. Find the closest answer if your opinion cannot be found.

How often do you write math contests?

- A) All the time B) Most of the time C) Sometimes D) Never

How well do you think you do on those contests?

- A) Very well B) Well C) Decent D) Mediocre E) Bad

Do you think that preparing for contests the day before is useful?

- A) Yes, Always B) Most of the time C) Sometimes D) Never

How much sleep is required for a math contest?

- A) 8+ Hours B) 6-8 Hours C) 3-6 Hours D) Sleep Is irrelevant

When is it time to stop practicing and go to sleep?

- A) Right away B) When you're tired C) When you cannot focus D) Never

Thank you!

Figure 1: The graph models how students performed on the Cayley contest six days in a row when asked to prepare for it at the cost of sleeping half the time.

(Figure 2)



(Figure 4)

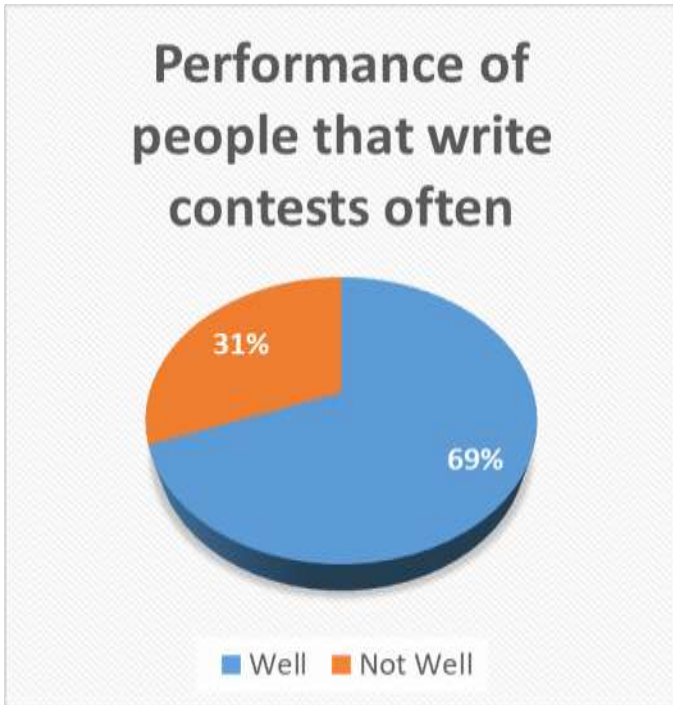


Figure 4: From the survey modeled in Figure 3, this graph models how students that write contests often perform on those contests.

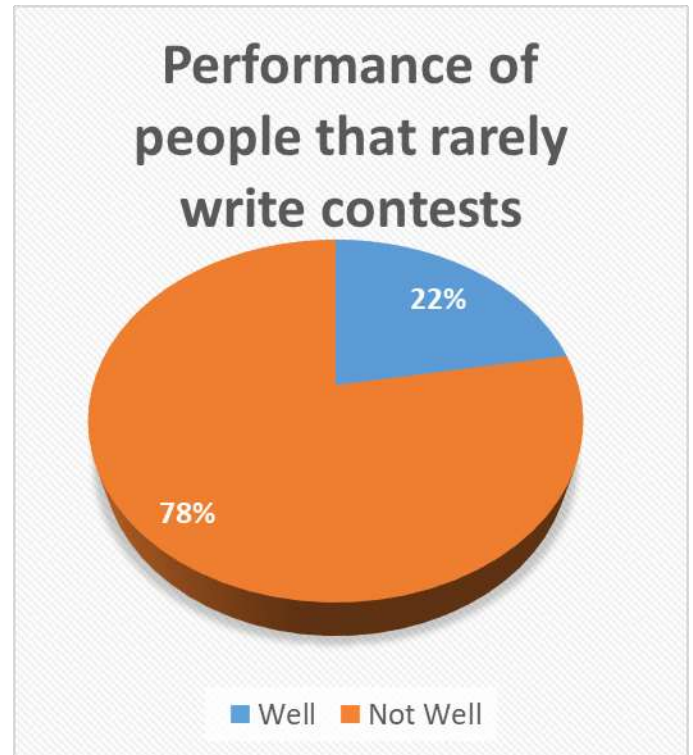


Figure 5: From the survey modeled in Figure 3, this graph models how students that don't write contests often perform on those contests.

(Figure 5)

## V. Discussion and Conclusion

The hypothesis was proven wrong in the experiment. There was no correlation between high contest scores and whether the contest was prepared for, and exactly 80% of the test subjects agreed that when they practiced instead of sleeping at their regular time, they were harmed. It is best to sleep at your regular bedtime the day before the contest so that you feel comfortable writing it, as practice the day before the contest is not enough to make a change in your score.

This finding could be hard to understand, as it goes against common belief. In this case, extra practice

does not help you. This is because doing well on contests is related to the experience that you build through out the years, and such experience cannot be obtained in a single night because our brains need time.

That is why the test subjects in the experiment had no correlation between whether they did better on the days of preparation or the days without. However, for all the subjects, there was a trend of score improvement, with 80% of the subjects ending with a slightly higher score than what they started with, due to the experience they've accumulated. This shows that overtime experience is what makes a change to your contest score, which can be further explained by the most interesting correlation in the survey. Out of the 27 applicants that write contests sometimes or never, 21 of them (77.7%) do not think they do well. Out of the 13 applicants that write contests most or all the time, 9 of them (69.2%) do either well or very well. This tells us that there is a strong relation between your experience through out the year and how well you do.

Practicing for a contest the night before is ineffective, which makes it harmful to lose sleep over it. However, practicing for a contest over a longer period is effective for increasing your contest scores.

## **VI. Application**

From this project, you know a trick to doing better in math contests. But there is so much more to take away from this. The reason behind the conclusion is because the brain needs time, that you cannot improve enough by doing everything in a single night. This can be used to help inspire other projects or aid research in these fields (Effects of sleep, Learning techniques and strategies, etc.). More importantly, these findings should help students around the world understand the importance of practicing overtime, always preparing. Cramming all the work in the last day, whether it be for a test or a contest will not be as effective as practicing overtime, ahead of time.

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## I. Abstract

The argument of whether the hot hand fallacy is true or not continued for many years in the scientific field. Two researchers called Miller and Sanjurjo (Jesse S. 2016) proved by using data from NBA players that the myth is true. Since it's been proven true, the next step will be what factor(s) will cause basketball player hot hand. If positive result is found, coaches can use it to change match plan such as starter lineup by ensuring hot-hand period happened as much as possible. During the experiment, 2 high school basketball players were shooting basket for 30s, 1 min, and 2 mins and get their own rebound to simulate real matches. They will also play against each other for 5 mins to see the result. After this experiment, most of the analyzed data showed that the number of 2 or more hits on basket grouping together grows as the time pass, especially in the 2-mins shoot out. Thus, the conclusion is that the possibility of activating a hot hand streak and the amount of time player on court has positive proportion, which means unless a player is lucky enough to get a hot hand streak early, players needs to play more and more on court to have higher chances of activating the streak period.

## II. Introduction

Hot hand is a term used mostly in sports field, mainly in basketball, it means that for a period of time in game, a player's shooting accuracy raises significantly. Almost all player of basketball announced that at some point their shooting accuracy will be roughly 100% (Thomas G., 1985). If coaches know when a player will have hot hand streaks, he/she can substitute player in a more effective way according to which player is more likely to have streaks on court, same theory can apply to subbing out players that are least likely of having a hot hand streak. Hot handed player will continuously score, and that can change the whole situation of the game.

hot hand and what will affect the streak period in game. Thus, the question of the project will be: What will cause high school and professional basketball player "hot hand"? It is hypothesized that if a player spends more time playing on court, then the possibility of shooting streak happening will increase. The hypothesis was stated because of a classical example of hot hand. In 2015, Klay Thomson (in Golden State Warriors vs Sacramento Kings) dropped 37 points in only the third quarter (The majority of NBA players never score 37 points in a *game*), and he played the most minutes in the team with 33 minutes (NBA, (2015, Jan 23<sup>rd</sup>). At the same game, DeMarcus Cousins

To know if a player is going to have hot-hand streak, couches have to figure out what will cause



from Sacramento Kings played the most minutes in game with 35 minutes, he scored 28 points, beating the third place by 9 points. From game highlight, he also had a hot hand streak at the middle of last period, but relevantly short.

### III. Method

Player started at the midpoint of the basketball court and ran to the basket when timer starts, the player began shooting at the basket. After each shot, the player got the rebound themselves and shot again, but the position must be at least 2 meters away from previous shooting position and outside the key. During the observation, each result of the shot was recorded on the sheet given (see chart 0). Previous steps were repeated until time given ended, each subject participated three times, shooting for 30 seconds, 1 minute, and 2 minutes (independent variable). In the end, the record sheets was used to see how many streaks has appeared by creating a graph, drew line of best fit on the graph to compare with the streaks found. For the versus between two subjects, to simulate real life situation in a match with no one dried out, the time was set to 5 minutes and the player who had the ball would be offense and the other one would be in defense. Record result of each shot on Chart 0. According to the defination, hot hand streaks can be found that if in a specific time frame, the shooting percentage is extremely high, which means at some period the results are grouped in such a way that most of them are positive (makes).

|        | S<br>h<br>o<br>t<br>1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | ...<br>(continue |
|--------|-----------------------|---|---|---|---|---|---|---|------------------|
| 30 s   |                       |   |   |   |   |   |   |   |                  |
| 1 min  |                       |   |   |   |   |   |   |   |                  |
| 2 mins |                       |   |   |   |   |   |   |   |                  |
|        |                       |   |   |   |   |   |   |   |                  |

Chart 0: Templete of experiment used chart. Blank cells started from second column are for ✓ or X representing whether the player make the shot or not.

In this experiment, the independent variable was the time player spent on court since the hypothesis is that the possibility of shooting streak increases as the time player spent on court increases. So if the hypothesis is correct. The streaks found should be mostly at the end of the periods, especially when player participates in 1 min and 2 mins.

The dependent variables were total makes and total shots taken by both players. Since the relationship of time and shooting streaks was not determined, number of shooting streaks would not count as one of the dependent variables. Total shots were directly affected by time being played and which player has played (how fast can the player shoot). Total makes also depends on total shots taken and accuracy of the specific player. These two sets of data is important because they can draw out the graph and analyze which time period hot hand happened.

The controlled variables were the two players, the environment factors (quality of court, quality of basketball, weather), and date . Environmental factor affect performances, test subjects should be constant physically and mentally. So it is important to maintain these two factor the exact same throughout the experiment. This was the reason why date is constant – done everything in one day.

IV. Results

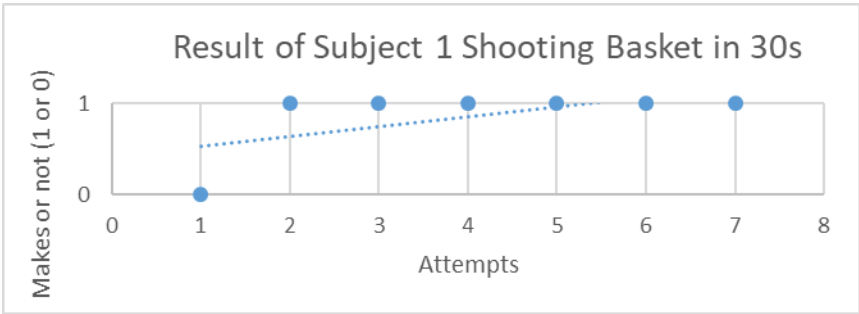


Figure 1

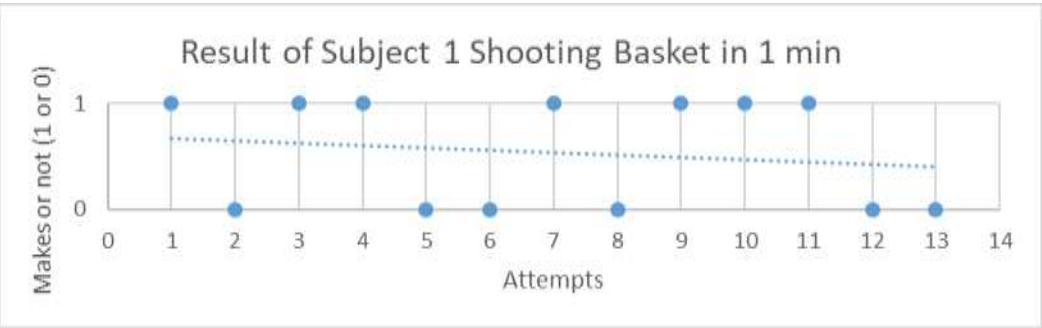


Figure 2

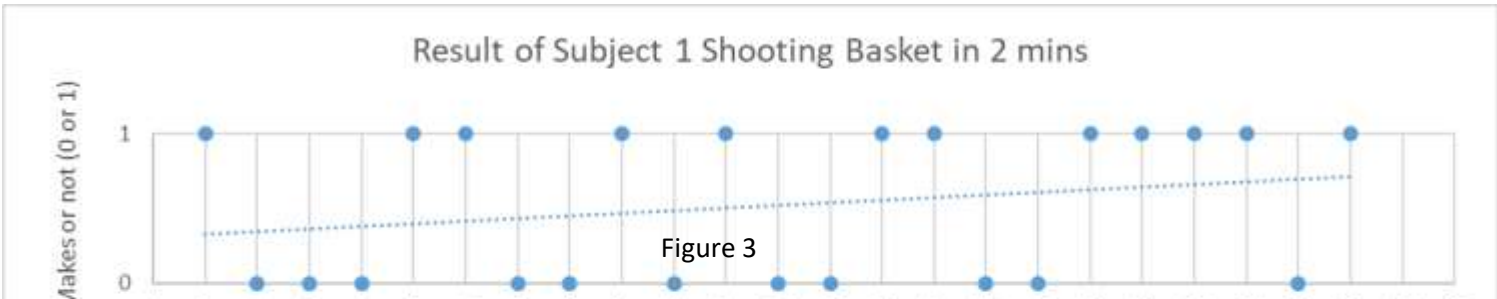


Figure 3

|                                                    |           |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
|----------------------------------------------------|-----------|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Participant name: Object 1 (Gr.11, Shooting Guard) |           |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Time                                               | Attempt 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| 30s                                                | X         | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 1 min                                              | ✓         | X | ✓ | ✓ | X | X | ✓ | X | ✓ | ✓  | ✓  | X  | X  |    |    |    |    |    |    |    |    |    |    |    |
| 2 mins                                             | ✓         | X | X | X | ✓ | ✓ | X | X | ✓ | X  | ✓  | X  | X  | ✓  | ✓  | X  | X  | ✓  | ✓  | ✓  | ✓  | X  | ✓  |    |

Table 1: All results of test subject 1

|                                           |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |  |  |  |
|-------------------------------------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|--|--|--|
| Participend Name: Object 2 (Gr.9, Center) |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |  |  |  |
| 30s                                       | X | X | ✓ | X | ✓ | X | X |   |   |   |   |   |   |   |   |   |   |   |   |   |   |  |  |  |
| 1 min                                     | X | X | X |   | X | ✓ | X | X | X | ✓ | ✓ | X | ✓ |   |   |   |   |   |   |   |   |  |  |  |
| 2 mins                                    | X | X | ✓ | X | X | X | X | X | ✓ | ✓ | X | X | X | X | ✓ | X | ✓ | ✓ | X | X | ✓ |  |  |  |

Table 2: All results of test subject 2

Table 2: All results of test subject 2

|                |   |   |   |   |   |   |   |   |   |   |  |   |   |   |   |   |
|----------------|---|---|---|---|---|---|---|---|---|---|--|---|---|---|---|---|
| 1v1 5 min game |   |   |   |   |   |   |   |   |   |   |  |   |   |   |   |   |
| Object 1       | X |   | ✓ | ✓ | X | ✓ | ✓ | ✓ | ✓ | X |  | ✓ | ✓ | ✓ | X | ✓ |
| Object 2       |   | ✓ | X | ✓ | ✓ | X | ✓ | ✓ | X | X |  | ✓ |   |   |   |   |

Table 3: Results of both player in versus

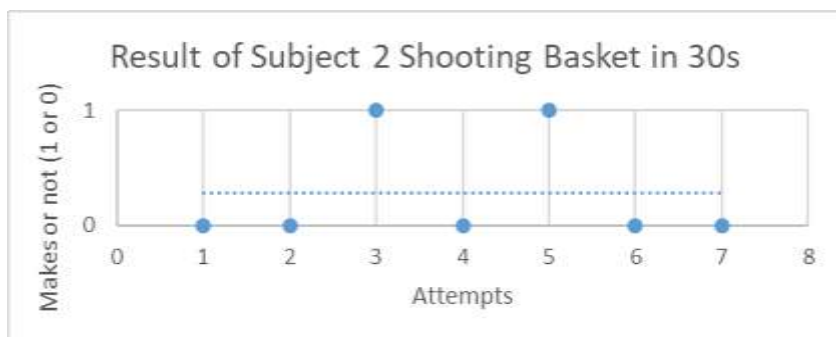


Figure 4



Figure 5

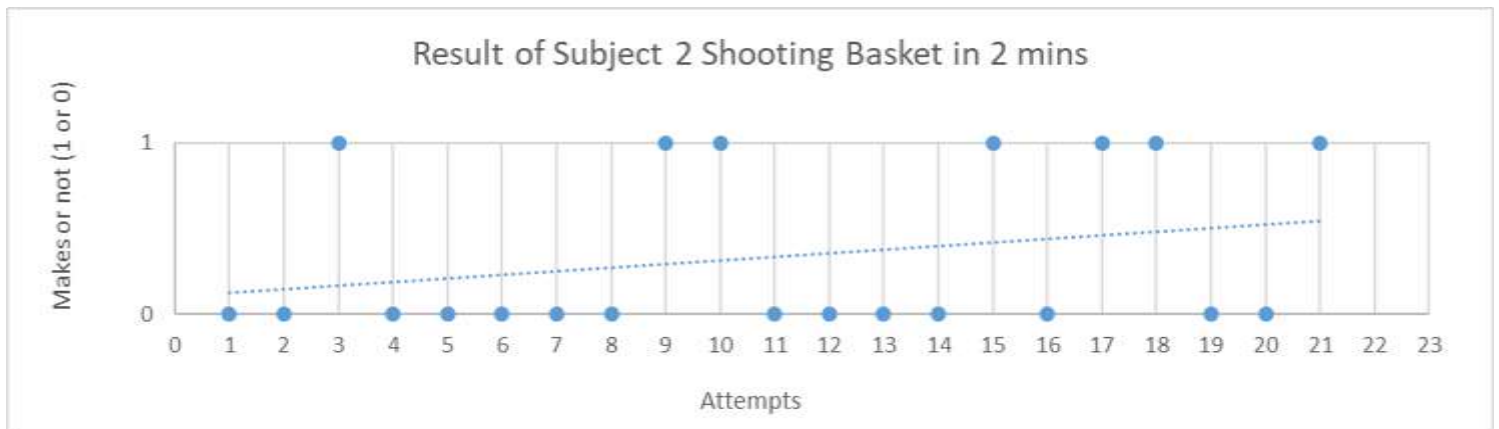


Figure 6

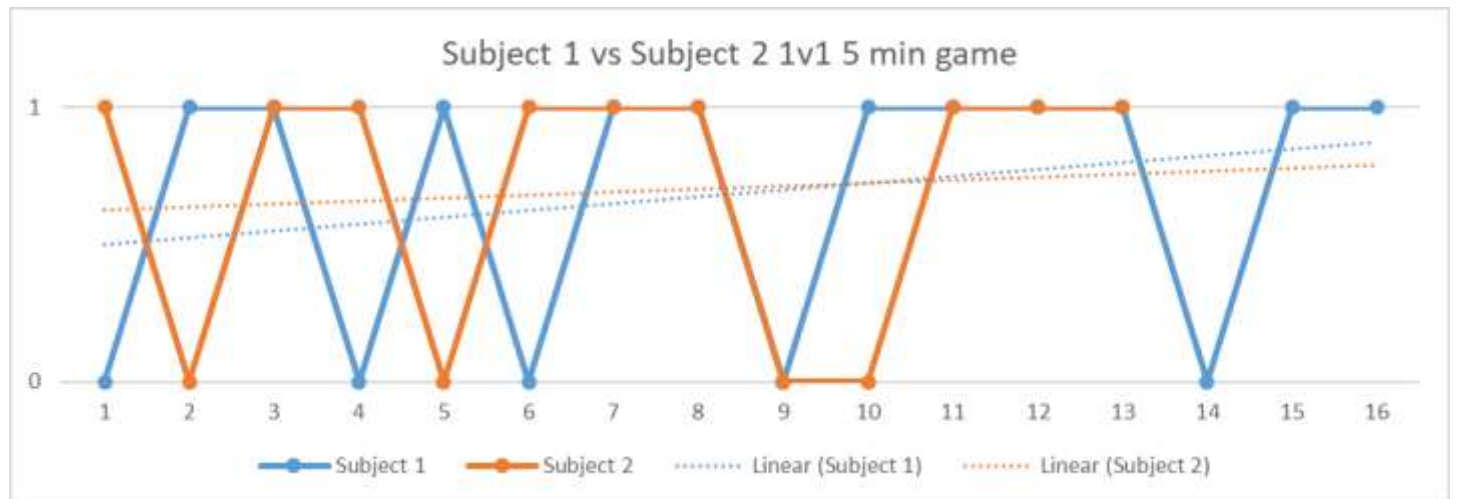


Figure 7: Versus experiment result of both players

## V. Conclusion

From that data that was collected from this experiment. The hypothesis of “the more time player spent on court playing, the higher possibility of hot hand occurring on a player” is correct. To find hot-hand, according to the definition, the streaks can be found that if in a specific time frame, the shooting percentage is extremely higher than their normal accuracy, which means at some period the results are grouped in such a way that most of them are positive (makes). For most charts, such as Figure 3 and Figure 6, the intensity of makes is going higher as the time passes, analyzed from lines of best fit for each graph. And all data sets except Figure 4, shows that hot hand streak was activated at the end of each individual experiment. For example, in Figure 3, test subject 1 had a streak period at attempt 18 to attempt 23 because during this period, shooting percentage is almost 100%, only one shot missed. For Figure 6, test subject 2 has an shooting streak at attempt 15 to attempt 21. Although this set of data is not too obvious since average accuracy of the player is low. But the accuracy in this time frame is significantly higher, 57.1 %, comparing to accuracy for the whole period, 33.3% (which already included the streak but still low), this period can be called a hot hand streak. Almost all of these streaks happened in the end of the period given (Figure 2, Figure 3, Figure 5, Figure 6), therefore hypothesis was proven correct.

The initial problem with the experiment is that subject 1 practise with the basketball net in the experiment almost everyday before so subject 1 will be familiar with the basket, which may increase the accuracy in this specific experiment, this is the reason why subject 1 in Figure 1 has such high accuracy and has a hot hand streak from attempt 2 to attempt 8, accuracy is 100% flat. However, this does prove my theory since he practiced beforehand, so for his muscle, they were shooting at the beginning of the practise to the end of his first participation in the experiment, which means at the point when that streak period happened was not in the beginning, but the end.

In versus experiment, there aren't any sign of hot hand by definition. However, according to Miller and Sanjurjo's research (Jesse S. 2016), because cold hand is already baked in the stats in real matches, so if a player is consistent with the accuracy, it will be counted as hot hand. Both test subjects are maintaining their accuracy throughout the match. What's more, subject 1 has raised his accuracy after shot 9, and subject 2 has raised his accuracy after shot 5, and this is a good indicator of hot hand appeared. Other tests are also consistent and raised their accuracy when time increases. For Figure 4, the shot accuracy maintain the exact same throughout the 30 seconds, which can be explained by the theory above that a hot hand appeared (weaker compare to others). The only exception is Figure 2, the accuracy goes down because subject 1 missed the last two after the streak period (attempt 7

to attempt 11), which is obviously an indication of cold hand and it happened from time to time just like hot hand.

## VI. Application

This result can be used in other fields of sports since hot hand is not limited in basketball, it also occurs in other sports such as baseball, soccer, and table tennis. It is also used in gambling. But most importantly, this research can be applied in human biology, especially in muscle memory researches. Since muscle memory was formed by doing the same task again and again, it is possible that it is the same as shooting basketball at the hoop again and again, after using enough time to build this muscle memory, will the hot hand appear because of it? It fits my result – hot hand needs more time being played on court since it takes time to build that muscle memory. So if this result will be used by other scientists, it can be used as one of the control factors when scientists want to find other factors, so their data will be more accurate. Human behaviour scientists can study what is the relationship between muscle memory and hot hand streaks.

In the basketball field (“the big picture”), if a player wants to have a hot hand streak as soon as possible, he/she should treat warm-up before game seriously, and try to take some shots. If the player is off court, at least try to run the ball while watching teammates play, this way the player will not cool himself down during the break.

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\*This is for data from the 2015 Kings vs Golden States for both teams

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# **Factors Affecting Discrimination Against Those with Mental Illnesses**

Sahar

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## **I. Abstract**

In this experiment, major factors affecting discrimination against those with mental illnesses were determined. Multiple subjects were questioned as well as interviewed to see what they thought was the major factor in discrimination against those with mental illnesses. After analyzing the results and further communications with the subjects, it was discovered that all of them said that it was the media that had the greatest influence. Two subjects with mental illnesses were also asked their thoughts and it was said that the media as well as certain minor external factors, such as relationships, had effects on their mental state. In this experiment, it was found that the media was the largest factor for discrimination against those with mental illnesses.

## **II. Introduction**

This project encourages students to explore and expand their knowledge about their interests. This allows students to explore the scientific side of their interests and learn new things. The topic chosen for this project was factors affecting discrimination against people with mental illnesses.

It is important to know what factors affect discrimination against those with mental illnesses so that there is less of a stigma placed on mental illnesses (Mental Health UK) and so that those affected by them have less pressure on them (Liz Szabo). People with mental illnesses have more pressure on them when seeking help when there are people around them who have negative views. Finding the answer to this problem is important so that mental illnesses aren't stigmatized and have negative views placed on them (CAMH) so that people

do not have to feel pressured while seeking aid. This will help the general public become more educated and thus helping to start making changes in society for a better future. This can help lower the number of people with mental illnesses because many of them do not receive help.

There are many things to look at when determining what factors affect people's views on mental illnesses.

What are the major factors that affect people's views on mental illnesses? From this question a hypothesis was derived: if people are more socially connected through the media, then they are more likely to have negative views on mental illnesses, because of the taboos on the topic through the media.

### **III.** Methods

The experiment was conducted with three regular subjects and two subjects with mental illnesses were interviewed. The questionnaire given consisted of four open answered questions that the subjects were given an unlimited amount of time. Subjects were taken into a quiet room with no distractions for optimal results. Once the questionnaire was completed, a short interview was conducted with the subjects to ask them to elaborate on their responses. The question from the questionnaire consisted of:

What factors do you think affect the discrimination against people with mental illness?

Do you think the media has any influence on this?

What does the media describe mental illnesses as and how might this relate to discrimination?

What do you think the greatest population of people with mental illness have in common?

For this experiment, the environment in which the subjects took the questionnaire had to be the same for result to be as exact as possible. Age, gender, ethnicity and religion didn't matter, it was better to have a wide variety of subjects to have diverse

opinions. The original experiment did not fit to find results so the procedure was changed for a better fit.

### **IV.** Results

Results from the surveys with the three subjects are given.

#### **Figure 1 shows results from subject 1**

Subject 1

What factors do you think affect the discrimination against people with mental illness?

The biggest ones for me are race, religion and sexual orientation.

Do you think the media has any influence on this?

Definitely. Before they were always putting this taboo on people affected by mental illness, but it has improved. Even now they sneakily put that kinda thing in there.

What does media describe mental illnesses as and how might this relate to discrimination?

They glorify it way too much and because of this people started taking it as a joke.

What do you think the greatest population of people with mental illness have in common?

Lack of support. A lot of cultures don't really accept it as an actual illness.

#### **Figure 2 shows results from subject 2**

Subject 2

What factors do you think affect the discrimination against people with mental illness?

From what I've seen, probably media.

Do you think the media has any influence on this?

Like I said, yes. The media sort of brainwashes people into thinking there's something wrong with mental illnesses.

What does media describe mental illnesses as and how



might this relate to discrimination?

As an illness that is always visible. So, for example when a super cheery girl comes out and says, "I've got depression," people don't really take it seriously.

What do you think the greatest population of people with mental illness have in common?

People not taking them seriously. And this is all because of the medias influence on people's brains.

**Figure 3 shows results from Subject 3**

Subject 3

What factors do you think affect the discrimination against people with mental illness?

Social media.

Do you think the media has any influence on this?

Yeah, they're always giving it a [negative] image.

What does media describe mental illnesses as and how might this relate to discrimination?

I think they romanticize it too much. Not too sure how it would relate to discrimination.

What do you think the greatest population of people with mental illness have in common?

It's all because of uneducated people.

**V.** Discussion & Conclusion

It is evident that the media has greatly impacted the outcome of views on mental illness. While things have improved, it still isn't perfect. Every subject agreed that the media has influenced people's views on

mental illness by romanticizing it and glorifying it. An example given by all the subjects was the show '13 reasons why'. People are more likely to follow the trends provided by the media and by glorifying mental illnesses and even putting slight taboo on them, has influenced it. Unlike what was stated earlier, race didn't have as big an outcome as media. What this means is that the media is giving inaccurate views on mental illnesses with is slowly conditioning people to become more and more used to the image the media is putting out. This can lead to misconceptions about what the mental illness really are and thus creating unintentional taboos as well as extra stress on those seeking help.

**VI.** Application

This information could be used by the general public to help start making changes in media representation. This can be applied in other fields of study by changing the way one might unconsciously put negative images on mental illnesses. These results fit into the 'big picture' by showing how mental illnesses are not only a part of daily lives, but they are often misinterpreted.

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# **NBA players most efficient release angle for free throws using the most efficient free throw shooters**

Sartaj

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## **I. Abstract:**

The question investigated was, what is the most efficient release angle for the arc of a free throw? The results are important as it can help many players improve their shooting by implementing the release angle and it can help many coaches making sure all their players are within the range of the optimal release angle to improve their free throw shot overall. Gathering the data was a bit difficult, after recording the subject's free throws from the first and second half, an average of the two shots was created. With the average shot the release angle was found. This was done to the best free throw shooters and some very poor free throw shooters too see the differences. The results ended with the optimal release angle is between 42-50 degrees and that the subject was an all-star player. Overall any player that didn't have a 90% success on free throws either didn't play in the NBA long enough, wasn't an all-star caliber player, didn't take enough free throws, or didn't have a release angle in-between 42 and 50 degrees.

## **II. Introduction**

This information is important as it will provide data on the best possible arc on free throws and will help coaches teach developing players what arc they must use to be as efficient for free throw shooting. It is also important as using the best free throw arc you can check with the shooters height what the ratio of the height to

arc is and make the most efficient arc for many heights. Knowing this info will improve young player's free throws shots drastically, with practice and good form many amazing free throw shooters can be made. What is most efficient arc for free throws, used by the best free throw shooters? Based on the articles, A high arcing shot is used by many long-range

shooters although, for free throws there is a wide range of possible missed shots as the ball has more momentum the higher it is, according to Winning Hoops building the perfect arc article. The article also mentions that a very low arcing shot is also fast which lets it have the low arc and is not optimal. Meaning the perfect sweet spot would be in the middle of a high arcing and low arcing shot. Predicting Steve Nash will have this type of arc since he is the best free throw shooter of all time but, free throws can be improved many other ways. Not only by improving your arc.

### **III. Methods**

Choose a number of players that played or are playing in the NBA, better if all players have the same height. Find a video of each of the players taking two shots in the first half and two in the second half. Calculate the parabola of each of the player's free throws from both halves. Find the average for a first half free throw and a second half free throw for each player. Calculate

the peak height of both shots for each player and the release angle. Compare the subject's arcs, release angles and their free throw percentages to see who has the better arc. Only do the next steps if the subject's heights are different.

Create a ratio for height to arc for all subjects, check what ratios and what subject has the better free throw percentage to find the better arc.

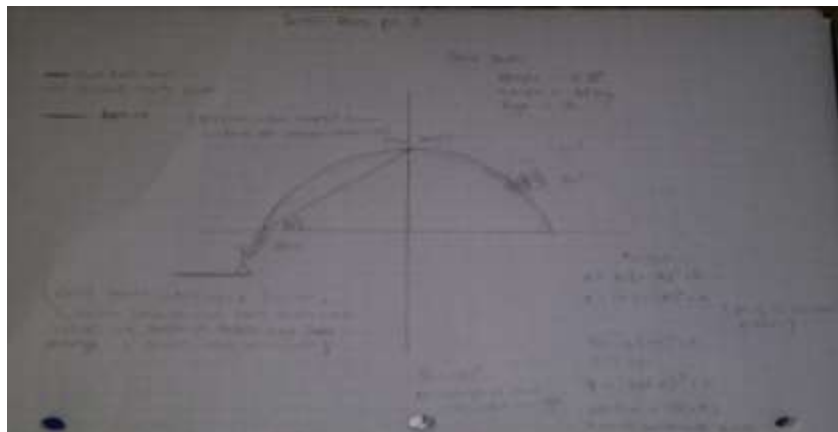
The dependent variable is the Arc of the free throws in both halves. The Independent variable is the different Players being compared

The Controlled variables are the subject must be a NBA player, the shot must be a free throw, and it must be shot in a professional game.

These are all controlled variables as there is no point in researching random mediocre players so, its best to use NBA players always. The arc can change and the free throw is being analyzed. Lastly free throws matter more in a game compared to practice or anything else and may even matter more in certain situations.

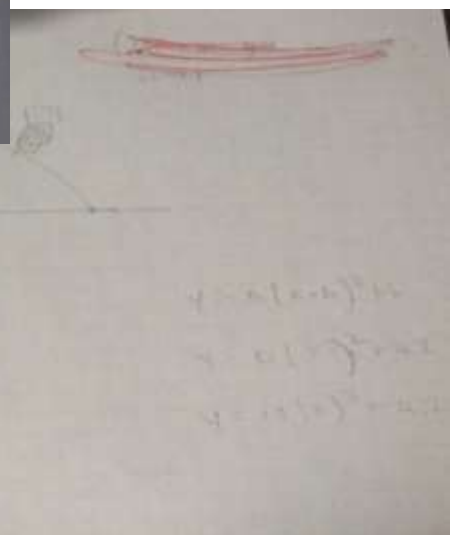
#### IV. Results

**Figure 1**



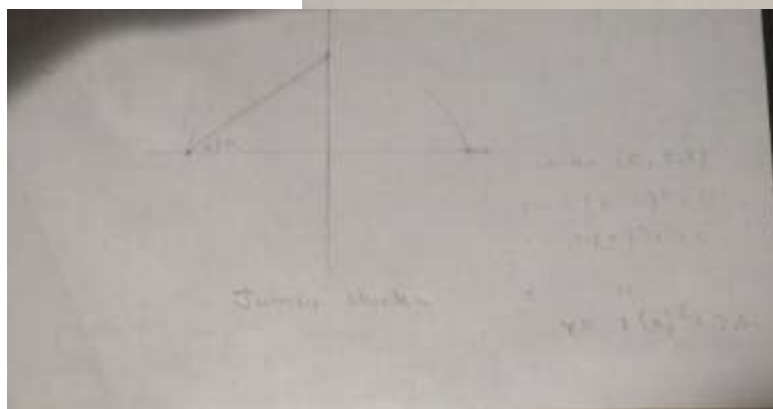
Stephen Curry free throw arc, release angle, and peak height.

**Figure 4**



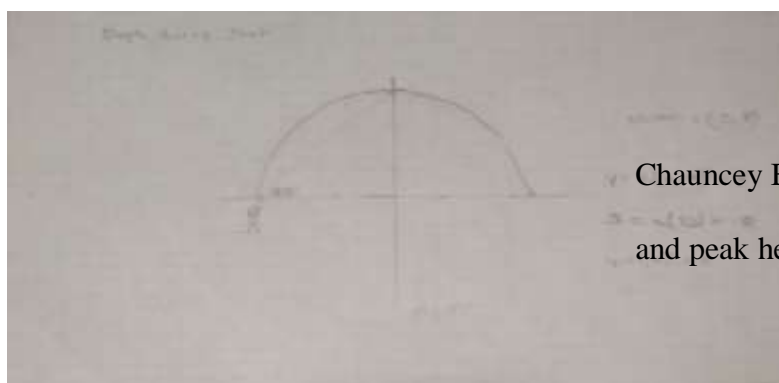
Steve Nash Free throw arc, release angle, and peak height.

**Figure 2**



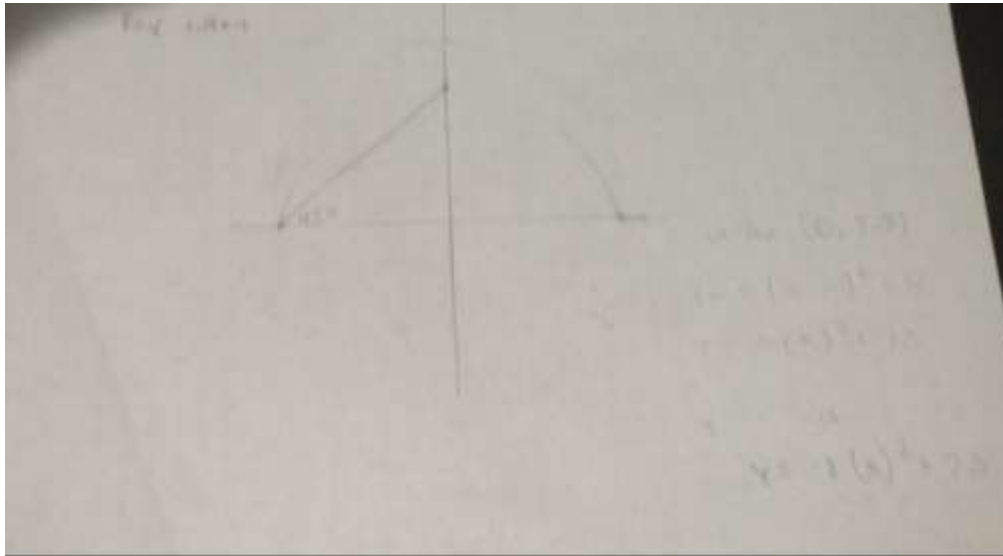
James Harden free throw arc, release angle, and peak height.

**Figure 3**



Chauncey Billups free throw arc, release angle, and peak height.

**Figure 5**



Ray Allen free throw arc, release angle, and peak height.

## **V. Discussion & Conclusion**

The hypothesis was correct in some ways. As most shooters with the free throw having an angle of 40- 50 degrees were the highest percentage shooters stat wise and with the research. But, overall practice and experience was the major role in free throw success. The high arcing shots had bounced off the back of the rim if the shot wasn't a swish. The low arcing shots hit off the front or back of the rim unless it was a swish. To answer for the most efficient free throw arc for someone with a height of 6'3 to 6'5 to have the angle of the shot

be between 40 to 50 degrees and the arc must have a compression of 2-3. As mentioned in the article there are many ways that a shot can be messed up and it's not so much that the free

throw with the angle of 40-50 degrees and the A value of 2-3 is a better shot. It just has less chance for mistakes as although the arc is important not as important as practice and muscle memory. There are many cases of this with players having a high arc or a unique shot form that still have major success. A great example is Magic Johnson as he had a very unique free throw form but still have a above 90% free throw percentage throughout his career.

## **VI. Application**

Other than practice being the most important piece to developing any shot. The data can't be used in any other fields of study within basketball as once the distance of the player

from the net increases or decreases the arc changes drastically. The general public and basketball community now know to improve a free throw, one way is to have a release angle between 40-50 degrees. Coaches and players everywhere can use this to try and improve their own free throw or their student's free throws. Although the best way to improve the free throw shot is just through simple practice as it doesn't make perfect but, it most certainly makes progress.

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# **Exoskeleton Device to Reduce Hand Tremor for Those Who Have Parkinson's/ET**

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## **I. Abstract**

The purpose of this innovation was to see if and how a device could be built to reduce hand tremors caused by Parkinson's or Essential Tremors. It is important to see if a device could be built namely to aid the millions of individuals that suffer from hand tremors without any means to effectively reduce the tremors. The method through which the above was done was an innovation. The device itself was built of three main components (circuit, exoskeleton, and prosthetic). The project was based on using an Arduino controller, connecting it with a servo and vibration sensor and then programming the Arduino to activate the servo based on the input from the sensor. In addition, an exoskeleton would be built from fabric encasing the arm with levers on each finger acting as triggers that are attached with cables. The cables would run through the exoskeleton and join with the prosthetic hand. The hand itself would be constructed of popsicles and the fingers would bend according to how much slack or tension was in the cables. The exoskeleton would join with the prosthetic via cables that translate mechanical movement and hence control the arm. The exoskeleton would join the circuitry by having the servo attached to the cables and sensor with the exoskeleton. The servo would control whether to connect or disconnect the cables to stop the translation of movement. The results differed slightly then what was expected.

A device was successfully built to address the above issue (Figure 1-3). However, there were many complications while constructing the device. In addition, the mechanism to stop the tremors is not particularly consistent.

## **II. Introduction**

It is important to see if a device can be built to limit hand tremors for several reasons. The main reason would be to aid roughly 7% of adults over the age of 65 that have ET (Wickelgren, 2009) and the 10 million people globally that have hand tremors due to Parkinson's disease (Nazario, 2017). Hand tremors is a symptom that can be caused by

an array of reasons. However, it is most associated with Parkinson's disease even though essential tremor (ET) is the most common reason for hand tremors (Holland, 2015). The construction of an exoskeleton that limits hand tremors will assist individuals in their daily lives by lessening the tremors that can make simple tasks like picking up a cup challenge.



How can an exoskeleton device be built to limit shaking, stabilize the hand, and increase motor function ability?

If an individual suffers from hand tremors due to reasons such as Parkinson's disease or essential tremor. Then an exoskeleton would assist them by limiting their hand tremors. This is because tremors are commonly caused by a neurological disorder such as Parkinson's disease. Therefore, it is possible to create an external device to reduce the tremors. For example, the research team, from Benny Lo's lab at the Imperial College of London have made an exoskeleton prototype that proves that technology is able to combat hand tremors. Their device uses vibrations that are triggered by hand tremors to counter shaking and keep the arm relatively balanced and stable.

### **III. Methods**

The method by which the exoskeleton was created was first the circuit and electrical system were made. The controller board was attached with a servo motor and vibration sensor. Then the servo was installed on pins 5V, GND, 9 and the sensor was installed on pins 3.3V, GND, and 8. The controller board was then mounted at one end of the breadboard and a power module was installed on the other end. After which the L293D chip was installed with the pins connected on both halves of the board. Once all the pieces were in place the controller board was connected with a computer via USB, a yellow light then turned on indicating the device was assembled correctly.

Once the circuit was made then an exoskeleton was made to hold the circuit. This was done by creating 2 straps for the arm using fabric and Velcro. Then the circuit was attached onto the straps and secured. After which 3 straps were created for the forearm and 1 for the hand, this used the same process as the one above. Then a 1ft long piece of fabric was used to attach the straps for the arm and hand at 90 degrees to the 1ft fabric with roughly 5" between each strap. Then the vibration sensor was glued onto the intersection of the hand strap and 1ft piece of fabric. Then paper was used to make four rings that fitted around each finger. Then a 2" Popsicle stick was attached on one end of the ring and 3" of fabric attached to the other end of the Popsicle in order to connect it with the hand strap. Then a 3.5" Popsicle was added on top of the previous Popsicle on which the ring was mounted; the 3.5" Popsicle was checked to be flush on the ringside. the previous steps were repeated three more times.

Next, 2 pieces of straw (.5" to 1") were cut and glued to the first forearm strap and the other on the second forearm strap. After which, a strand of yarn was glued to the protruding end of the 3.5" Popsicle, and the other end of yarn was threaded through the straws. The above steps were repeated 3 more times. Next each end of the yarn was glued to an elastic band which is glued onto the third forearm strap. Another piece of fabric was glued on top the third forearm step and the servo motor glued

to it. At this point, the device appeared similar to figure 1.

Next, a Popsicle was cut into two 1", 1.5", and 2" pieces. A rubber band was cut into .5" pieces and those pieces were used to attach the 1", 1.5", and 2" Popsicle pieces, this step was repeated with the other set of Popsicle pieces. Next a straw was cut into .5" pieces and attached to each of the 1", 1.5", and 2" popsicles. The other layer of popsicles and rubber bands were glued on top. The above process was repeated 3 more times. Next, each of the 2" popsicles was attached 90 degrees with another Popsicle. The structure was reinforced with additional rubber bands and Popsicle sticks until the structure appeared similar to figure 2. The entire "hand" was attached to 2 wooden dowels and a piece of yarn ran through each of the "fingers" which was attached to the very tip of its respective finger.

**Independent Variable:**

**Vibrations:** The vibrations are caused by the hand and are not controlled. This variable is purposely not controlled to collect the different vibration levels of the hand tremor which will affect the arm lock.

**Dependent Variable:**

**Arm lock:** The arm lock is a mechanism that determines when to increase/ decrease slack in the arm wires (that translate movement). This mechanism will change to respond to the independent variable (vibrations).

**Control Variables:**

-Location: This was selected as a control because the location of the exoskeleton arm is fixed on the person.

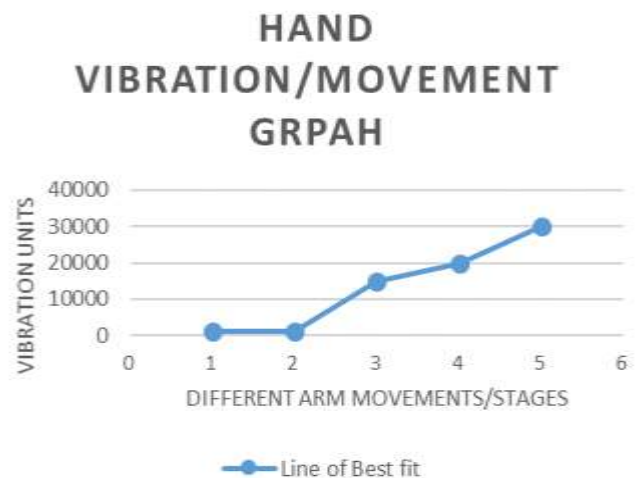
-Mechanical translation of movement: This was selected because the translation of movement is fixed to the exoskeleton which's location is also set.

-Program: The program was chosen as a control variable because the program is loaded into the cache of the controller and does not change at all.

-Exoskeleton structure: The exoskeleton structure is physically fixed, tied to a certain location on the person and does not affect/move/change at all.

## IV. Results

Graph 1: The graph shows the vibration sensor detecting different levels of vibrations through different types of arm movements.



1-3: Hand movements (writing, pointing, etc.)

3-4: Hand tremors (hand vibrating/shaking)

#### 4-6: Arm movement (waving, lifting arm, etc.)



Figure 1: Shows the exoskeleton portion of the device. It includes the servo and vibration sensor.

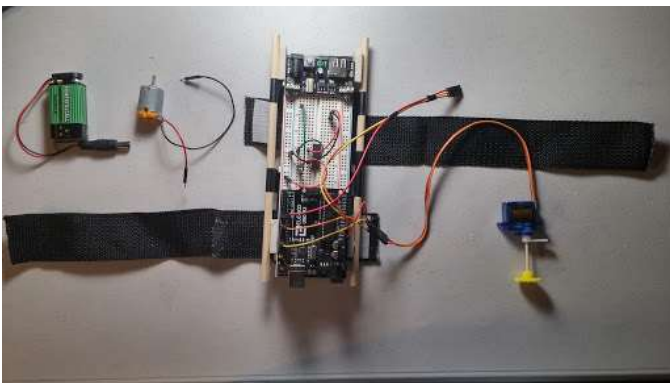


Figure 2: Shows the main circuitry and the arm mount. The circuit is based on an Arduino and includes a vibration sensor as input and servo motor as output.

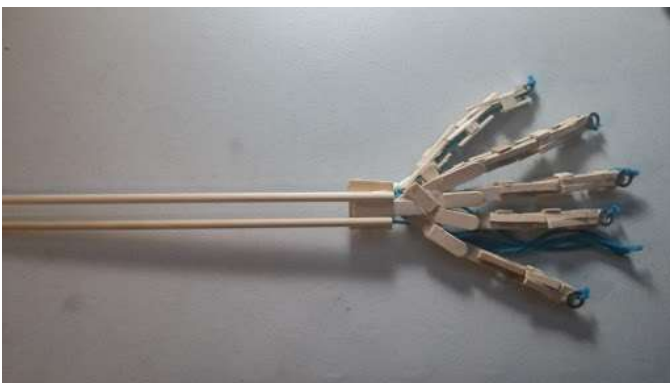


Figure 3: Shows the prosthetic arm which will be attached to the exoskeleton in figure 1 via blue yarn.

Program:

```
#include <Servo.h>
```

```
Servo myservo; // create servo object to control a servo
// twelve servo objects can be created on most boards
```

```
int pos = 0; // variable to store the servo position
int EP = 7; //variable to store the vibration sensor position
boolean ran=false;
boolean ranI=false;
int count=0;
int post=0;
```

```
void setup() {
  myservo.attach(9); // attaches the servo on pin 9 to the servo object
  pinMode(EP, INPUT); //set EP input for measurement
  Serial.begin(9600); //init serial 9600
}
long TP_init(){
  delay(10);
  long measurement=pulseIn(EP, HIGH); //wait for the pin to get HIGH and
  returns measurement
  return measurement;
}
```

```
void loop() {

  long measurement =TP_init();
  delay(50);
  Serial.print("measurement = ");
  Serial.println(measurement);

  if (measurement < 20000 && measurement > 3000 && ran==false){ //Used
  data from above chart to create values.
    while (post <= 90) { // goes from 0 degrees to 180 degrees
      // in steps of 1 degree
      post +=90;
      myservo.write(post);
      // tell servo to go to position in variable 'pos'
      // waits 15ms for the servo to reach the position
    }
    ran=true;
    ranI=false;
  }
  else if(measurement==0){
    count++;
    Serial.print("count");
    Serial.println(count);
  }
  if(ranI==false && count==10 || count > 10){
    while (post >= 0) { // goes from 180 degrees to 0 degrees
      //myservo.write(pos);
      post -=90;// tell servo to go to position in variable 'pos'
      myservo.write(90); // waits 15ms for the servo to reach the position
    }
    ran=false;
    ranI=true;
    count=0;
  }
}
```

Figure 4: Shows the program inside the Arduino that controlled the circuitry (figure 2) and incorporated the data from figure 1.

Physical Stats/attributes of the device:

- The weight of the device is roughly 150 grams.

- The device at its maximum distance is roughly 2 feet long.
- The hand prosthetic and the arm circuitry are the only 2 ridged parts, the rest is flexible.
- The main colours of the device are black, white, blue, green, and a light brown with small amounts of other colours such as red, purple, yellow, orange, and gray.
- The device can be deconstructed into 3 parts.
- The device has a minimalistic theme/design, with wires incorporated into mounts, circuitry is stacked, and cables are also incorporated within the prosthetic hand.
- The device currently is made of around 250 pieces.

The program can be divided into 4 versions.

Version one created a basic outline and function of the program, version two added in DC motors and mechanism to activate motor specifically through hand movements. Version three added a vibration sensor which was combined with version two. This led to the motor activating when a vibration was detected. Version 4 incorporated a servo motor which had specified range of movement. The current version (4) is loaded into the rest of device.

## **V. Discussion & Conclusion**

How can an exoskeleton device be built to limit shaking, stabilize the hand, and increase motor function ability?

An exoskeleton device was successfully able to be built and limit handshaking to a certain degree. The materials used for the exoskeleton were mainly rubber, wood, fabric, and plastic. The circuitry was built on an Elegoo UNO R3 board (Arduino) and the program was written in C++ (programming language) inside the Arduino Integrated Development Environment (IDE). However, due to cost and time restraints, the device was not as well built as it could have been.

Referring to section 3 the main issue with any exoskeleton was its size, weight, and battery life. The materials listed in part A were used to overcome the restrictions exoskeletons face. The materials (rubber, wood, fabric, and plastic) were used to keep it light and as flexible as possible. In addition, since minimal metal was used that kept the entire device quite light at 150 grams despite being around 2 feet long. In order to address the battery life an Arduino board was used, this lets the circuitry be efficient and made it easier to use low power components in the device itself. As stated in part A, due to restraints in cost and time cheap materials such as Popsicle sticks and rubber bands were used, this took away from the exoskeletons durability and practicality in everyday scenarios. In a second version, the device will mostly if not entirely be custom 3D printed which would resolve the above issue and still keep the device light.

## VI. Application

This information is a valuable asset not only towards the medical industry but many others as well. Examples of where exoskeletons have a viable future are in medical, labour, military, and transportation industries. The ability to build practical exoskeletons can be used to enhance human strength for the military and labour. In addition, exoskeletons can be used to treat other conditions such as paralysis and muscle atrophy. The general public would be affected by exoskeletons through advancements in society, comparable to how smartphones affected the public and the new market niche such a device would present. The scientific community would have more support to make advancements in that field. The aforementioned results hold great promise.

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# **Cost Efficient Exoskeletal Arm for Arm Curling Rehabilitation Using Pneumatic Muscles**

Shayaan

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## **I. Abstract**

Many athletes and common folk acquire injuries on their elbows such as forms of tendonitis and claim that their elbows hurt performing even the simplest tasks which requires curling of the arm. The purpose of this innovation is to provide these people with a cheap active rehabilitation device using pneumatic muscles which allows them to recover while performing day to day tasks. The rehabilitation device is an exoskeletal device which is made by connecting 2 pieces of wood, which would act as the bones, and attaching pneumatic muscles to them to enable movement of the arm. The end product operated as expected and only costed \$22 (CAD). In the end, if any enhancements were to be made, a valve would be connected to the pneumatic system to allow convenient extension of the forearm.

## **II. Introduction**

Pneumatic muscles are cheap and easy to make by yourself and could have many uses. It could make one's rehabilitation process less of a hassle and enable them to participate in everyday activities that would otherwise be limited due to their injury. The assistance of pneumatic muscles could also enhance the strength of any patient whose symptoms include elevated levels of catabolism, pain in their muscles or tendons, or even the elderly. An exoskeleton for the leg has already been developed and tested on people who never thought that they could walk again due to their age. Statistics show

that muscles weaken up to 40.9% when people enter their 40's. Pneumatic muscles could also help people with tendonitis by letting the tendon heal while the work load is spread between both the tendon and the artificial muscle.

How could pneumatic muscles be used to create a cheap and reliable rehab device for the arm?

If people with injured muscles or tendons where to use an exoskeletal pneumatic muscle device while undergoing rehab, the patient could spend most of the time outside of the clinic, doing daily tasks and still getting rehabilitated, due to the pneumatic

mechanism, for a less price and while being comfortable. Stroke survivors who develop non- hemiparesis had Medicare costs averaging at \$53,319 over a 4-year span (Zorowitz, 2009). Non- hemiparesis patients can have single limbs which are extremely weakened or can not move at all. Using an exoskeletal structure and pneumatic muscles could help the patient do everyday task and spend less time, money, and effort on the old-fashioned rehab (although some would still be needed). Questions that arose were, “Will it be too bulky?” and “Will it be safe for the patient?” To make use of the artificial muscle successfully, it had to be ensured that the device could in no way further injure an already injured patient. A safe system should not be able to cause the user any harm by default of the structure’s design (Chaoqun, 2016), and pneumatic muscles seemed to be the pinnacle of this statement.

### III. Methods

- Cut 2 pieces of latex tubing, 10 inches each.
- Cut 2 pieces of braided sleeving, 13.5 inches each.
- Place each 10-inch latex tube into separate 13.5-inch braided sleeves, these will now be referred as the pneumatic muscles.
- Use zip-ties to seal shut 1 end of the on both pneumatic muscles.
- Cut 3 18-inch pieces of silicone tubing.
- Insert 1 piece of the cut silicone tubing 1.5 cm into each of the open latex tubing of the pneumatic muscles.
- Tighten separate zip-ties on each pneumatic muscle on the area where the braided sleeve, the latex tube, and the silicone tube meet.
- Connect the ends of the pneumatic muscle’s silicone tubes to 2 ends of a Y-connector.
- Connect the last 18-inch piece of silicone tubing to the last end of the Y-connector.
- Connect the loose end of the last silicone tubing to an air compressor
- Saw a piece of a wooden rod into 2 pieces, one 18 inches and the other 12 inches.
- Drill holes at either ends of each of the pieces of wood.
- Align the holes of a two-holed blank tag with the holes in the 2 pieces of wood
- Insert screws into either hole, tightening the hole on the smaller piece of wood completely, leaving 2 mm of space between the blank tag

and the screw of the longer piece of wood.

- Drill a hole into the back side of the longer piece of wood 3.5 inches down from its open end
- Drill a hole into the back of the smaller piece of wood 1.5 inches away from the tip closest to the blank tag.
- Cut 2 6-inch pieces of wooden rods.
- Drill holes completely through the middle of both rods.
- Use screws to connect the 6-inch rods through there holes into the holes created in the 18 inches and 12 inches rods.
- Assure the 6-inch rods are perpendicular to their attached rods.



*Figure 2 Exoskeletal arm without pneumatic muscles attached.*

- Connect a pneumatic muscle to the right sides of both 6-inch rods by

wrapping the ends of the zip-ties from the ends of the pneumatic muscle around the rods

- Hot glue the ends of the zip ties onto the wooden rods.
- . Connect a pneumatic muscle to the left sides of both 6-inch rods by wrapping the ends of the zip-ties from the ends of the pneumatic muscle around the rods
- Hot glue the ends of the zip ties onto the wooden rods.
- Wrap all of the visible wooden pieces using electric tape.
- Hot glue 2 pieces of 10-inch cloths 3 inches apart on the 12-inch rod starting at 4 inches from the tip of the loose end.
- hot glue 4 pieces of 15-inch cloths 2 inches apart on the 18-inch rod starting at 1 inch from the tip of the loose end.

#### **IV. Results**

This innovation was able to contract the pneumatic muscles allowing the users arm to curl without having to apply any force and reduces the amount of force needed to apply when curling objects. Using this innovation led the user to not have to load the biceps and elbow tendons when picking up items. The pneumatic muscles were able to produce enough force to allow the user up to 5 pounds without having to apply any voluntary effort.



## V. Discussion & Conclusion

The purpose of this innovation was to create a cost efficient exoskeletal arm using pneumatic muscles for rehabilitation of the arm curling muscles and tendons. This would allow the user to use their arm while rehabbing at the same time instead of having to let their arm rest for multiple weeks, months, or even years.

The exoskeletal arm was able to help the user curl their arm and due to the pneumatic muscle contracting like a real muscle would, the user's movement is not restricted. Pneumatic muscles also have an exceedingly small risk of malfunctioning, unlike motors which could force the user into inherently unnatural positions and further the user's injury.

A concern would be if the exoskeletal arm would constrict movement of other muscles, such as the shoulders, due to it being too bulky. This was not an issue in the end product, as observed in figure 2.



*Figure 2 The exoskeletal arm does not constrict movement of the shoulder.*

The main issue was that due to a lack of a mechanism which would aid in releasing the air from the pneumatic system, although this issue could be resolved by either disconnecting the silicone tubing from the air supply, which would release the air from the muscles and let the user perform elbow extension.

## **VI. Application**

An enhanced version of the exoskeletal rehab arm containing a valve and muscle signal sensors could help the general public by providing a versatile way of rehabbing injuries affecting the ability to curl items with an arm. This innovation could aid in not only rehabilitation, but also serve as a cost efficient and temporary solution for arm paralysis, but manual use of the pneumatic muscles might be required since paralysis is most likely caused due to damage of the nervous system affecting the ability to send signals to muscles to contract. The use of pneumatic muscles in exoskeletons could also be

doi:10.1310/tsr1605-309

used to decrease the fatigue of combatants at war or manual labor jobs.

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# **The Effects of Meditation on a Student's Focus, Mood, and Quality of Sleep**

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## **I. Abstract**

This study was conducted to see how meditating during a certain time of day can effect a student's focus, mood, and quality of sleep. During the procedure, four students were told to meditate using a meditation app called Simple Habit and each student was instructed to meditate at a different time of day for two weeks; two students who didn't meditate at all also participated. The students were asked to fill out a survey where they rated their focus and productivity on a scale of 1-10 every day and also wrote down their mood, and the amount of sleep they had that night. Students who meditated during the morning said they felt mostly focused and happy, while those who meditated during the night were well-rested and energetic the next morning. The students who didn't meditate at all had fluctuating amounts of energy and focus, and struggled to have consistent sleeping patterns. Overall, this project has shown that meditation can have a positive effect on a student's wellbeing, as it can help improve their productivity, which can lead to less procrastination and less stress. Meditating is also a good way to relax for a little and just stop thinking about everything that must be done in the busy, modern world .

## **II. Introduction**

Stress and mental health are becoming a big issue in schools and workplaces; in 2014, 48.7% of university students attended counseling for their mental health conditions, which is 3% higher than the 45.2% in 2012 (Novotney, 2014). Since meditating helps slow down breathing, quiets the mind, and helps people find peace within, it can ease mental health issues like depression and anxiety; some clinicians are even trying it as a course of treatment before turning to medication (Marturana, 2016). Elizabeth Ward, a clinical psychologist, says that she's had patients who take medications and meditate simultaneously and she's been able to see the benefits within weeks of treatment (Marturana, 2016). By conducting more research on meditation, not only will it be a less costly way for students to

get treatment for mental health, but students will be able to get a deeper understanding of how useful it is and can start on their path towards bettering their mental health right away.

The question asked is, "How does the time of day and amount of time spent meditating affect a teenager's mood, work habits, and quality of sleep?"

If someone meditates in the morning, then they should be able to perform better in school and during the rest of the day because meditation allows people to improve critical thinking (Shaw, 2016). An 8-week study done by the Harvard Gazette (2011) showed an increase of grey matter in the hippocampus region of the brain which is responsible for learning and memory (Le, 2015; McGreevey, 2011), which means that students who

meditate will be able to attain more information, which will lead to better test scores, which leads to a decrease in stress. If someone meditates at night, then they should be able to sleep better and fall asleep quicker because meditation helps clear the mind which means they won't have any late-night thoughts that could keep them up (Shaw, 2016). As for the overall mood of the person, they should be happier and less stressed if they meditate daily because it is supposed to help people take control of their mind and develop a healthier lifestyle (Marturana, 2016). It will take a while to see the full effect that meditation has on the brain because it is not something that will happen in one day. If the person doesn't meditate daily, it's okay because as long as they don't stop for too long, they can still continue to train their brain.

### III. Method

Four teenagers meditated every day for two weeks using the Simple Minded meditating app. Each teen was assigned a specific time of day to meditate (e.g. one person meditated in the morning, another at night), and was told to meditate in a quiet room. A survey was created to record their moods, work habits, and quality of sleep over the two weeks. Each teenager was told to fill out the survey every day for the duration of the study. At the end of the two weeks the data was collected and graphed.

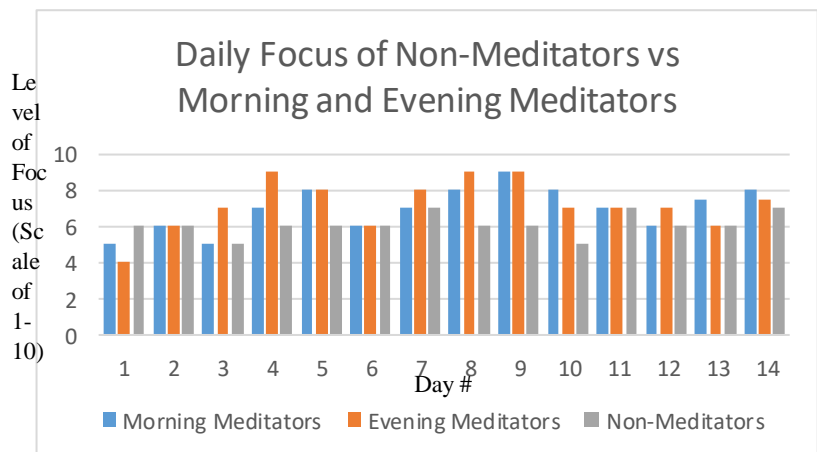
The independent variable in this experiment was the time of day because it didn't depend on any other variable, since it was already assigned to the participant.

The dependent variables were the subject's mood, work habits, and quality of sleep because these were

affected by who the subject was, and the affect that meditation had on them.

The controlled variables include the app that was used to meditate because if they all used different apps, the data wouldn't be comparable. The surrounding environment when the subject also meditated had to be the same because if someone meditated in a noisy room, they wouldn't get results similar to someone who meditated in a quiet room. The survey that was filled out every day was also a controlled variable because each subjects had to answer the same questions in order to have data that was actually comparable.

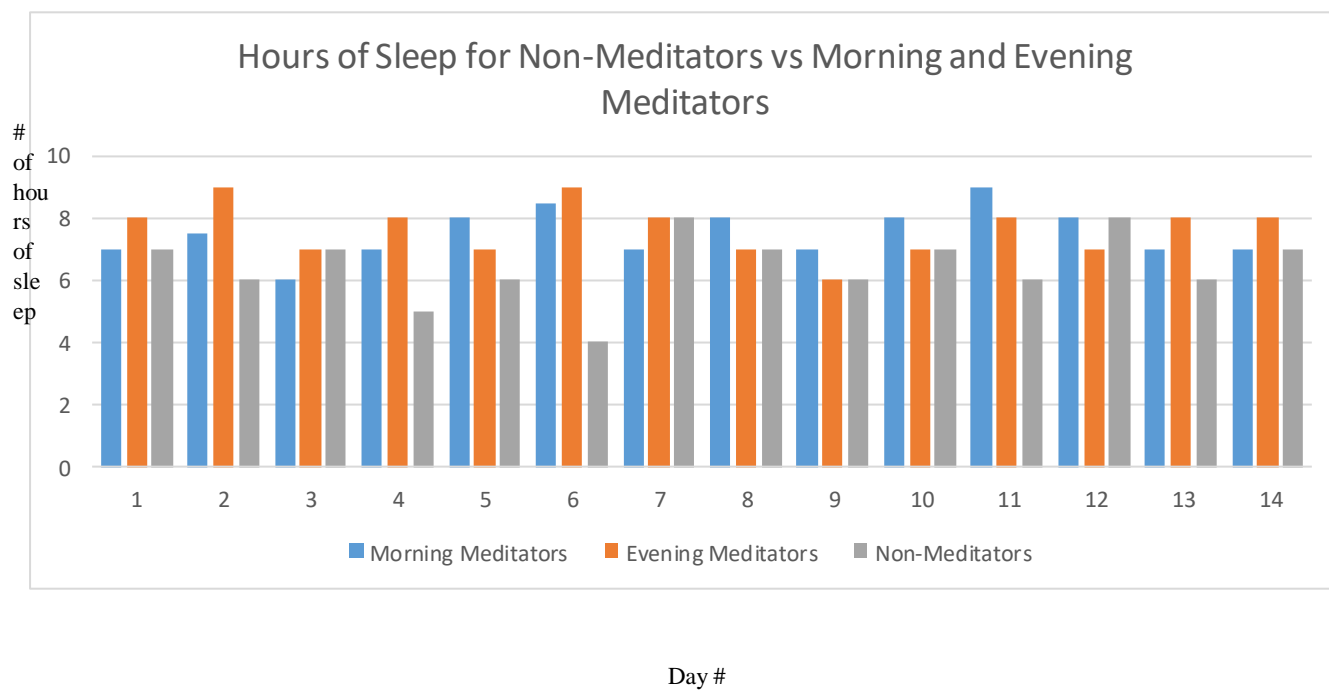
### IV. Results



**Figure 1:** Shows the average levels of every day focus of morning and evening meditators vs non-meditators.

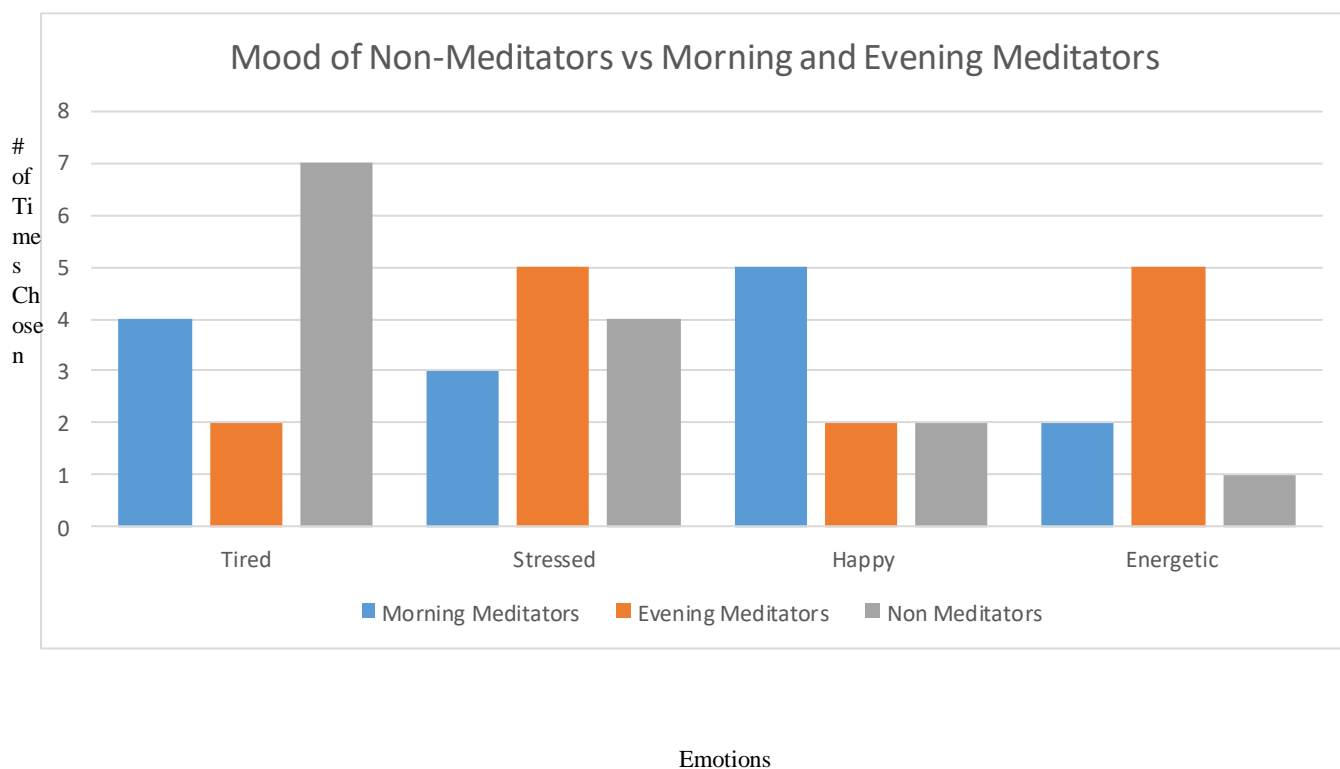
The graph above (Figure 1) shows that the morning and evening meditators were able to have more steady levels of focus on a daily basis, while non-meditators had fluctuating amounts of focus. This

happened because meditation allows people to improve their critical thinking skills.



**Figure 2:** Shows the average amount of sleep for morning, evening, and non-meditators

The graph above (Figure 2) shows that the students who meditated were able to sleep better and have more consistent sleeping patterns because they were able to clear their minds through meditation.



**Figure 3:** Shows the average mood of meditators and non-meditators

The graph above (Figure 3) shows that the both morning and night meditators were able to have more positive emotions than those who didn't meditate at all. This was most likely because the meditators were able to get more sleep and be more productive, so they were able to feel happier and more energetic.

## **V. Discussion & Conclusion**

Yes, the hypothesis was correct. Those who meditated in the morning were able to be more focused throughout the day while those who meditated at night got more sleep and were more energetic overall. On the first day of meditation, the morning meditators averaged 4.5 for focused on a scale of 1-10 while evening meditators averaged 5 (Figure 1). However, the next day, the morning meditators climbed up to an average of 7 while the evening meditators only went up to a 6. The morning meditators were able to become more focused faster and remained consistently productive for the duration of the experiment (Figure 1). The evening meditators had better sleep schedule (Figure 2) and answered that they felt mostly energetic when asked about their mood (Figure 3). For the most part, they got around 7-9 hours of sleep a day and were able to get about the same amount of sleep each day. The morning meditators were also able to get around 6-9 hours of sleep each day, but their sleep pattern was inconsistent and they replied that they felt happy but tired when asked how they felt (Figures 2 and 3). Non-Meditators were also studied and they were shown to have very inconsistent sleeping patterns and said they felt stressed and tired on most days. Some days they would get 8 hours of sleep while

they got 4 the next day, and they would average 9/10 for focus one day and then it would drop down to a 5/10 the next, then climb back to a 7/10 the next day. Overall, this experiment showed that morning meditators have more focus, productivity and positive emotions, evening meditators have consistent sleeping patterns which resulted in more energy, and non-meditators might have inconsistent habits and experience very different moods from day to day.

Since meditation improves critical thinking, meditating in the morning is preparing the brain to think for the entire day, which is why the morning meditators are able to be more productive and focus. Meditation also improves memory, which leads to performing better on school tests, which can lead to happier emotions, which is why both the morning and evening meditators felt more happy and relaxed. Meditation also clears the mind and allows a person to go to sleep without having any late-night troubling thoughts, which is why those who meditated in the evening were able to get more sleep and have more energy. Meditating in general also makes the meditators feel more positive emotions because they are able to just take the time to breathe and reflect on their day, which allows them to relax and let go of any stress for some time which is why

the meditators replied with emotions like happy or energetic when asked about their mood. The non-meditators on the other hand didn't give themselves time to just sit, think, and clear their mind which is why they felt stressed and anxious constantly. An error that was made during the experiment was some meditators not meditating every day. If this error didn't happen, then the data would've been average out more precisely and it would be more accurate, but since it did happen, some of the averages were not fully accurate. Another error that occurred was the setting in which the meditator meditated. When asked about the location of their meditation, most participants said they meditated in their bedroom, however there were a couple that said they'd meditated in the living room while their parents were right next to them. This could've caused the participant to react differently to the meditation because they were around other people and not in a quiet room, which could've affected the results.

## **VI. Application**

This information can be used by psychologists and counselors who are trying to get their patients to lower stress levels, or for patients who have mental health issues like anxiety. Stress is becoming even more common nowadays, especially in youth, so if teens can incorporate meditation into their everyday lives, they will be able to have the chance to sit and think daily, which will be very beneficial for their mind long-term. Especially since meditation can be

done anywhere, at any time, it is an efficient way to train the brain and more people should meditate because it definitely is a good way to learn to control the mind and body. These results as a whole are beneficial to students and adults who are experiencing stress, or tiredness and want to start working towards developing a healthy lifestyle.

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# Free Energy Generator Efficiency Test for Household Use

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## I. Abstract:

In the world, electricity has always been a problem either that has an abundance of it or having it but being able to pay the bills. Well, the Free Energy Generator could have helped solve this problem. The Free Energy Generator is a device which consists of small and affordable parts, the device's function is to generate electricity. The gear used were a certain ratio to increase the number of RPM so the increase of RPM would result in more electricity being generated. The device mainly consists of a generator motor and a motor which were connected by gears. The motor rotates the gears causing both the gear to rotate making a dynamo. The result however didn't reflect efficiency, because there was a loss of energy through unwanted forms like friction. The Free Energy Generator would have been a great help to people in developing countries, the dynamo could have produced electricity.

## II. Introduction:

Nowadays the biggest challenge in the world is competing with the electricity bills and the environmental factor after fossil fuel usage, an alternative source is being researched. A Free Energy Generator will help produce renewable, cheap and environmentally safe electricity source. It is an unlimited source of electricity, it never ends and always generates more. There is only a start-up cost of installing the motor, generator and smaller components. The product is accessible and inexpensive for all households in developing countries. It does not emit Greenhouse Gases and hence safe for the environment. It doesn't require big power grids and annoying windmills. Would a Free Energy Generator be efficient enough to be used for a house and the running electricity? If the project

reflects efficiency, then the Free Energy Generator can be used as an unlimited electricity source, because it would be an infinite source. The device would save money because it only has a start up cost. There will be no digging for it or even worries for storms, it will be running and producing electricity 24/7 nonstop. The worry for the limited resources will be gone. It will be more beneficial than crude oil, windmills and solar panels for many reasons like money and availability.



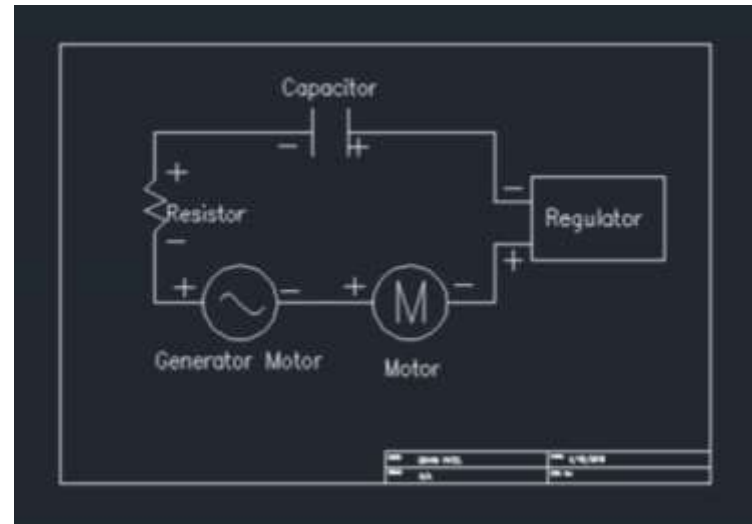


## Dynamo with Resistor or Capacitor

### III. Methods:

Assembly the 84 teeth gear onto the motor shaft, and the 36 teeth gear to the generator motor shaft using the axle connectors. Secure the motor and generator motor onto a 7" by 12" sheet of plywood, making sure the gear teeth meshing into each other. Solder a 3" wire from the positive lead of generator motor to the negative lead of motor, then solder the wire from positive lead of the voltage regulator to negative lead of generator motor. Using the negative wire from the regulator solder that to the positive lead of capacitor (specification for capacitor 100V-220uF). Afterwards solder the negative of the capacitor to the positive lead of resistor (specification for resistor 5.5 ohms and 10W), finally solder the negative lead of resistor to the positive of motor. Follow *diagram 1.1* for help. performance of the experiment and my goal for Free Energy Generator.

In the experiment, the dependent variables was the gear ration to increase the torque and speed, the motor and generator sizes and models was the independent variable. These are the components of my experiment which can enhance the

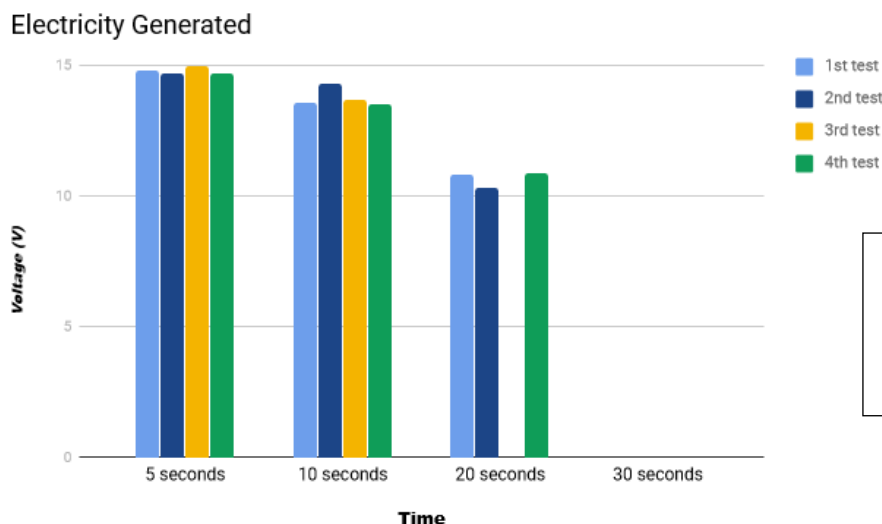


*Diagram 1.1* Circuit Drawing of Free Energy Generator

### IV. Results:

After conducting the experiment, the data collected

showed that the project couldn't sustain enough



*Image 1.3* shows the drop in voltage over time, in most of the attempt the voltage dropped to 0 at 30 seconds.

power in the set circuit for it to be a continuous dynamo. Which is displayed in *Table 1.2* and *Image*

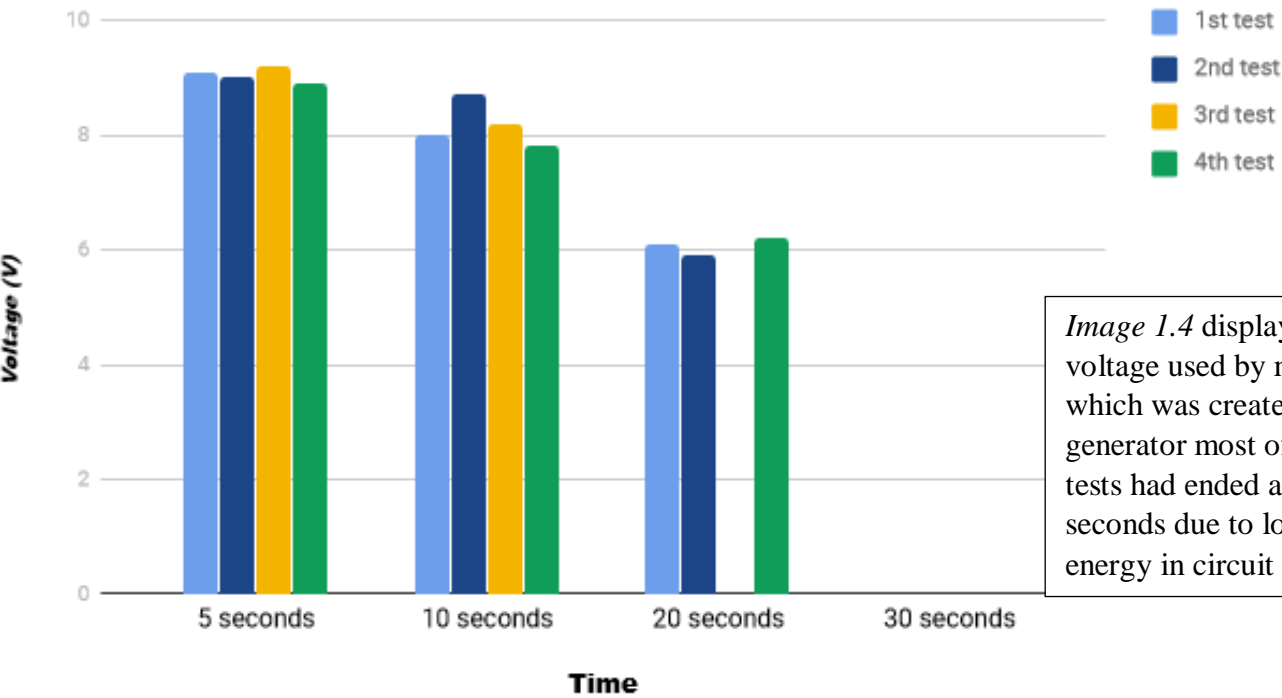
*1.3* and *Image 1.4*

|                                  | 0 seconds                   |                             |                             |                             | 5 seconds                   |                             |                             |                             | 10 seconds                  |                             |                             |                             | 20 seconds                  |                             |                             |                             | 30 seconds                  |                             |                             |                             | Aver-age |
|----------------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|----------|
| Attempts                         | 1 <sup>s</sup> <sub>t</sub> | 2 <sup>n</sup> <sub>d</sub> | 3 <sup>r</sup> <sub>d</sub> | 4 <sup>t</sup> <sub>h</sub> | 1 <sup>s</sup> <sub>t</sub> | 2 <sup>n</sup> <sub>d</sub> | 3 <sup>r</sup> <sub>d</sub> | 4 <sup>t</sup> <sub>h</sub> | 1 <sup>s</sup> <sub>t</sub> | 2 <sup>n</sup> <sub>d</sub> | 3 <sup>r</sup> <sub>d</sub> | 4 <sup>t</sup> <sub>h</sub> | 1 <sup>s</sup> <sub>t</sub> | 2 <sup>n</sup> <sub>d</sub> | 3 <sup>r</sup> <sub>d</sub> | 4 <sup>t</sup> <sub>h</sub> | 1 <sup>s</sup> <sub>t</sub> | 2 <sup>n</sup> <sub>d</sub> | 3 <sup>r</sup> <sub>d</sub> | 4 <sup>t</sup> <sub>h</sub> | N/A      |
| Voltage from Generator Motor (V) | 0                           | 0                           | 0                           | 0                           | 14.8                        | 14.7                        | 15                          | 14.7                        | 13.6                        | 14.3                        | 13.7                        | 13.5                        | 10.8                        | 10.3                        | 0                           | 10.9                        | 0                           | 0                           | 0                           | 0                           | 9.1      |
| Voltage used by Motor (V)        | 0                           | 0                           | 0                           | 0                           | 9.1                         | 9                           | 9.2                         | 8.9                         | 8                           | 8.7                         | 8.2                         | 7.8                         | 6.1                         | 5.9                         | 0                           | 6.2                         | 0                           | 0                           | 0                           | 0                           | 5.4      |

Table 1.2 All Data Collected

Table 1.2 All Data Collected

Electricity Used by Motor



**V. Discussion and Conclusion:**

The hypothesis was incorrect, the project was not efficient enough to keep the dynamo continuous. A Free Energy Generator is definitely not efficient to power a house. The

**VI. Application:**

This useful data and information collected, can help improve perpetual motion machines and even the design of the Free Energy Generator to make its efficiency rate higher. This information can also be taught to students that there is always

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dynamo can only run for 30 seconds. The problem was that the energy was being transferred (for example the gear were creating friction).

transfer of energy. Many students have a difficult time understanding that energy is never produced or destroyed it is transferred. The data and information will be used for the future for improving the perpetual motion machine and for teaching reasons.

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# Muscle Memory Produced by Mundane Tasks

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## Abstract

The purpose of this study is to identify the activation of muscle memory through the means of pursuing (mundane) tasks. The given actions are spinning a pen, throwing 3 balls of different weights vertically in the air, and taking typing tests using two keyboard types – smooth and gaming. According to the results displayed, spinning a pen will gradually increase the level of muscle memory; the ball throwing experiment shows dramatic increases and decreases in muscle memory, but eventually forms a highest value at the end; and lastly, the typing experiment, on average, was constant, giving no vivid sign of muscle memory development. In conclusion, the hypothesis was only partially correct, as the pen-spinning and ball-throwing experiment did follow it, however the typing experiment stated otherwise.

### i. Introduction

The general purpose of this project is to develop an understanding on how the human brain can perform tasks through the means of maximizing subconsciousness. According to the article *How Muscle Memory Works and How It Affects Your Success*, written by Adam Dachis (2011), the brain implants the performed action as muscle memory, and depending on whether the subject is doing it the wrong way or the right way, if it is done consistently, the subject will have the habit of doing it in their particular manner. In other words, if the subject does something the right way, they can progressively improve on that action, however, if the subject does a given action incorrectly in

consistent manner, it will become difficult to overcome it.

Which brings to the question: how long does it take for one to develop muscle memory (or “second nature”) for a given action?

The hypothesis of this experiment states that if someone performs a given action, and does so continuously, then that certain action will become registered within the brain and the effect of muscle memory will activate. This is due to the idea that if someone decides to something continuously, the mind will recognize that certain action and proceed with the way of how the person normally does it.

### ii. Methods

The experiment of this project consisted of three different parts, all taking the span of 10 days. The subject was to spin a pen, using the Charge technique (a continuous rotation of a pen using the thumb and index finger or ring finger); the subject lay on a flat surface, facing upwards and vertically threw three balls, each with increasingly different weights; lastly, the subject was to take typing tests using two different keyboards, being smooth and gaming keyboards. Before experimenting, the objects obtained were inspected to see if they were suitable for the experiment; the pen that was obtained was long, and at one end of the pen, the weight was imbalanced so that it was easier to coordinate the rotation of the pen; also, the subject was to weight the balls that were obtained so that the three balls had a substantial difference in their weight (the three balls were 37g, 105g, and 219g, respectively). During the experiment, the subject was to record the rate of fluency. The part in which the subject was pen-spinning was recording using time (in seconds) of how long they were able to maintain their spin. Similarly, the ball-throwing part of the experiment was also recorded using time (in seconds), taking the results of how long the subject was able to keep throwing the ball vertically. Lastly, on the typing tests, the subject was to record the number of words typed per minute.

The **independent variable** in the case of this experiment was the time elapsed during each part of the experiment – the outcome of time produced the effect of muscle memory

The **dependent variable** was the overall effect muscle memory – depending on the time taken for the experiment, muscle memory acted accordingly

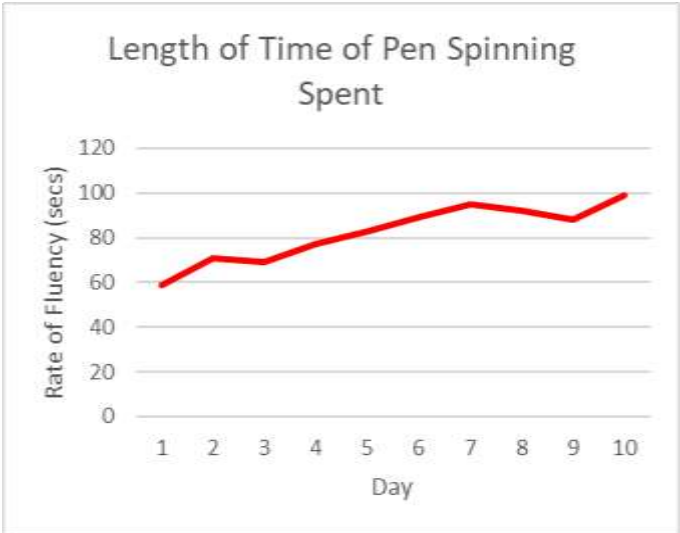
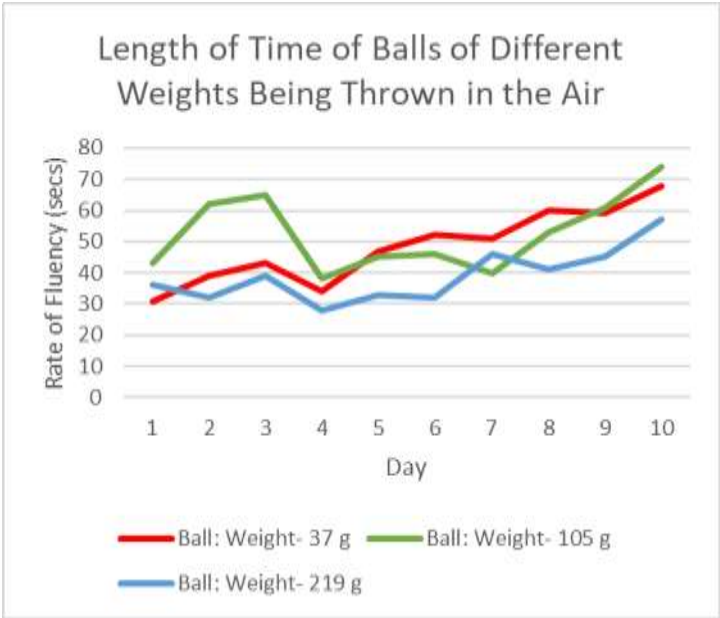
The **controlled variables** of the experiment were:

- All parts of the experiment were kept the same – incorporates consistency of the experiment
- All techniques used for each given part of the experiment were, too, kept the same – incorporates consistency of the experiment (e.g. for the pen-spinning part of the experiment, the Charge technique was always used)
- The experiment was taken place in the same environment – temperature and area did not host an effect during each performance of the experiment

### iii. Results

**Table 1:** The length of time on how long the pen was able to be kept spinning using the previously mentioned Charge technique. Day by day, the rate of fluency (on average) increases. Day 1, the value was lowest, being at 59 seconds, while by day 10, the value peaked at 99 seconds.

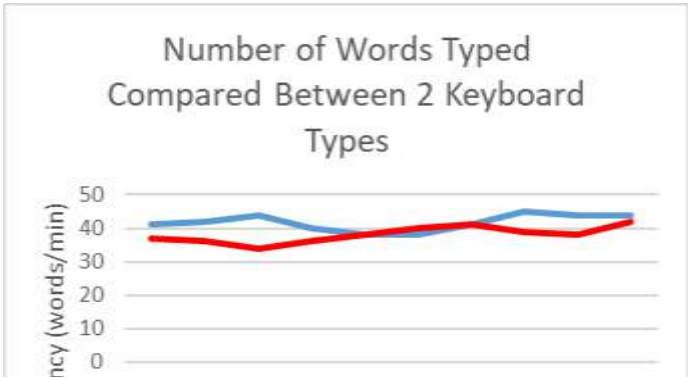
**Table 3:** Typing tests of both smooth and gaming variety keyboards are displayed. The resulting values did not show a (substantial) sign that muscle memory was present during the



#### iv. Discussion & Conclusion

In conclusion, the hypothesis given was partially correct. The statistics of Table 1 displayed sufficient evidence that muscle memory took effect during that part of the experiment, as the timed values were gradually increasing. Within the statistics of Table 2, muscle memory was harder to identify, as the values were significantly increasing and decreasing in parts, especially in the 105g ball; by day 3, it reached its second highest value at 65 seconds, then dropped to its lowest value at 38 seconds, displaying a substantial climactic drop. Lastly, within the stats of Table 3, the values displayed almost no muscle memory whatsoever. The average of all resulting values was practically constant, as the mean was approximately 40 wpm and provided no slope.

The results demonstrated a sufficient amount of understanding on the length of time it takes to produce muscle memory. The pen-spinning



**Table 2:** Three balls of different weights are compared on how long they can be thrown vertically without any error. According to the statistics, there were many drastic increases and decreases, but by day 10, all performances reached their highest.

part of the experiment displayed that muscle memory was reassuring, as the values in general were constantly increasing. The ball-throwing experiment should be further investigated, as the values seem to have significant increases and decreases. The best way to confirm that muscle memory can be present in it is to extend the length of the experiment and revisit the results once more. The typing experiment contradicts the hypothesis, so similarly to ball-throwing experiment, it would be strongly advised to continue with the experiment for a longer period until muscle memory can be evident.

It is predicted the reason for finding insufficient evidence of muscle memory being applied within the experiment could mainly be due to inconsistencies of when the experiments were pursued; the subject did not do the experiments everyday, rather they were unavailable to perform these tasks. If they were vacant each day, it is believed that all parts of the experiment within this project could have improved the visibility of muscle memory being invoked.

#### **v. Application**

The information gathered within this SCICAN! project can be used in various other fields of study related to biology, as well as anthropology and other human sciences. It can be used as how simple, mundane tasks like the ones demonstrated in this experiment can affect more significant or unexpected tasks, like how it affects exercise, education, etc. In terms of its fit into the “big

picture”, it demonstrates, as just mentioned, that it can affect one’s everyday lives and possibly produce a drastic increase in the level of exercise and education. It all counts on the person to pursue these little tasks to produce large scale outcomes that positively affect them.

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## **The Effects that Skill Level in Chess has on Memory**

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### **I. Abstract**

The question investigated was if a person's proficiency in chess had an effect on a their ability to remember information. The importance of the question lied in the fact that a person's memory is the most important asset they could have, because if it's not sharp, fully enjoying and optimizing on life can be very difficult. To answer this question, participants that varied in skill pertaining to chess performed two tests. The first was a card-matching memory-flip game, and in the second test participants would be told ten words and after ten minutes they would have to recite as many as they remembered. The results for both tests showed no correlation between skill in chess and memory performance, which indicated that a person's proficiency in chess had no effect on their ability to remember information. The implications of the results are that a chess players memory doesn't extend past the game itself, because the game does not reinforce every aspect of memory.

### **II. Introduction**

In this project, the recollective abilities of chess players of various skill levels are compared with each other. The information derived from this project is vital, because having the capability to recall upon past actions and events is important when making decisions in the present. Dr. Marino Gafanovich (2015) says researchers have found a link between playing chess and reducing the possibility of developing dementia, Alzheimer's, and other debilitating mental illnesses. This information gives insight on how chess is potentially life-saving; therefore, it is important to

fully analyse the neurological affects of this game, as to come to a conclusion on the lifelong impact it can play on memory. That is why this experiment focused on how proficiency in chess affects someone's ability to remember information.

It is hypothesised that if a player has a higher rating/more experience in chess than another, then their memory will be better, because higher rated players dedicate thousands of hours more to learning various patterns on the chessboard, ergo improving their overall ability to retain general information.



This hypothesis is justified by further proof and research. For example, when a particular position is set up on a chessboard board, according to Bill Wall (2014), beginners are able to recall the correct location of about four pieces in 5 seconds, whereas grandmasters recall virtually all of the more than 20 pieces. This shows that more skilled chess players are able to identify patterns in the board while beginners only see a jumble of pieces; reflecting on both groups’ ability to call back on what they have seen. Furthermore, when considering a chess players memory away from the board, it is still highly proficient. There is a significant increase in the performance of auditory-verbal memory in expert chess players compared with non-chess players (Medical Journal of the Islamic Republic of Iran). This justifies that time spent on mastering the game of chess can enhance the brain’s ability to remember information in general. Overall, playing chess can lead to better memory, since the game requires the brain to recollect and process information.

**III. Methods**

In the first test, a twenty-four card-matching memory-flip game was used. The participant would sit at a table, and then have the ‘UNO’ cards arranged in a face-down six-by-four grid in front of them. In the set of cards, there were twelve pairs of matching cards. The participant would flip a card in the grid, and if they then flipped another card that matched the first, both cards were taken out of the





game, otherwise they were both flipped back over. Performance was measured by the number of flips taken to match all the cards, and this test was executed twice – each with a different starting layout.





*Figure 1 – First Game Set-up*

In the second test, a participant would be spoken these ten words to twice, which were: delicious, fugitive, comprehension, guidance, abhorrent, behemoth, stylistic, passionate, unrequited, wardrobe. After ten minutes, they would verbally recite as many as they remembered. Performance was measured by the number of words recited perfectly.

In the experiment, the independent variable was the rating/skill level of the participant in chess, while the dependant variable was how each participant performed – number of flips to finish the matching game (test 1); percentage of words recited correctly (test 3).

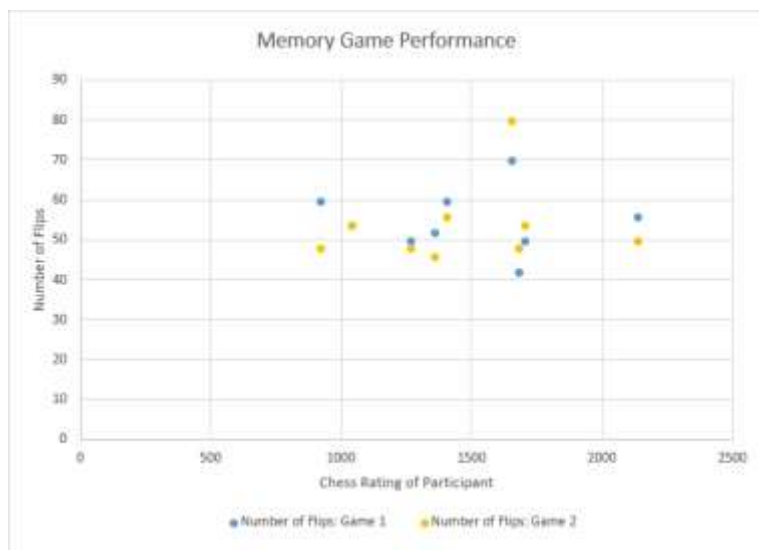
One control variable was the tests used on each participant – each test subject received the exact same testing process and identical tests. This made the testing fair and equal, because no participant got test that could have been slightly more difficult – which allowed the results to truly show which people exceled past the rest in memory.

|                                                                                     |   |                                                                                     |                                                                                     |                                                                                     |   |
|-------------------------------------------------------------------------------------|---|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|---|
|  | 2 |  | 7                                                                                   | 4                                                                                   | 6 |
| +2                                                                                  | 5 | 9                                                                                   |  |  | 3 |
| 1                                                                                   | 1 | +2                                                                                  | 5                                                                                   | 7                                                                                   | 3 |
| 4                                                                                   | 8 | 9                                                                                   | 6                                                                                   | 8                                                                                   | 2 |

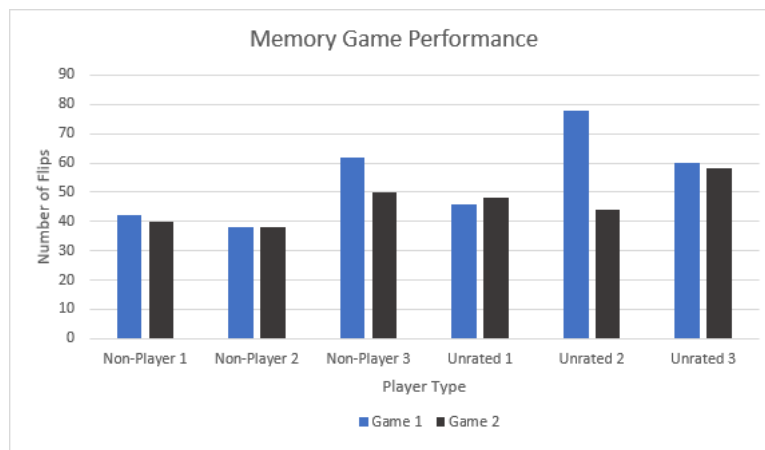
|    |                                                                                     |   |   |                                                                                     |                                                                                     |
|----|-------------------------------------------------------------------------------------|---|---|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| 1  |  | 5 | 8 | 7                                                                                   | 2                                                                                   |
| 2  |  | 4 | 9 | 6                                                                                   | 6                                                                                   |
| +2 | 9                                                                                   | 5 | 7 | +2                                                                                  | 3                                                                                   |
| 3  | 4                                                                                   | 1 | 8 |  |  |

Another control was the person who performed the tests on the participants – therefore each subject got the same experience as the others. Which was especially important when participants were read the ten words, because different voices are harder or easier to understand. Furthermore, the time of day that the experiment was done on was the same for all contestants, because some people can't easily receive and recall information early in the morning or late at night. All tests were conducted during the afternoon to ensure the results compare everyone on the same basis.

#### **IV. Results**

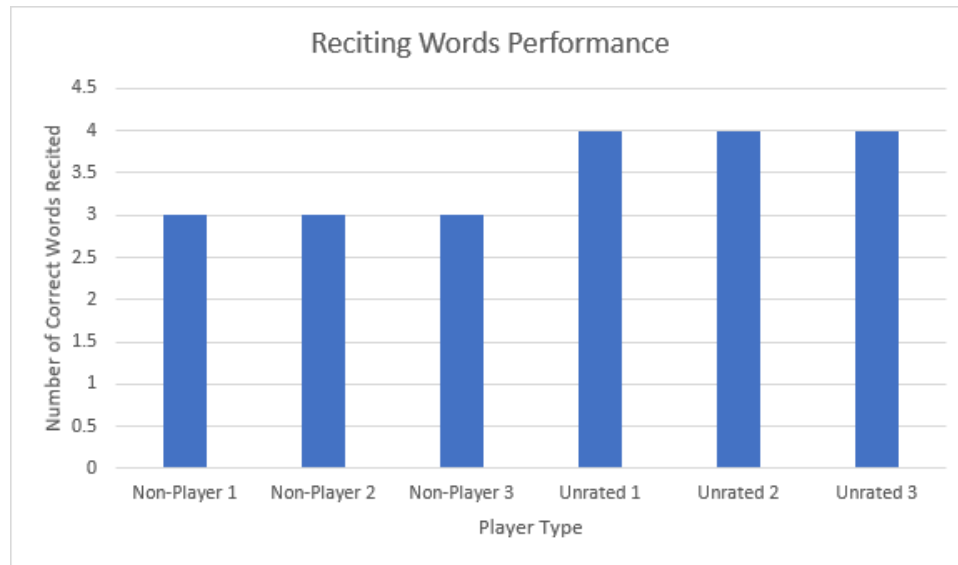


*Figure 3 – Scatter Plot Comparing the Performance of the Rated Players in Both Memory Games*



*Figure 4 – Bar Graph Comparing the Performances of the Non-Rated Players Both Memory Games*

itself. Only one journal (Medical Journal of the



*Figure 6 – Bar Graph Comparing the Performances of the Non-Rated Players in the Second Test*

## **V. Discussion and Conclusion**

The results from the essential data of the experiment, show that the hypothesis had been proven incorrect. How proficiently one plays chess does not influence their memory retention. The first scatter plot, containing the memory game test results, did not indicate that a higher rating in chess would lead to less moves required to finish. In fact, the data had absolutely no correlation, as there was even an average range of 30 moves between two players with almost equal rating (1650 and 1676). Furthermore, the data for the second test also had no correlation, which proved the hypothesis wrong again.

The results show that more skill in chess does not indicate better memory, because a chess players memory likely doesn't extend past the game

Islamic Republic of Iran) explicitly stated that a chess player's memory is better in a more general sense. The game only requires somebody to memorize positions, but it doesn't reinforce the memory involved in more common applications, or short-term memory. The articles referred to stated that chess stimulates the brain, but perhaps the game is not broad enough in terms of engaging all the senses, to improve every single aspect of memory.

However, the results do pose the question of whether or not a player's proficiency in chess means better memory in relation to the game itself. To answer this inquiry, tests could be done to see how well participants can memorize a position on a chess board. This test should be done to further expand on this project.

One error that may have occurred is a miscounting error when the number of moves was being tallied for the card-matching test. However, these mistakes of adding or subtracting one or two extra moves to a few participants' scores would have barely changed the results or the experiment, since the overall average would only differ slightly. Another problem that arose, was that some of the participants were being watched by many people during testing. This unnecessary pressure to not do something wrong in front of other people possibly caused some participants to do worse on their tests. However, if these problems didn't exist then the participants might have done better, but not enough to suddenly satisfy the hypothesis established earlier.

## **VI. Application**

From this research project it has been revealed that chess still does a positive impact on the brain, and this information can be used in other fields. For example, it can be used in Alzheimer's research to study the way a sick brain reacts to

strategy game such as chess. In addition, the general population, can also make informed decisions, on whether they should play chess or even get their children to do it. Overall, the results show the tip of the iceberg on this topic, and they've opened the doors of exploration into future research, about how chess affects your brain on the cellular level.

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# **How doing splits/groin stretches over a set period of time effects a person's ability to do roundhouse, axe and hooking kicks.**

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## **Abstract**

The purpose of this experiment was to find out how doing splits/groin stretches for ten minutes everyday for four weeks can affect a person's ability to do roundhouse, axe and hooking kicks. This experiment was conducted by tracking the number of kicks landed on a sparring opponent from both left and right legs of the subject and checking the height of the kicks from both legs. The tracking portion occurred only on the testing days where the three kicks were tested. In the experiment there was an increase of the height for the roundhouse by six and a half inches for the left leg and 8 inches for the right leg. For the axe kick the height increased by four inches for the left leg and three inches for the right leg. For the hooking kick, the height increased by 5 inches for the left leg and three and a half inches for the right leg. and the number of roundhouse, axe, hooking kicks in the end was four more than the initial amount of kicks landed on the sparring opponent. In the conclusion the experiment ended off as a success due to the fact that there was an increase in height for all three kicks and the number of kicks landed on the sparring opponent increased.

## **Introduction**

Answering the problem of getting better kicks is important because to become a better martial artist overall, the martial artist must find the answer which will let him/her achieve this goal. A Taekwondo martial artist would also want to know because in Taekwondo the main focus is kicking and this article states that, "*Stretching* is an essential component to any sports training program, but in *martial arts* it becomes vitally *important* because of the extreme range of motion required for many of the kicks" (Walker, 2008). Another reason to solve this problem is because though some martial artists are naturally stiff, they still have the ability to do some kicks pretty well So, if stretching can loosen a

person up; there is still a chance that the person will be able to do the kicks better.

If doing splits or groin stretches for 10 minutes everyday for five weeks can affect a person's ability to do martial arts, then the person's roundhouse kick, hooking kick and axe kick will get better because it will get his/her legs ready according to this webpage, it states, "everyone who engages in any kind of sport knows the importance or stretching before and/or after engaging in physical activity. In those kinds of activities that require a lot of use of your legs, stretching is important in getting your legs ready for use.". (Dragon, 2018) Also groin stretches can help

produce effective kicks as said in this webpage, which states, “For effective and injury-free kicks, therefore, stretching and strengthening exercises for the groin region should be a major part of your

### **Method**

This project was an experiment to find out if stretching the groin really can make a person’s roundhouse, axe, and hooking kick better overall. This experiment was conducted over a period of time. This was an original experiment based on personal interests.

Firstly, to do this experiment the subject must know how to do the stretches required for the experiment. There are two versions of the stretch and the subject may choose which stretch they wish do. For the independent splits stretch, the subject spread their legs slowly sideways in a standing position and far enough once tension is felt, keep spreading until there is a lot of tension in the groin area and hold for one minute, then repeat for ten minutes. For the assisted splits stretch the subject must find a partner to help them with the stretch. The subject will then spread their legs apart sideways in a sitting position, then the partner of the subject will place his/her legs at the end of the subject’s legs, the partner will then push the subject’s legs apart and will pull the subject’s arm towards themselves, keep spreading the legs apart until there is a lot of tension in the groin area and hold stretch for one minute, then repeat the stretch for ten minutes.

training routine.” (Kelliher, n.d.). This shows that for kicks to be effective, the groin area of your body should be stretched.

For the experiment, the testing days will be held on Wednesdays and Mondays. The subject has to measure the initial height of the

roundhouse, axe, and hooking kick in the first week without stretching, and after stretching for a week the subject will kick a target and measure the height the kick was at for both left and right legs. Later on the subject can subtract the height of the initial kicks from the height of the newer kicks. Do this step on every Wednesday for five weeks. For the first week the subject has to spar someone and keep track of how many of the kicks they landed on their sparring partner for both left and right legs, and after a week of stretching the subject will repeat this step. Do three matches of sparring and total up the kicks from the three matches. Do this step on every Monday for four weeks. This step will be done to measure the flow of the kicks.

The experiment’s independent variable is that the subject is stretching to make their roundhouse, axe and hooking kicks better. The experiment’s dependent variable is that the subject is measuring if their kicks will get better by measuring the height of kicks and the flow of the kicks during sparring. The controlled variables are that the subject will only be doing groin stretches

and will only be doing certain kicks. These are controlled variables because the subject is testing whether their kicks will get better by doing groin stretches, which is something that cannot be

changed in the experiment and will stay the same always. There are certain kicks because they are kicks that are used very often during sparring matches in Taekwondo

## **Results**

Table 1

| <b>Date Tested</b>            | <b>Measure of original kick subtracted from new kick</b>              | <i>Table 1 displays the height</i> |
|-------------------------------|-----------------------------------------------------------------------|------------------------------------|
| Original kick- April 18, 2018 | Roundhouse: L-62" R-62.5"    Axe: L-59" R-58"    Hooking: L-60" R-59" |                                    |
| April 25, 2018                | Roundhouse: L-2" R-2.5"    Axe: L-1" R-0.5"    Hooking: L-2" R-1"     |                                    |
| May 2, 2018                   | Roundhouse: L-3" R-3.5"    Axe: L-2" R-1"    Hooking: L-3" R-2"       |                                    |
| May 9, 2018                   | Roundhouse: L-5" R-6.5"    Axe: L-3" R-2.5"    Hooking: L-4" R-3"     |                                    |
| May 16, 2018                  | Roundhouse: L-6.5" R-8"    Axe: L-4" R-3"    Hooking: L-5" R-3.5"     |                                    |

*of the original kick in inches and the difference between the newer kicks and the initial kick of both left and*

| <b>Date Tested</b>                           | <b>Number of hits landed using roundhouse, axe, and hooking kick<br/>(Sum of three sparring matches)</b> |
|----------------------------------------------|----------------------------------------------------------------------------------------------------------|
| Original # of kicks landed<br>April 16, 2018 | Roundhouse: L-6 R-5    Axe- L-0 R-1    Hooking- L-4 R-4                                                  |
| April 23, 2018                               | Roundhouse: L-6 R-6    Axe- L-0 R-2    Hooking- L-4 R-4                                                  |

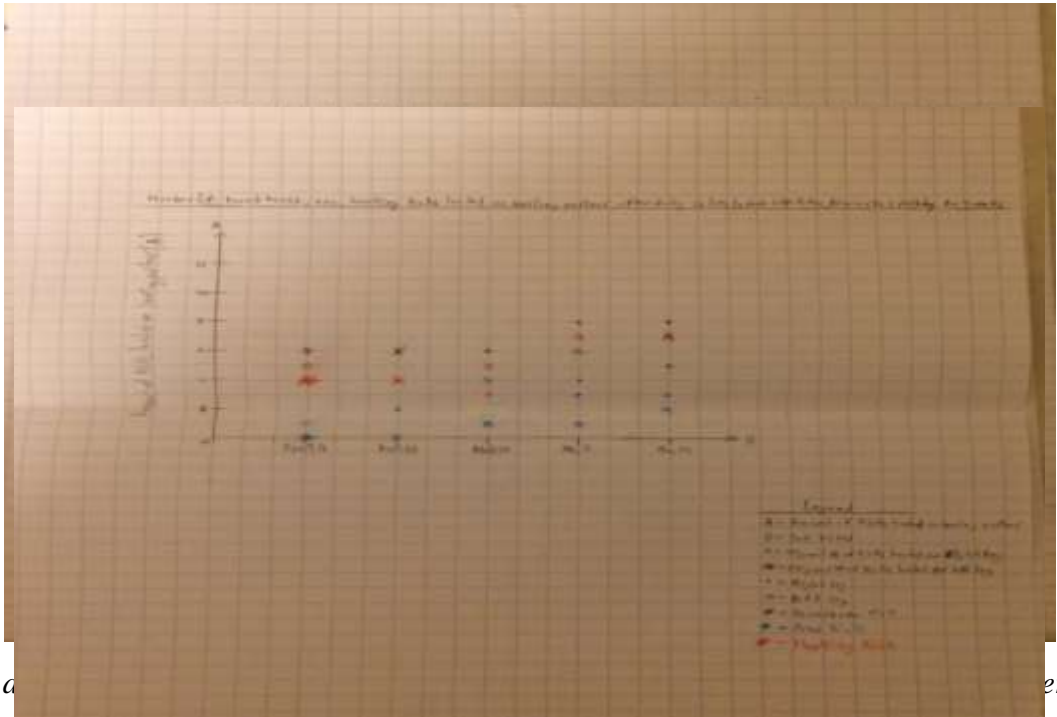
*right legs.*

|                |                     |              |                  |
|----------------|---------------------|--------------|------------------|
| April 30, 2018 | Roundhouse: L-4 R-6 | Axe- L-1 R-1 | Hooking- L-5 R-3 |
| May 7, 2018    | Roundhouse: L-6 R-8 | Axe- L-1 R-3 | Hooking- L-7 R-4 |
| May 14, 2018   | Roundhouse: L-7 R-8 | Axe- L-2 R-3 | Hooking- L-7 R-5 |

Table 2

*Table 2 shows the initial amount of kicks landed on the sparring opponents after three matches including the initial amount without doing stretches.*

Figure 1



*Figure 1 gives a visual representation of the data collected over the period of four weeks. It also shows the initial heights.*

Figure 2



*Figure 2 displays the trend of increase of the amount of kicks landed on the subject's sparring opponent over the period of four weeks*

### **Conclusion**

Yes, the Hypothesis was correct. In the experiment the height of the roundhouse, axe and hooking kick went up and the difference between the kicks after the stretching and the original kicks increased also. The number of kicks landed on a sparring partner increased every week but not at a fixed rate and by the end of the experiment each kick had a total increase of 4 kicks landed in the sparring opponent. The increase of hits fluctuated, and the results were very close to the previous testing weeks. In conclusion a person roundhouse, axe, and hooking kick can get better by doing splits/groin stretches.

Previously, in the Importance of Stretching article, it said that stretching allows martial arts moves to be done with more flow and could gradually increase the range in motion and speed of kicks. This connects to the experiment because

when testing the kicks during sparring the increase in the kicks landed proved that the kicks got faster and the range in motion increased due the splits and groin stretching. The WALLACE on WINNING: Analysis and Advice on the Top 10 Actions Bill

"Superfoot" Wallace Says You Need to Take to Become a Champion article said that doing stretches would give you full control over your legs, ultimately making your sparring ability.

### **Application**

This experiment could be useful for every martial artist who is looking to improve themselves, due to the fact that doing splits/groin stretches will help them not only increase their flexibility but make their kicks better at the same time.

The general public or scientific community could use information from this experiment to test other ways martial arts kicks can be improved and can show how doing stretches in general can reduce the risks of sports related injuries.

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Table 2

|               | Normal Popcorn                                                                                                                                                               | Vacuum Popcorn                                                                                                                                                                                                 |
|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Shape/texture | <ul style="list-style-type: none"> <li>- a little hard</li> <li>- burnt by stove (possibly due to cooking error)</li> <li>- oily</li> <li>- kinda irregular shape</li> </ul> | <ul style="list-style-type: none"> <li>- fluffy and whitish</li> <li>- seems a bit bigger than normal popcorn</li> <li>- kinda squished</li> </ul>                                                             |
| Popping       | <ul style="list-style-type: none"> <li>- popped in short bursts throughout</li> <li>- about 20 kernels were unpopped</li> </ul>                                              | <ul style="list-style-type: none"> <li>- popped slowly at beginning, but then very rapidly near end of 5-minute limit</li> <li>- only 7 kernels were unpopped</li> <li>- the oil bubbled a lot more</li> </ul> |
| Taste         | - tastes normal, but hard                                                                                                                                                    | - tastes weird, almost like vinegar                                                                                                                                                                            |
| Smell         | - Burnt, but still delicious                                                                                                                                                 | - Doesn't smell much like anything, kinda like butter                                                                                                                                                          |





Figure 3 - attempting to freeze water by boiling it

Figure 4 - Comparison between normal popcorn (left) and vacuum popcorn (right)



Figure 5 - Insulated water with cup and towel



Figure 6 - 25 pieces of each type of popcorn counted out and compared

#### IV. Discussion/Conclusion

The original hypothesis for this experiment was that if food was cooked under a vacuum, the result would be larger in size, as there is less pressure pushing on the outside of the food than from the inside. The hypothesis is proven to be correct, as shown by the popcorn in experiment 2. It was evident that the average size (not mass!) of vacuum corn was larger than the normally popped corn when the same amount of each type of corn was placed in a glass and compared. The quality of the vacuum popcorn also appears to be better, as they were softer and whiter. This result is achieved because there are less particles in

the chamber, allowing for a larger “potential difference”, in other words, bigger expansion. The purpose of the experiment was also to determine the difference of vacuum chamber cooking and pressure cooking. Vacuum chamber cooking increases the visual appeal of food (as in size), but not the overall quality of cooking. As shown by experiment 1, the boiling point is lowered, reducing the maximum heat something could get before it turns into gas, which causes it to be not well cooked. However, with pressure cooking, the boiling point is raised which increases the amount

of heat the food retains while cooking, resulting in a better cooked food.

#### Experiment 1 - Freezing water by boiling

At about 2 minutes, the water started boiling violently, but no heat was added. Therefore, the temperature of the water wasn't heated to its boiling point, the vacuum lowered water's boiling point to the temperature of the water. This is shown by the glass of water boiling, but cooling dramatically. However, the vacuum pump used overheated before the water could get a chance to freeze solid. The water, however did get to as low as 3°C.

#### Experiment 2 - Vacuum Popcorn

It was very evident that the vacuum popcorn had a larger average size. This is

most likely due to the lower amount of matter inside the chamber, and the expanding water vapour inside the popcorn have more room to spread out more, and faster, (as they want to achieve equilibrium inside the chamber), which causes the popcorn to have a larger volume.

#### Possible Errors

Possible errors in the experiment are that when air is let back into the chamber, the pressure change may have crushed the vacuum popcorn, causing it to be smaller than what it should have been. Also, the seal most likely had a leak in later experiments, as shown by the water not getting below 10°C, although the pump was left running longer than earlier experiments, as shown by Table 1.

### V. Application

As shown by experiment 2, the size of food increases along with the quality, which could be useful for filling popcorn bags with less kernels, effectively saving money. Otherwise, this method could be used to quickly remove moisture from something or reduce the temperature, as long as there is water present inside the substance. As shown by experiment 1, water boils away

too quickly to gain any heat, so the temperature decreases.

The biggest problem with vacuum cooking is the low amount of heat that can be retained from the food (17), if it required water to cook. For example, if noodles were being cooked with a pan of water and external

heat, the noodles wouldn't cook, as the water cannot retain heat under vacuum, however, if a slice of pizza was placed under vacuum, with external heating, the pizza would cook fine, and will benefit from being cooked under vacuum (as in larger size and higher quality).

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## **External Factors Affecting Concentration**

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### **I. ABSTRACT**

How do surrounding factors affect a person's ability to concentrate on a task and how can efficiency and accuracy be maximized? Subjects complete identical tests in different environments with different amounts of noise and types of music. The results are recorded, averaged and compared. Subjects perform the worst when working in a room with noise and chatter, but the best when tested with classical music playing in the background. When words were prominent within the surroundings, results display that the performances were weaker than without. Subjects' performance was peaked when classical music was playing while tests are simultaneously completed.

### **II. INTRODUCTION**

The average concentration span for a person is approximately 20 minutes (Alex En, n.d). Distractions surrounding a person are the reason for low levels of productivity and efficiency. How are a person's concentration levels affected by their surrounding environment and how can people improve their concentration spans? External factors are changed to test which surrounding is the best and worst for the brain's concentration.

It is hypothesized that if someone is studying in a quiet environment rather than one with noise and chatter, their ability to concentrate is better and they are able to retain more information than the latter. This is because while you study,

your brain is concentrated on one main thing, and the background noise subconsciously increases general stress levels and encourage headaches. Research with noise levels showed that most people studying in quiet environments performed with higher results than those studying with background noise, therefore it is theorized that having noises in the background distracts the brain and causes a drop in performance.

### **III. METHODS**

Prepare four different math tests with the same level of difficulty throughout the four questions and provide environments to test the subject in. The subject is tested in four different



environments: one with classical music in the background, hip hop music in the background, a completely silent room, and one with plenty of noise and chatter surrounding the subject. Seven subjects are needed between the ages 14-16 with a variety of grade levels. The time the subject uses to complete the test will be recorded as well as the score received when done the test. Methods are repeated for all four different environments with the four different math tests for seven different subjects.

The independent variable in this experiment is the noise that surrounds the subject as the test is simultaneously completed. The dependent variable

is the amount of time the subject uses to complete the test. The controlled variable is the person taking the test, the type of noise present in the testing room, and the type of test given to the subject in a particular room. To use the same person throughout the length

of the test guarantees results are not changed by individual aptitude, but by external factors. The type of test given when in a specific environment ensures that no one had an advantage to the different questions on each test, making certain results can be compared accurately.

#### IV. RESULTS

**CLASSICAL ROOM (Table 1):**

| <b>NAME</b> | <b>SCORE<br/>(out of 4)</b> | <b>TIME<br/>(minutes)</b> |
|-------------|-----------------------------|---------------------------|
| Ellen       | 4                           | 3.40                      |
| Jessica     | 1                           | 3.17                      |
| Annie       | 3                           | 2.59                      |
| Sahana      | 4                           | 3.00                      |
| Judy        | 4                           | 4.35                      |
| Nour        | 2                           | 9.47                      |
| Abuk        | 3                           | 5.06                      |

**Table 1:** Scores and recorded time usage for seven subjects completing the test while in an environment when classical music plays in the background

**SILENT ROOM (Table 2):**

| <b>NAME</b> | <b>SCORE<br/>(out of 4)</b> | <b>TIME<br/>(minutes)</b> |
|-------------|-----------------------------|---------------------------|
| Ellen       | 3                           | 5.13                      |
| Jessica     | 2                           | 5.02                      |
| Annie       | 2                           | 5.01                      |
| Sahana      | 2                           | 4.33                      |
| Judy        | 4                           | 6.40                      |
| Nour        | 1                           | 6.24                      |
| Abuk        | 3                           | 6.45                      |

**Table 2:** Scores and recorded time usage for seven subjects completing the test while in an environment when absolute silence.

**HIP HOP ROOM (Table 3):**

| <b>NAME</b> | <b>SCORE<br/>(out of 4)</b> | <b>TIME<br/>(minutes)</b> |
|-------------|-----------------------------|---------------------------|
| Ellen       | 4                           | 4.44                      |
| Jessica     | 1                           | 4.39                      |
| Annie       | 1                           | 4.41                      |

|        |   |       |
|--------|---|-------|
| Sahana | 3 | 3.46  |
| Judy   | 4 | 6.20  |
| Nour   | 0 | 10.39 |
| Abuk   | 2 | 6.16  |

**Table 3:** Scores and recorded time usage for seven subjects completing the test while in an environment when hip hop music plays in the background.

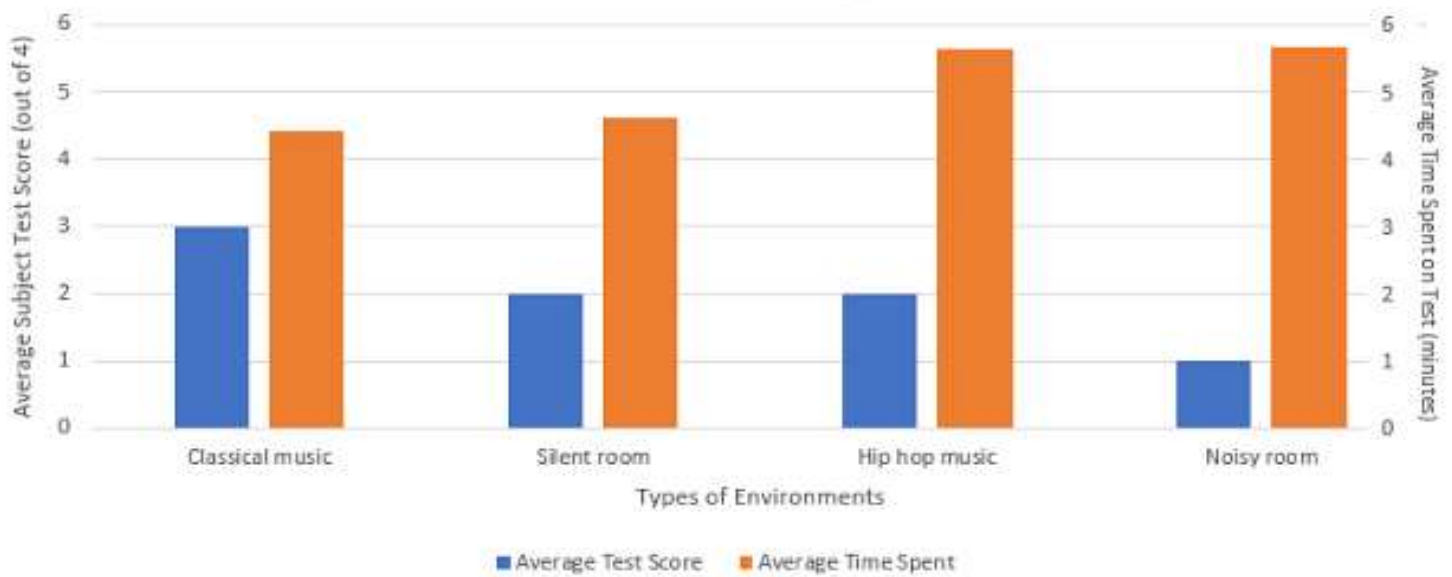
**NOISY ROOM (Table 4):**

| <b>NAME</b> | <b>SCORE<br/>(out of 4)</b> | <b>TIME<br/>(minutes)</b> |
|-------------|-----------------------------|---------------------------|
| Ellen       | 2                           | 5.42                      |
| Jessica     | 1                           | 5.02                      |
| Annie       | 1                           | 4.21                      |
| Sahana      | 1                           | 4.27                      |
| Judy        | 3                           | 7.30                      |
| Nour        | 0                           | 9.23                      |
| Abuk        | 1                           | 4.21                      |

**Table 4:** Scores and recorded time usage of seven subjects completing the test while in an environment with lots of noise and chatter within the room.

(Figure 1)

### External Factors Affecting Focus



**Figure 1:** Average of all the scores and recorded times in every individual type of change in external environment. Placed on a graph together for easy comparison.

## V. DISCUSSION/CONCLUSION

The hypothesis was incorrect. It was hypothesized that the result would be better for someone working in a quiet environment free of noise, but the data collected shows that the highest and most efficient test scores were when subjects were given classical music to listen to while simultaneously doing the test.

The data collected is categorized into two parts. One for the accuracy of the subjects thinking process (the score of their test) and their efficiency (the time it took to complete the test). The results of the collected data display that subjects perform the highest on the test, in both sections, when listening to classical music with an average accuracy of 75%. When the test was completed in the completely silent room, the accuracy and the

efficiency were both lowered compared to the completion with classical music by 33%. While completing the test simultaneously while listening to hip hop music, compared to results from the silent room, subjects performed with the same accuracy of 50% but with less efficiency. When subjects were asked to complete the test in a noisy room, accuracy was lowered to an average of 25% and the efficiency was the lowest compared to the other tests. The initial purpose of this experiment was to see how a person's levels of concentration was affected by their surrounding environment and to see in what ways someone can improve it. The collected data shows that the level of concentration is most negatively affected when in a room complete with noise and chatter. Accuracy was around the same when working in a silent room and listening to hip hop music, but efficiency was higher

in the silent room. The facts show that to have the highest level of concentration, accuracy, and efficiency, the subject should listen to classical music while completing their work.

In a study done in 2015 a group of students were monitored while given classical music and hip-hop music while studying. The results display that hip-hop music has an interference with the brains ability to concentrate on a singular task for extended periods of time. (Mark A. W. Andrews, 2010)

Some problems and sources of error that may have affected the results is the stress of being timed. When the subjects were told they are being timed during the test, stress levels rose, and they rushed to complete the test shifting some of their attention to the time. If subjects had not known about the timing of their test they would have preformed without the stress factor and results could have been more accurate.

## VI. APPLICATION

This information would be valuable to the general public because concentrating on a task is one of the things that people must face everyday. People suffer from lack of concentration on a task and their mind will spend hours, wandering away when a deadline lies looming ahead. With this new information being applied into a normal life productivity levels would increase, and more time could be left for enjoyment purposes. If classical music is played while concentrating, accuracy and efficiency will be maximized.

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# **The Effects of Practice on an Individual Practicing a Specific Skill Set**

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## **Abstract**

The purpose of this study is to find out if practicing a given skill will improve that skill and how long it will take for the skill to show improvement. The skill studied skill to determine the results is shooting accuracy in hockey using different shots. Four targets are placed in the corners of a hockey net, the test subject than shoots fifteen shots from 10ft, 15ft, 25ft, and 35 feet while aiming for the corners. This process is used for wrist shots, slap shots and snap shots. After the shots are taken the average amount of pucks shot into the corners is averaged out to yield the shooting average. Results are recorded over a one-month period and analyzed afterwards. The resulting trend in data after one month is a continual upward trend in all three shots' shooting accuracy. Improvement in shooting accuracy is shown almost immediately and continues upward after almost every practice session. The conclusion of this study is that practice plays a significant role in the development of a skill and improvement can be seen almost immediately and consistently after consistent practice.

## **Introduction**

The purpose of this study is to determine if practice is really a useful method of improvement. Determining this would allow for better use of time and more efficient paths to achieving a skill. If the success point is unknown, it is much harder to know when and how a goal will be achieved. In hockey, professional players practice hours per day but are also naturally gifted. Young players may not be quite as gifted but are just as committed and it is important to know how much progress can be made over a given period to set proper goals. "One

properly-run practice is the equivalent of 11 games when it comes to puck touches," says ADM (American Development Model) Regional Manager Ty Hennes. By finding out if practice is the real key to improvement it is possible to format practice schedules towards a more specific point to increase effectiveness. This then begs the question; how does practice affect the skill that being practiced? If it improves the given skill, how long will it take to show improvement?

The hypothesis for this study then is; If consistent practice shooting a puck is achieved, then improvement will show in shooting ability. Practice involves constant repetitions, “Repetition will make the motions seem natural,”” The key is repetition, repetition, repetition.” (Stephenson, M) If consistent practice schedules are not followed and practice

## **Methods**

The methods for the study are very simple and can be repeated as many times as there is a need for data. It is also important to remember that this process can be used for wrist shots, snap shots, and slap shots. To begin the board that the hockey pucks will be shot from needs to be placed 10ft from the front of the hockey net. After the board is set 15 hockey pucks are to be shot from the board, aiming for the targets set in the corner of the net. After the shots are taken make note of the amount of shots that hit the targets and proceed by moving the board back another 5ft, so it is fifteen feet from the goalmouth. Repeat the shooting sequence once again shooting 15 pucks and tallying the amount shot into the corners. This method is then repeated for shooting pucks from a board 25ft and 35ft from the front of the net. Once the shooting is finished and all the results are tallied, calculate your overall shooting average by adding all the pucks shot into

becomes less and less frequent, improvement will slow and potentially regress. Since the “10 years and 10,000 hours of purposeful practice for an individual in ANY field to achieve expert mastery” (Neeld, K.) will not be reasonable, mastery of the skill can not be achieved but substantial progress can.

the corner targets and dividing them by the total amount of shots taken.

The variables for this study are outlined here and should be followed closely to yield the most accurate results. The independent variables consist of the distance from the net when shooting and the type of shot used. The dependant variable is the shooting accuracy of the test subject. The control variables are the size of the targets, amount of shots taken, net size, stick used, regulation pucks used, shooting board used and the ground conditions at the time the shots were taken (wet/dry etc.). The control of the regulation pucks allows a guarantee that the pucks all weigh the same, therefor not skewing results. The ground conditions are also controlled to ensure that there is always the same amount of friction on the puck when it is shots because water from the ground could get onto the pucks and shooting board.

## **Results**



At the end of the data collection, all three types of shots improve substantially as can be seen in Table 1. Over 9 practice sessions with each shot, the wrist shot improves the most as can be seen in Table 2. The overall trend in the data through each session is upward though there are some abnormalities when the practice session recorded a worse shooting average than the one before it. The wrist shot accuracy showed a 12% increase from the first practice session, the snap shot 16%, and the

slap shot by 18%. The average increase shooting accuracy per session for the wrist shot was 2.63%, for the snap shot 2%, and the slap shot 2.25%. As can be seen in all 4 graphs, the initial increase in shooting percentage after the first two practice sessions was greater than the increase in the last two weeks. This shows that the increase in skill gets harder as the person’s individual skill in that area increases.

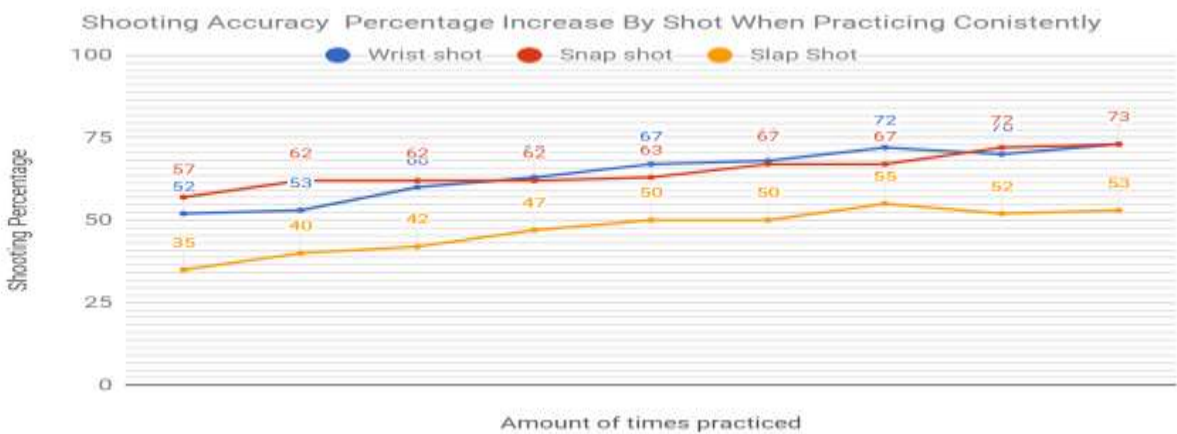


Table 1: This graph shows the overall shooting accuracy percentage improvement for the three types of shooting over a month. Each percentage on the graph demonstrates the overall shooting accuracy for that one practice session.



Table 2: This graph demonstrates the overall shooting accuracy increase for just wrist shots over a month. Each point on the line demonstrates the shooting accuracy for the one practice session.

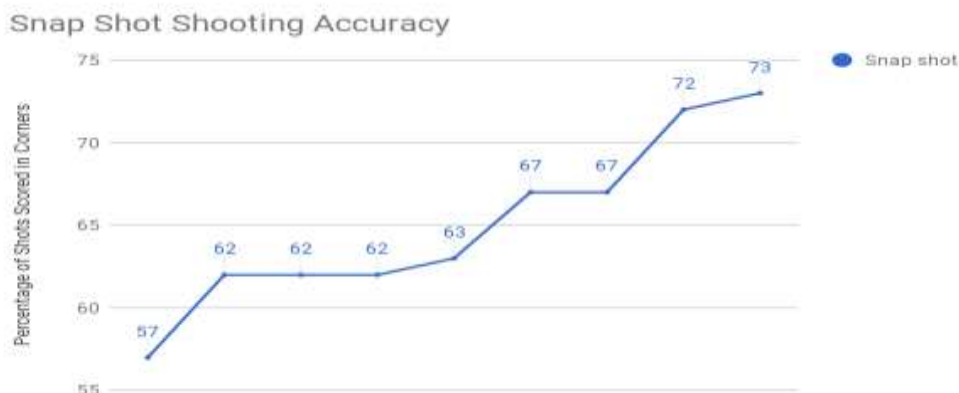


Table 3: This graph demonstrates the overall shooting accuracy increase for just snap shots over a month. Each point on the line demonstrates the shooting accuracy for the one practice session.

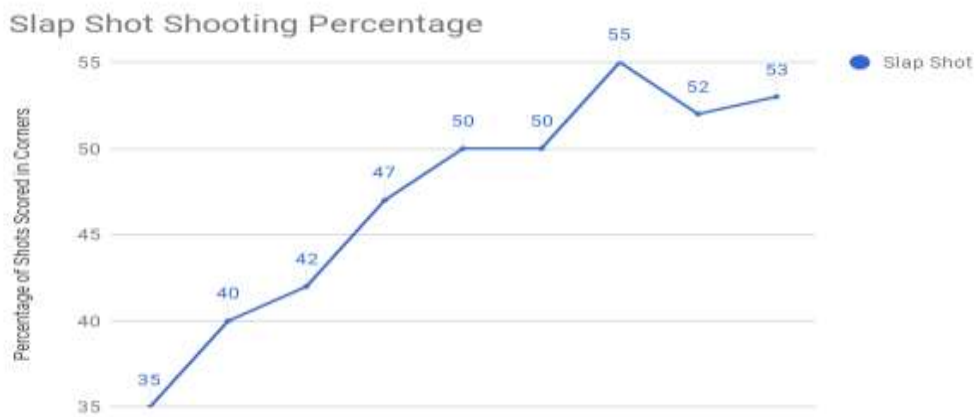


Table 4: This graph demonstrates the overall shooting accuracy increase for just slap shots over a month. Each point on the line demonstrates the shooting accuracy for the one practice session.

## Conclusion

In the end the hypothesis was correct. The hypothesis stated that if consistent shooting practice is achieved, then improvement will show in shooting accuracy throughout all three types of shots. The data collected over the course of this study shows that all three shooting accuracies

improved by greater than 15%. The purpose of this study was to see if practice truly improves the skill being practiced, and how long it would take to see improvement in that skill. This study answered both questions, practicing shooting did cause an improvement in the shooting accuracy of the shot

types practiced. Improvement was also seen within the first two practice sessions for the shots.

The results of this study have proven that practice does lead to improvement, this is mainly due to muscle memory. As practice was achieved, the muscle memory of the technique was developed allowing for a more consistent shot with less shots missing the targets and therefor improving the shooting accuracy. This can be seen in the data as the shooting accuracy of wrist shots, snap shots and slap shots improved and as the muscle memory was built the amount of abnormalities in the data decreased, showing that the improvement in the shot was mainly in consistency. These results resemble the results of many other investigators proving that practice does really work to improve a skill.

### **Application**

This study could be applied to many other fields outside of hockey. In any other sport this data would be equally useful and accurate as there is the capability to develop muscle memory anywhere in the body. Though the muscles affected by the practice may be different in another sport they development of muscle memory would happen there as well, resulting in improvement. These results could also be applied to manual labour such as factory work because the repetition of a task would also build muscle memory and therefor result in less errors and potentially faster completion of the task.

As every study has errors in some form it is important to identify what could be changes to further improve the accuracy of the study. Though these errors may have slightly changed the exact numbers, they do not affect the overall data trend or the results of this study. One of the errors was that the test subject's other hockey schedule was not considered, this meaning that the subject received more practice at hockey arenas that were not counted. This could have allowed them to show greater improvement in shooting accuracy than they would have otherwise. The other error was that the subject was not always equally rested when practicing, this potentially allowed for more abnormalities in the data due to fatigue.

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## **The Effects of Three Distinct Case Designs with Equal Mass when Fitted on Pieces of Glass when Dropped at Certain Heights**

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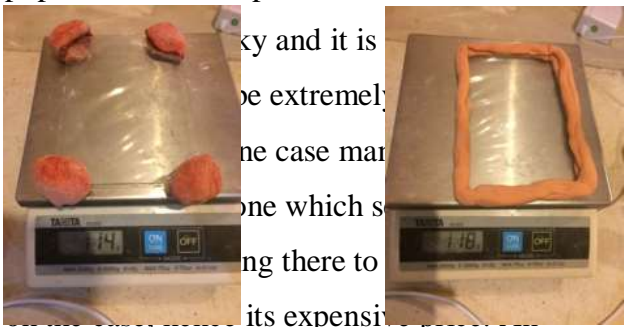
### **Abstract:**

*The purpose of this experiment is to observe the effect on pieces of glass when fitted with three distinct case designs and dropped at certain heights to ultimately determine the most protective design. Drop tests were conducted thoroughly with each case design. The first case design only focused its protective matter on the corners, the second case focused its protective matter on the edges and the third case focused its protective matter on the back and on the edges. It was observed that the case with its protective matter focused on the corners performed the best (a few scuffs at most) when graded on a crack-severity criteria. This is likely due to the fact that rectangular (smartphone shaped) objects rarely fall perfectly flat or on an edge but mainly on a corner and if protective matter is only put on portions where the phone is most likely to meet the ground first, the case will perform the best, as it did in the experiment having at most a few scuffs. The implications of this study are the effects on the mindset when a new case is ought to be purchased for the purpose of protecting a device. If it is known which portions of a phone case are useless (meaning the portions serve no protective functionality), it would be common knowledge to buy the right case for a device and not waste money on a case which uses an excess amount of material.*

## INTRODUCTION

The purpose of this experiment is to observe the effect on pieces of glass when fitted with three distinct case designs and dropped at certain heights to find which case is the most protective.

This problem is important to solve because a lot of money is spent on buying bulky cases for devices even though the cases may not be very protective. According to Amazon's best-selling phone case list, two types of cases are the most popular. The first option is a case which is



example would be the Otterbox Defender Series, bulky all around the edges when it should only be bulky on certain parts. The other option would be

a phone case with absolutely no protective function, aesthetically pleasing (Spigen Ultra Slim) which is number one on Amazon as of January 2017. If the problem were to be solved, money would not be spent on purchasing expensive cases and convenience could be achieved by having a case that isn't very bulky but is also protective.

### Case 3

Question:

Where should the protective matter of a phone case be located in order to ensure maximum protection?

Hypothesis:

If phones rarely fall perfectly flat and usually on a corner, then a phone case which has its protective matter concentrated at the corners would be more protective than any other design because if the matter was concentrated on the place which phones tend to crack at, no material would be wasted on spots which serve no protection and maximum protection may be reached.

## METHODS

Case Designs:

Procedure to Make Silicone Material:

Put on a surgical mask to avoid breathing in acetic acid fumes from the silicone. Then, pour out 150 mL of silicone into a measuring cup.

Measure out 10 mL of food colouring (colour does not matter) and pour it onto the measuring cup containing silicone. Mix the silicone with the food colouring using a mixing stick until all food colouring is evenly distributed within the silicone. Immediately after mixing, measure out 20-30 grams of cornstarch and add it to the silicone-food colouring mixture. Put on latex gloves and mix the cornstarch with the silicone-food colouring mixture using hands, mix the silicone-food colouring mixture and the cornstarch until there is no more visible corn starch. Now, once no cornstarch is visible in the mixture, mold the material onto a piece of glass in one of the case designs. Once the clay like mixture is molded into the desired shape, let it sit for about 5 minutes and when the mixture is rubbery, it is now ready for testing (The King of Random, 2012).

#### Experiment Procedure:

Put on safety glasses as there is a chance of glass breaking. Take the four corners of the first case design and fit the pieces onto a piece of glass. Then drop the piece of glass with the first case design from a height of 50 cm and note damages. Take the four corner pieces off the piece of glass and set the dropped piece of glass aside. Then, fit the four corner pieces onto another piece of glass and drop from a height of 50 cm. After noting damages, remove the four corner pieces off the piece of glass which has just been dropped and drop test one more piece of glass with the corner pieces at a height of 50 cm. Take the second case design and fit it around a piece of glass. Drop the case from a height of 50 cm and after taking note of damages, fit the same case around a different

piece of glass and drop once more at a height of 50 cm. After dropping the second case for a second time, take case two and fit it around another piece of glass and drop it for a third time at a height of 50 cm. Finally, take case three and fit it around a piece of glass and drop at a height of 50 cm and note damages. Take another piece of glass and fit case three around the new piece of glass and drop at a height of 50 cm. After noting damages, take the ninth piece of glass and fit the third case around it, drop it once more from a height of 50 cm and note damages.

Finally, repeat previous paragraph but dropping at a height of 100 cm for every drop test for a total of 18 drops.

**Independent:** In this experiment, the independent variable is the case around the glass. The purpose of the experiment will be to see how the different shapes of a case can affect the protection of the glass piece, so the case design will be changed.

**Dependent:** The variable being measured in this experiment is the condition of the glass after the drop. How many cracks/deepness of cracks.

**Controlled:** The controlled variables in this experiment are the glass manufacturer, height for every sequence of tests, surface being dropped on, and the material which the case is made of. The material in each case used is the same mass.

The piece of glass was controlled because some glass manufacturers may have thicker or denser glass than another manufacturer causing one type of glass to be stronger than the next. The pieces of glass used in the experiment were from Dollarama photo frames (all frames purchased

were the exact same). The height of every drop was controlled because the higher an object is dropped from, the faster its speed will be the moment before it drops, meaning the piece of glass will have a harder impact when falling on the ground and be more damaged than a case

which was dropped at a shorter height. The material was regulated due to the fact that some materials absorb shock better than others, the type of material could not change as it could skew results.

## RESULTS

**Figure 1** is a criteria which is used to quantify the severity of damages of pieces of glass when dropped. Refer to criteria for numbers in Table 1 and Table 2

| 1                                     | 2                                        | 3               | 4                 | 5              |
|---------------------------------------|------------------------------------------|-----------------|-------------------|----------------|
| Completely Shattered into Many Pieces | Many Cracks, Shattered into a Few Pieces | Multiple Cracks | Parts are Scuffed | No Damage Done |

**Figure 1:** This criteria above is referred to as the “crack severity criteria”.

| Severity of Drops at 50 cm | Case 1 | Case 2 | Case 3 |
|----------------------------|--------|--------|--------|
| Severity of Drop 1         | 5      | 4      | 3      |
| Severity of Drop 2         | 5      | 4      | 3      |
| Severity of Drop 3         | 5      | 4      | 2      |

**Table 1:** The table above refers to the severity of drops at the height of 50 cm.

| Severity of Drops at 100 cm | Case 1 | Case 2 | Case 3 |
|-----------------------------|--------|--------|--------|
| Severity of Drop 1          | 4      | 4      | 2      |
| Severity of Drop 2          | 5      | 3      | 1      |
| Severity of Drop 3          | 5      | 3      | 1      |

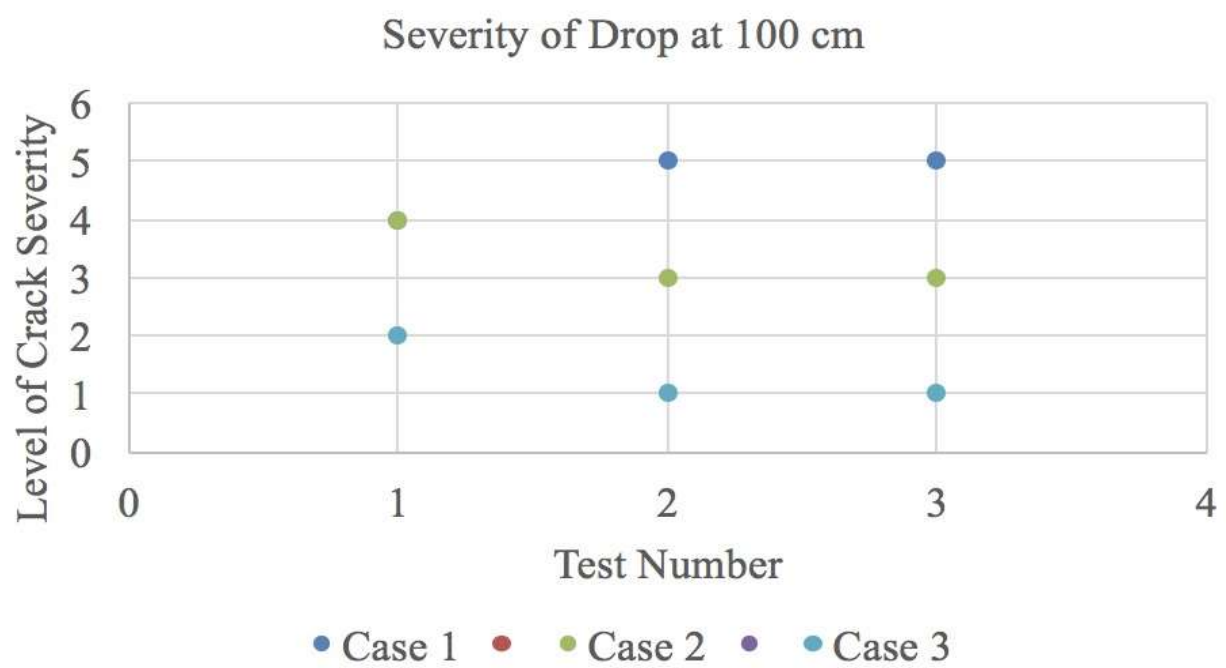
**Table 2:** The table refers to the severity of drops at the height of 100 cm.

### Severity of Drops at 50 cm





**Figure 2:** Graphical form of **Table 1**



**Figure 3:** Graphical form of **Table 2**

## NUMBER OF TOTAL CRACKS

**CASE 1**

0

**CASE 2**

7

**CASE 3**

>15

## DISCUSSION/CONCLUSION

The hypothesis is correct. The case which has its protective matter concentrated on the corners performed the best. In all tests, the first case design had no cracks but occasional scuffs. The initial problem was that when buying a phone case for the purpose of protection, cases would be bought which focus the protective matter on portions which served no functional purpose (determined to be anywhere but the corners). If case manufacturers focused all of their material on the corners of phones, lots of money could be saved. Most case manufacturers that promise the best protection bulk up the edges of their phone cases which can add unnecessary weight.

The results of the experiment proved that the design of the first case was the most effective meaning that a device case manufacturer should focus the protective matter of the created cases only on corners. To minimize the margin of error, the same amount of material was used for all three case designs (114g – 118g) and it was observed that the third case was extremely obsolete and broke at every drop. This was because the protective matter was spread across a wide surface which left all parts of the phone prone to breaking as no spot was specifically strong. Although it did

not perform the best, the second case was the most visually appealing and would be the perfect sacrifice, nice looking and moderately protective. The measures taken to ensure minimal error were that the material is the same on every case, the amount of materials which ultimately make up the final material were the same, the surface on which the pieces of glass landed on, and the technique of drop were all regulated as well. The slight difference in each case was that each case design used a different type of food colouring (case one used red food colouring, case two used orange food colouring, and case three used a light orange food colouring) due to the limited supply of food colouring.

## APPLICATION

Now that it is determined that the best location to put protective matter is on the corners of a device, it must be pondered which case manufacturer is putting an excess amount of material on a product (Otterbox) or which case manufacturer is being efficient with materials by not putting protective matter on edges and back (Utomic). In the following images, Otterbox (Figure 4) focuses much the protective matter for its case on the edges, similar to case two (which was proven to be not as effective as focusing mass on corners), furthermore, Griffin (Figure 5) focuses substantially on the corners as well as a

little bit on the edges (protective matter on edges proven to not serve any protective functionality) and finally, Utopic, which produces cases that only focus on corners (Figure 6). To a degree, both Griffin and Otterbox put protective matter on portions which are proven to be considered useless. This could be done for the sole purpose of having an excuse to charge a higher cost for a product (excuse being that there is more material).

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Figure 4:

[https://www.amazon.com/OtterBox-DEFENDER-Case-iPhone-ONLY/dp/B00Z7SDEGW/ref=sr\\_1\\_19?ie=UTF8&qid=1516333121&sr=8-19&keywords=otterbox+defender](https://www.amazon.com/OtterBox-DEFENDER-Case-iPhone-ONLY/dp/B00Z7SDEGW/ref=sr_1_19?ie=UTF8&qid=1516333121&sr=8-19&keywords=otterbox+defender)

Figure 5:

<https://www.walmart.com/ip/Griffin-Technology-Survivor-Case-For-Apple-Iphone-5-And-5s-Black-blue/41483254>



Figure 4

Figure 5

Figure 6

Figure 6:

<https://www.utomac.com/collections/edge-plus/products/utomac-edge-plus-for-iphone-6-plus-6s-plus?variant=42060832718>





# **The Reason For Poor NBA Team Performances**

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## **Abstract**

NBA Teams are very interesting. Some of them are amazing and some of them are bad. Fans of the NBA hate it when their team loses despite knowing that the team is bad. Why are these professional teams doing poorly and how can they be fixed?. A simple simulation using NBA2K could give these teams a clue on why their team is doing poorly. Setting the season standards at 82 games and turning injuries off is the best possible method of testing this experiment. The results that were acquired through this experiment provided some interesting details. Teams with a higher offensive rating had won on average 10 more games than teams with a higher defensive rating. Even if the teams higher offensive emphasis had a sub-par defense, they were still very successful. According to these findings, teams would prefer to look at the offensive stats or rating of a player when scouting rather than the Defensive rating and an offense that is more

## **Introduction:**

This is a major problem within the NBA. Currently only five NBA teams have a legitimate chance at winning the championship. These five teams have at least 1 superstar player, therefore making the rest of the NBA and their fans watching their team lose multiple games. As fans want to find a method that helps smaller and weaker teams succeed without spending too much money or praying for the draft lottery. According to basketball reference, all of the superstars from the best team make the most money and therefore deprive other teams of their star power. An example are the Golden state warriors who finished with a record 67-15 while having 3 all stars in Stephen Curry, Kevin Durant and Klay Thompson last year while the Brooklyn Nets suffered a painful 20-62 record with their best player being Jeremy Lin.

The Cleveland Cavaliers are also one of the best teams in the NBA with a 51-31 record and losing just one game on their journey to the finals. Even though in the regular season they were ranked as 25<sup>th</sup> overall in defense and at one point during the season they were dead last in defensive rating, but they were able to make up for it with their amazing offense. On the other hand, the Los Angeles Lakers had the 10<sup>th</sup> best defensive rating in the 2016-2017 season while having the worst offensive rating in the entire league. How can bad NBA teams be more successful without superstar players?

if supposedly bad NBA teams who have a low offensive rating and a high defensive rating struggle to win games, then they could adjust their offensive playing style emphasizing offense and getting better offensive players, because it is statistically proven that offense wins games

A very good example are the Toronto Raptors, who in the past four years have struggled in the playoffs, mostly because of their offensive playing style. In the 2017-2018 the raptors have had their best record in history at the midway point of the season, because they changed their offensive playing style to emphasize passing and shooting. This is all despite not having Legendary Superstars.

## **Methods:**



Select an NBA Team that has not made the playoffs and has struggled (Below .500) for at least 2 years (Ex: Phoenix Suns) And/or Create an NBA Roster with a maximum of 1 NBA All-Star (Excluding LeBron James, Kevin Durant or Stephen Curry) and the rest must be from an NBA team that has been struggling. Set Season Standards. 82 game seasons, best of 7 playoffs and 3 playoff rounds.

Set up Independent, Dependent and Controlled variables (Listed below) Run at least 100 simulations per session for accurate results. (1 session = Approx. 1 week). Record Findings in separate Journal. Independent variable will be the Roster of simulated NBA teams, the Dependent variable will be the record or playoff success of each team and the Controlled: variable will be the Roster of unused NBA Teams and season standards

## Results:

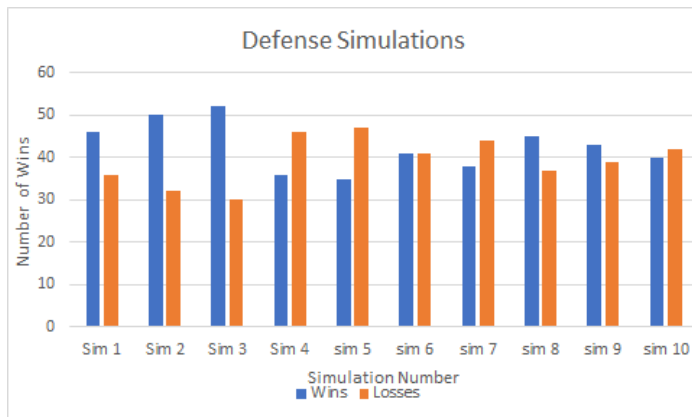


Figure 1 : The number of wins with teams with an offensive emphasis. 10 simulations. Blue represents the number of victories and Orange represents the number of losses. On average the Defensive teams won 42.6 games per season

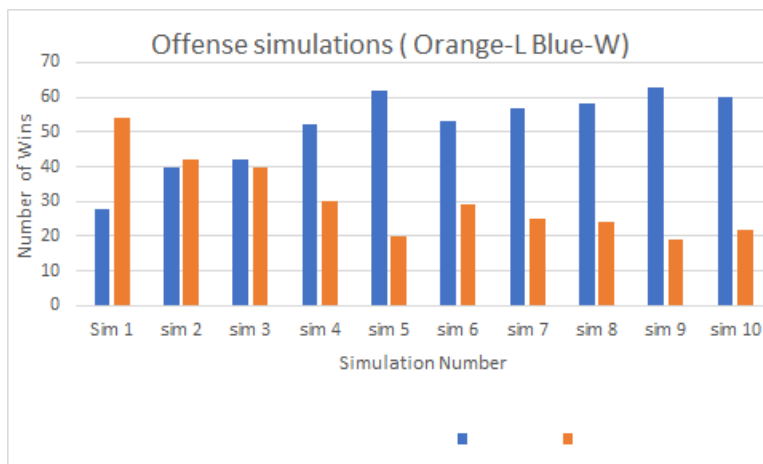


Figure 2: Teams with Higher Offensive emphasis. 10 simulations. Averaged about 52.5 wins pers season with the highest being 63 wins.



## **Discussion/Conclusion:**

After approximately three weeks of these experiments of NBA Teams. The results suggest that Offensive Emphasis has a much bigger chance of future success. Most of the teams that were on the Offensive Emphasis consisted of players that are better shooters and offensive rebounders. This seems to be key as Offensive rebounds provide more opportunities for scoring. Another reason is the possibility of Offenses playing at a much faster pace. Even in the current NBA Season, there is a clear correlation between the pace(Possessions per game) and Wins Per game. The Rebounding teams often failed to even make the playoffs. A reason this may be is because rebounding teams require much more 'Big Men' (6'9 or Taller) for Rebounding shots. Due to the large amount of 'Big Men', they were playing much slower than most of the 'smaller' teams and were outscored.

This experiment did not completely satisfy the hypothesis that was suggested at the beginning of SCICAN!. The hypothesis was that teams that could gather more well rounded players would succeed. This did not work as there are not many well-rounded players in the NBA and is the reason the offensive teams did so well. The offensive teams still had some defensive ability and rebounding ability, but the defensive players had much weaker offensive game which lead to them losing often. The data shows that the teams with well-rounded players did mediocre as they averaged only a 60% win percentage. This may be because, although the players may be well-rounded offensively and defensively they did not have as much skill. In conclusion, superstar players are not necessary for a successful team, but can be the difference between contenders and champions.

## **Application:**

The information found in this journal will be very helpful with basketball coaches. This information does not need to be NBA specific as it can be used for other teams such as high school or college basketball teams. Implementing this type of research in highschool or college will also help players have a better understanding for the game. NBA fans themselves can't do much other than spread the information out to coaches or managers of teams if possible.



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Scott Berry Kaufman, (August 5<sup>th</sup> 2014) , <https://blogs.scientificamerican.com/beautiful-minds/what-predicts-nba-success/>, Retrived on October 18<sup>th</sup> 2017

## Correlation Between Book Genres and IQ-Measured Intelligence

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## **Abstract**

The question this experiment is based around looks to investigate whether the book genre read by a person influences that person's intelligence. This is being tested because reading has been proven to affect a person's intellect, but no studies have been done to determine if the genre has a part in it. An IQ test is used to establish the intelligence of the subjects, along with a survey of preference of book genre. The results are that the more complex the genre, the higher the IQ of the subject. Various elements of a book are the reason for variations of intelligence. This information can be used by readers to figure out what books are best for intellectual stimulation.

## **Introduction**

The purpose of this project is to find out how book genres correlate with intelligence. Reading is proven to have many benefits on the brain such as memory development and being able to focus easily (Reader's Digest). However, books are split up into genres and some studies have found that reading certain genres can improve the reader's empathy and emotional intelligence or EQ (Scientific American and APA PsycNet). This is important because since a person's EQ can be affected, it's possible a person's IQ can be as well, a valuable tool when assessing someone's intelligence.

The question is "How does preference of book genre correspond with intelligence?". The hypothesis is that if people read books that necessitate the use of imagination to visualize the story, then those people will have a higher intelligence, because the more a person visualizes and thinks about what is happening, the more that person's brain will be stimulated (Reader's Digest).

## **Methods**

IQ is being used as a measure of intelligence because it accounts for some important parts of brain utilization and allows for quantitative comparison of results. Have the test subject take an IQ test with a time limit of twenty minutes. This IQ test should be of fifteen questions. Within the test, there must be questions that test spatial intelligence, short-term memory, processing speed, logical reasoning and mathematical ability. Record the score of each test. Ask what the subject's favourite genre is. Repeat these steps for each subject tested. All subjects must be of the same age and grade.

The independent variable is the test subject, which is changed to observe the results. The dependant variable is the IQ score. This is dependant on the test subject's preference of genre. The controlled variables are the IQ tests, the quiet working conditions, and the time given for the tests. The tests and time must be identical so it is a fair assessment for each subject. The working conditions must stay quiet so subjects can attain the same level of concentration.

## Results

**Table 1**

### IQ Score and Genre

Table 1: IQ score and Genre separates all the data by test subject, genre and score.

| Test subject | Genre            | IQ score |
|--------------|------------------|----------|
| 1            | Comedy           | 82       |
| 2            | Adventure        | 98       |
| 3            | Mystery          | 100      |
| 4            | Sci-Fi           | 105      |
| 5            | Fantasy          | 111      |
| 6            | Literary Fiction | 118      |



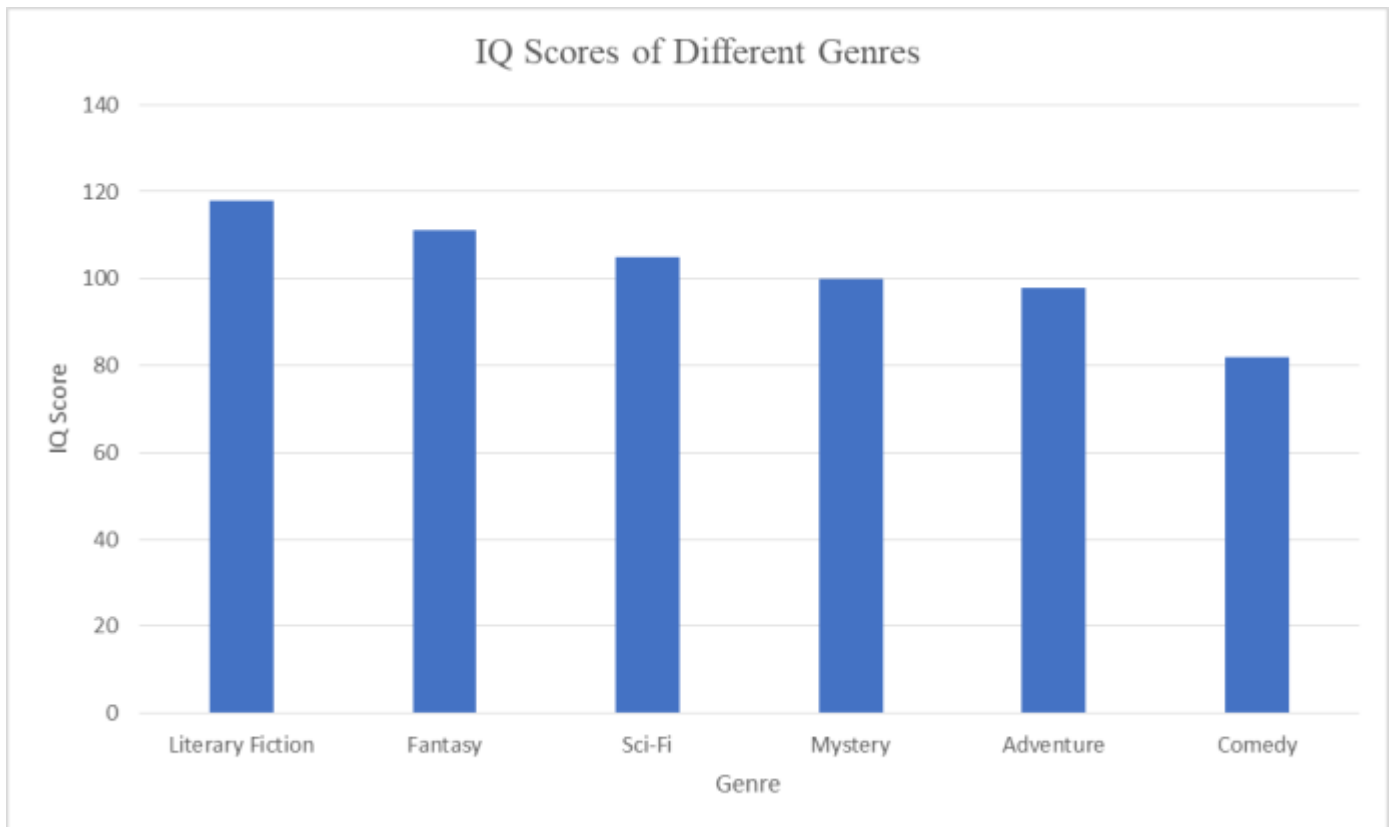


Figure 1: IQ Scores of Different Genres compares the IQ scores of the book genres from highest to lowest

## Discussion

The hypothesis is wrong since it predicts that genres that force a person to extensively use imagination would be the highest. Although Fantasy (111) and Sci-Fi (105) were the runners-up, both were bested by Literary Fiction (118). To answer the question, the data suggests that the more complex the genre, the more likely the reader will have higher IQ. For example, the highest IQ is from Literary fiction (118), which is very sophisticated because it analyzes the character's personality and motivations. On the other hand, the data proposes that Adventure has a lower score of 98 because it's often focused only action, and lacks the critical thinking (Literary Fiction, Mystery) or imagination (Fantasy, Sci-Fi) that other genres demand.

The genres become more intricate as the IQ scores go up, which could suggest a correlation. This relates to the original question that asked whether there was any correlation. Although the hypothesis was incorrect, the data does allude to some accuracy since the second-highest score was that of Fantasy, which does require visualization. No other investigations have experimented with this question but research consistently shows that reading develops the brain (Reader's Digest).

An issue with this investigation is that the sample size was very small. If the sample size is larger, the results would be much more reliable and would give a much better representation of the readers of each book genre

### **Application**

Fields of study that deal with the brain, such as Neurology could benefit from this study. Information about which book genres stimulate the brain more could help with delaying cognitive decay and start more research on how to stimulate the brain. The public also could apply this information because the advancement of the brain is something of interest. The big picture here is that the brain is the most important part of the body, and these results provide an opportunity to improve its functions.

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## **Effect of Different Amounts of Social Media Usage on High School Aged Teenagers**

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### **Abstract**

This study aims to study how different amounts of social media usage affects metrics such as grades on high school aged teenagers, which is extremely important in the 21<sup>st</sup> century, as more and more time is being consumed on it. This is doubly true for high school aged teenagers, as they spend some of the highest amounts of time on social media. This study has been conducted by sending a survey to Vincent Massey Secondary School through the e-learning platform

‘Edsby’. A Python program was written to analyze the data. This study has found that teenagers who were the happiest were those who went on social media the medium amount, and the teenagers with the best grades were the ones who went on social media the least amount. This data confirms the fact that social media is not necessarily unhealthy if used in a moderate amount but could be dangerous if used too much. This is possibly because social media starts to interfere with school work and other tasks as it is addictive.

## I. Introduction

Teens are spending more and more time every day on social media, and 24% of teens self-identify as going online "almost constantly", and it is still not well known what the effects of that is. There has been a study (Wolpert 2016) done on social media by UCLA that shows teens are more likely to "like" a post if it has received many likes. This kind of behavior, along with the fact that face-to-face interactions are decreasing could have potentially drastic effects on teen behavior and social interactions (Ehmke N.d.). Fully understanding the effects of social media is necessary for understanding how teens behave, when they consume large amounts of social media. This study aims to survey the effects of social media on happiness and grades. If teenagers consume less social media, then they will be more likely to be happier and have better grades. If teenagers use more social media, they will have worse grades and less happy lives. This is because social media is addictive

and presents an unrealistic window in to others' lives, and time spent on social media takes away from time studying, which will result in lower grades.

## II. Method

First, a short survey that takes under 30 seconds to complete will be created to prevent potential survey takers from leaving due to a long survey length. Questions that are asked include: Gender, Age, How often do you go on social media?, Which social media sites/apps do you primarily use?, How satisfied are you with your life, How well are you doing in school? (Grades). Then, questions that measure happiness, and mark averages in school will be collected. Non-identifying personal information such as age and gender will also be collected. The survey will be sent through Edsby School Talk to reach as many people as possible. A Python program will then be created to analyze data and return the average scores of each of Average Marks, Life Satisfaction for each of the social media usage amount categories. Finally, a graph will be created for each Average Marks, Life Satisfaction. Average

scores will be analyzed and conclusion of effect of social media will be drawn. The independent variable is the number of hours of social media per day, this is because the purpose of this study is to measure and study the effects of different amounts of social media usage. The dependent variable is the rating of happiness and grades, this is because these variables are what the study will use to compare the effects of different amounts of social media usage.

Finally, the fixed variables would be the place where the survey is taken, because if the survey was taken in different places, it can affect the data. For example, if the survey was given both offline and on Facebook, those who are on Facebook potentially spend more time on social media than those who took the survey offline. Age and gender will also be controlled for if a noticeable difference is found.

### III. Results

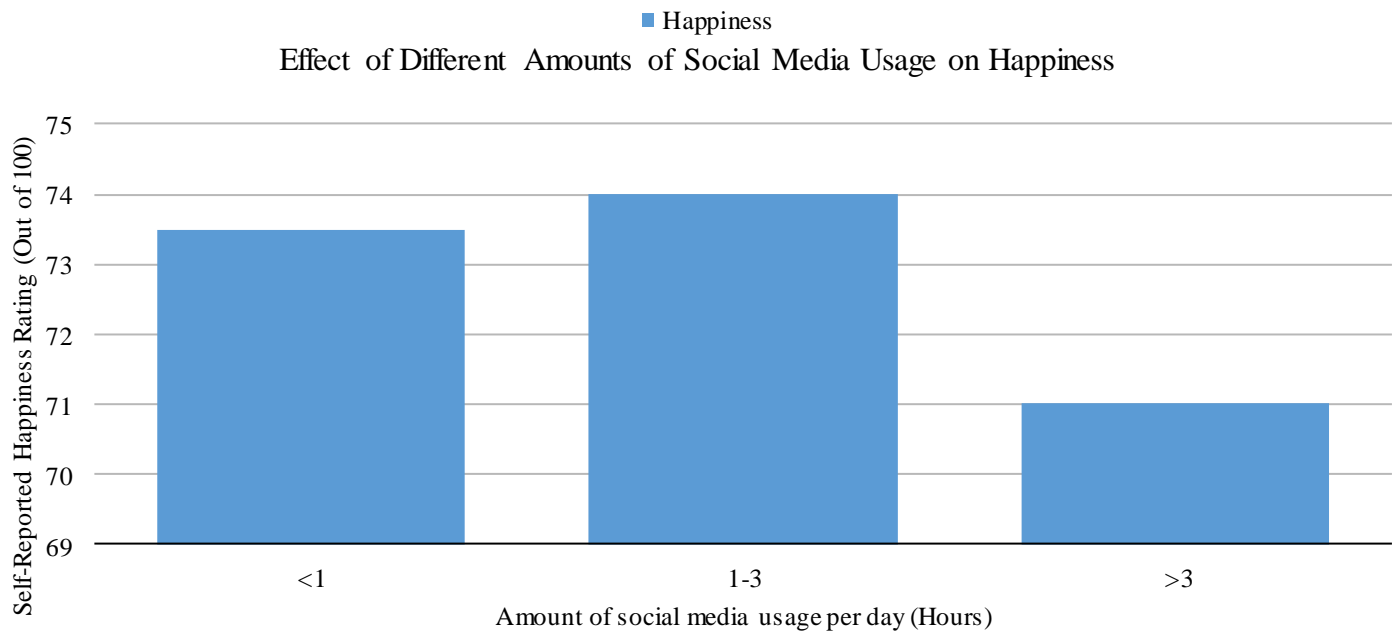


Figure 1: A bar chart showing the effects of different amounts of social media on self-reported happiness.

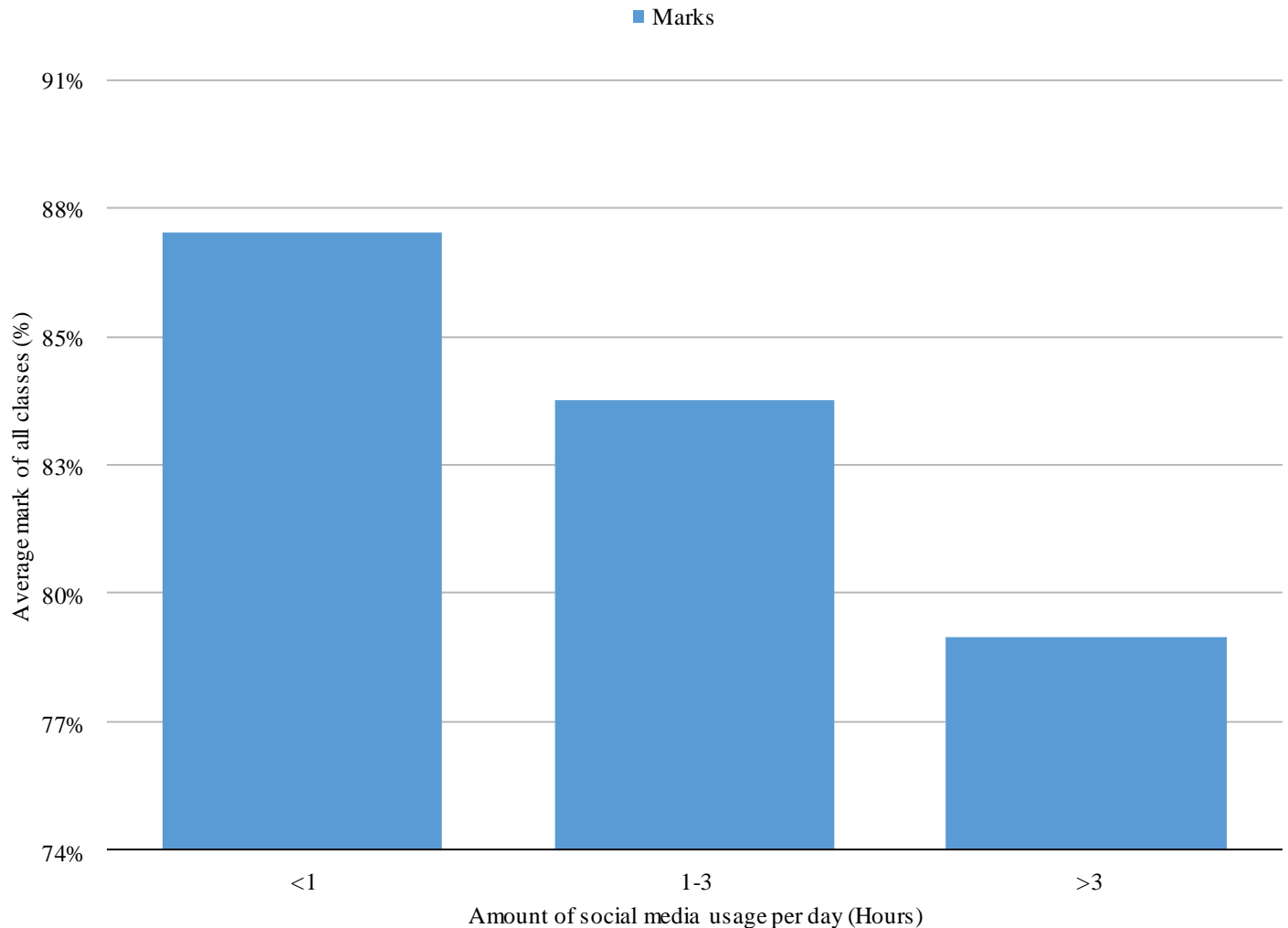


Figure 2: A bar chart showing the effects of different amounts of social media usage on the average of all class marks.

The results of this study shows that teenagers who go on social media for less than one hour per day had the best marks, those who went on social media for between one to three hours per day had the second highest marks, those who went on social media had the lowest marks. (Figure 1). The teenagers who went on social media for less than one hour had the second highest happiness rating, and the teenagers who went on social media for between one to three hours had the highest happiness rating, and those

who went on social media for more than three hours had the lowest happiness rating (Figure 2).

#### IV. Discussion/Conclusion

The hypothesis was partially correct as it was said that those with less social media usage would have the most life satisfaction. This was proven to be false (Figure 2), as those with medium social media usage had the highest life satisfaction. An explanation for this is that those with little social media usage don't socialize enough, which is important for life

satisfaction. Heavy social media usage was predicted to result in the lowest life satisfaction, and this was proven to be correct by the data. This can be explained by the fact that over usage of social media causes a person to feel bad about themselves due to comparing themselves with others. The prediction of marks based on social media usage was proven to be correct. This is logical as those who do not engage in extensive social media usage will have more time to study and/or with less distractions. The initial purpose was to determine the effects of extensive social media usage on teens. That has now been answered by comparing the average scores for 'Life Satisfaction' and 'Marks', the survey has indicated that extensive social media usage leads to low life satisfaction and poor grades, while a light to none social media usage leads to the best grades, but not as good life satisfaction compared to medium social media usage. A tradeoff will have to be decided between life satisfaction and marks, which is a personal decision and beyond the scope of this project. It can be seen from the data that those with light to none (<1 hour per day) social media usage had the highest marks out of the categories of '<1 hour per day', '1-3 hours per day', '>3 hours per day'. Medium (1-3 hours per day) social usage followed very closely with only a difference of 0.36/100. Heavy (>3 hours per day) social media usage had a comparatively heavy drop-off of 1.58/100. In terms of life satisfaction, medium social media usage had the highest reported life satisfaction score of 73.92/100, which was then closely followed by light to none social media usage with a score of

73.50/100. Again, heavy social media usage had a large drop-off down to 71.64/100. This study did not account for the fact that it was submitted through Edsby, a type of social media, which could have affected the balance of results. This is because frequent users of Edsby logically have a greater chance of caring more about their marks, while simultaneously spending more time on social media, thus affecting the results.

## V. Application

The results of this study can be applied to fields of studies such as adolescent psychology. Knowing how teenager's grades and happiness react to different amounts of social media usage allows for deeper studies to target and research why those effects such as medium amounts of social media usage causes the highest happiness rating occurs. Not only is this research significant to other researchers, it is also of interest to the general community. Many parents of teenagers are concerned about their child's social media usage, as this research presents a new train of thought that contrary to popular belief, some social media usage might be beneficial to happiness. The importance of social media to society at the present is undeniable, more and more of the world is now occurring in the digital sphere. Understanding the physical and mental effects of social media on teenagers is crucial, especially as more and more time is being spent on it, with 92% of teens reporting going on social media daily (Lenhart 2015), and as access to internet further increases around the world.





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### **Exploring the Uses and Ways of Potential and Kinetic Energy by Making a Fish Feeder**

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## ABSTRACT

Potential and kinetic energy are forms of energy that are more common and useful than most think, and can be used to create things like a fish feeder. Making the fish feeder was a complex process using various material skills such as: pipes, wood, elastics, an air dart, a plastic spoon, a marble, and tools. The materials are then put together in a way that the user starts the feeder making the air dart hit the marble in the spoon, which falls down the pipe and hits the box holding the fish food, dropping it into the fish bowl. Creating this fish feeder shows the ways and how energy can be used for numerous things in the world today.

## INTRODUCTION

This project works with potential and kinetic energy and establishes its different ways and uses. This way of physics can cause one to notice the multiple ways it can be included into the life of any

person by becoming a solution towards problems and reassuring the lives of future generations. Physics is also called “the fundamental science” because of its way of helping create theories and successful experiments related to the numerous other topics similar to potential and kinetic energy,

many of which are beneficial to people and will causes small but extremely effective changes to one's life. The purpose of this experiment is to learn how to use potential and kinetic energy to creatively make a fish feeder that is started by the user and goes through various steps before eventually dropping the fish food into the bowl, showing the possibilities and goals that can be achieved by using potential and kinetic energy. If height effects the amount of kinetic energy that is released (from potential energy

gained), then a certain height should allow the ball to fall and to gain and release enough energy to drop a decent amount of food into the bowl. This is because the height increases the amount of potential and kinetic energy with respect to the center of gravity which is where the total weight of the body may be thought to be concentrated. A "dropped" object converts its potential energy obtained from its height into kinetic energy as it accelerates. Therefore, the greater the height, the more kinetic energy will be released. (Sarah Friedl 2003-2018)

## METHODS

Creating this fish feeder starts by cutting long pieces of wood, that are in the shape of rectangular prisms. Cut two 26cm long ones, one 36.5cm long one, one 17.5cm long one, two 93cm long ones, and one 84cm long one and put a hook on each of the pieces with lengths 26 and 93cm approximately 2 cm from top. First glue the two

26cm ones against the edge of a wooden base and the 93cm ones 28.5cm from the same end with both pairs 4 cm apart on either side of the center line of the base. Then glue the 17.5 cm one 21cm from the same end and 0.5cm from the center line, the 84cm one 45cm away from the end and 2cm away from the center line, and the 36.5cm one 8.5cm from the same end and also 2cm away from the center line. It is best to put all the pieces that are individual and do not have another piece the same length as them on the same side of the center line. Take the small wooden slabs/pieces and use pivot arrangements (one on each side) to connect one to each of the pairs of wood that are 26cm long and 93 cm long. Then use elastics to connect the fish food box to the platform on the 26cm piece and the spoon to the platform on the 93cm piece by putting it around the slab and spoon or box, along with using another elastic to put around the slab and bring around the hook. Bring the pipe to the top of the 84cm tall wooden stick and curve it a bit towards the spoon. Lead the pipe towards the fish food box and use clamps and duct tape (put along 17.5cm and 84cm long wood pieces) to secure it and keep it in its proper position. One place a clamp is needed is right underneath the slab with the fish food (on the 36.5cm tall piece) where the pipe will end. Some other possible places for the clamps and tape are close to the top of the 17.5cm tall piece of wood and along the 84cm long piece. Connect the funnel to the top of the pipe where the marble falls. It is important to make sure that both ends of the funnel

are big enough for the marble to fall through. Stick the stand of your dart to the 17.5cm long wood piece and make sure to angle it towards the small wooden slab that holds the spoon. Put the marble in the spoon, push down on the pump of the air dart and watch the feeder do its job.

The independent variables in the experiment are: the structures and objects leading to the food being put in to the bowl – the objects do not change their state or use in any way. They constantly remain the same and are used that way as well. The dependant variables are: how one obstacle triggers the next or another, and how each of the obstacles works and uses the potential and kinetic energy based off of the obstacle that was before them. The controlled variables are the fish food, materials, and what obstacles are part of the overall experiment.



Where each of the wooden pieces are in the diagram:

Dart stand – 36.5cm

Pipe support – 17.5cm

Pipe start and beginning support – 84cm

Marble stand – 93cm

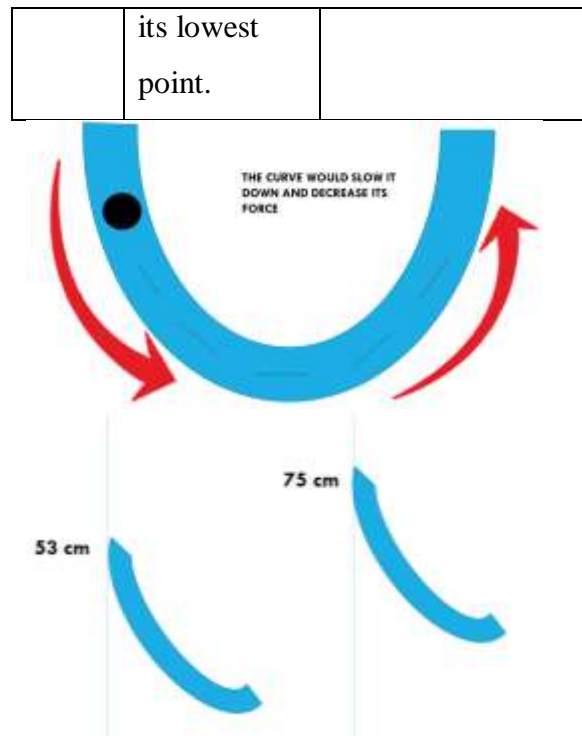
Fish food box stand – 26cm

### RESULTS

Table 1: Observations of the Pipe that the Marble Falls Down

| Trial # | Description                                                                                                                                                                    | Outcome/Results                                                                                                                                                                                                                                                                                                           |
|---------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Trial 1 | Pipe starts at a height of 53cm and has more of a shallow curve. Pipe goes all the way down and against the bottom wooden platform before curving back up towards the feed box | <ul style="list-style-type: none"> <li>- Hits feed box with very little force</li> <li>- makes very little amount of food fall out.</li> <li>- Sometimes barely touches the feed box</li> <li>- Elastic around the feed box does not cause to much of a tightness</li> <li>- Pipe is sturdy and stays in place</li> </ul> |
| Trial 2 | Increased height at which the ball starts falling to 75cm. Pipe still goes down all the way and is against the wooden platform                                                 | <ul style="list-style-type: none"> <li>- Hits feed box and makes more food fall out than in Trial 1.</li> <li>- Box moves as if it was hit with more force – ball hits it harder.</li> <li>- Elastic around the feed box does not cause to much of a tightness</li> </ul>                                                 |

|         |                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                              |
|---------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|         | before curving.<br>Curve sharpens very slightly because of the pipe being pulled up.                                                                                                                                                                                   | - Pipe is sturdy and stays in place                                                                                                                                                                                                                          |
| Trial 3 | Kept height where ball started at 75cm.<br>Created a sharper curve for the ball by not making the pipe go all the way down to the wooden platform and raising it up by holding so the ball has to travel less of a distance up after it falls from the top and reaches | - Hits feed with a good amount of energy<br>- drops a good amount of food in the bowl (more than in Trial 2).<br>- More force hits the box and<br>- Elastic around the feed box does not cause to much of a tightness<br>- Pipe is sturdy and stays in place |



Observations of other parts of the experiment that didn't really include as much potential or kinetic energy:

Table 2: Adjusting the Stand Holding the Marble at the Top of the Slide

| Trial # | Description                                                                                                               | Outcome/Results                                                                                                                                                                |
|---------|---------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Trial 1 | Wooden platform measuring 8.5 cm with a plastic spoon taped on top. The handle against the wooden surface and the part of | - When the end of the wooden platform (end with out the spoon) is hit with the dart, there is not enough force to allow the marble to fall out of the spoon and down the pipe. |

|         |                                                                                                                                                                                                                                                                                              |                                                                                                                                                                          |
|---------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|         | <p>the spoon that holds the food sticking out and adding 6cm.</p> <p>This part of the spoon will hold the marble and leads in to the pipe that the marble will fall down.</p>                                                                                                                | <p>- It moves but remains in the spoon.</p> <p>- Does not bend forward enough to allow the marble to fall</p>                                                            |
| Trial 2 | <p>Kept the structure of the wooden platform and spoon the same but added on popsicle sticks to the end.</p> <p>Taped four of them together along their long side and glued it to the wooden platform.</p> <p>Added about 8cm to the overall length of the structure holding the marble.</p> | <p>- When the dart hits the platform holding the marble, the marble is able to fall out of the spoon and down the pipe.</p> <p>- Rest of the steps continue smoothly</p> |



Table 3: Tightness of Elastics Affecting the Movement of the Fish Food Box

| Trial # | Description                                                                                                         | Outcome/Results                                                                                                                                                                                      |
|---------|---------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Trial 1 | The elastic was twisted a few times before being put on to the hook to tighten the grip on it and hold it in place. | <p>- The box was difficult to move</p> <p>- Required more force to hit it enough (so fish food would fall out)</p> <p>- Felt as though there was lots of tension and stiffness when it was moved</p> |
| Trial 2 | Decreased the number of twists in the elastic(s) before placing it on the hook                                      | <p>- The box was easier to move</p> <p>- Flowed a lot better when it moved</p> <p>- Required less of a push from the ball to get a decent amount of food out</p>                                     |





There are also other basic things that require trials and experiments. The tightness of the elastic connecting the fish food box to the two poles holding it up – changing the tightness by twisting (to tighten) or untwisting (to loosen) the elastic. The tighter the elastics would be, the more force it would take from the ball to hit the box enough and make the food fall out.

#### DISCUSSION/CONCLUSION:

Building a fish feeder that is started by the user and goes through various steps to eventually drop fish food into the bowl, proves that the hypothesis of height affecting the amount of kinetic energy released and that there is a height measurement that allows the ball to drop a good amount of food in the fishbowl, was true and possible. The result of the collected data proves that when the height is increases, it releases more kinetic energy and therefore the ball hits the food box harder because the greater the height, the more food would fall in to the bowl. It also proves that having the longer curve leading to the fish food decreases the amount of energy and force the marble releases by the time it reaches the food box. Whereas having a shorter curve allows the ball to keep its energy and hit the box with more force. Getting the correct measurements requires testing by increasing or

decreasing the height at which the marble begins to fall at and finding which height allows the marble to gain enough force to drop a decent amount of food into the bowl. Increasing and decreasing the height is what proves that the potential and kinetic energy changes and that in the case of the fish feeder, the height that causes the most productive fall and drop of food is the height of 75cm.

These results show an accomplishment of the original purpose and proves that the use of potential and kinetic energy is possible. The experiment and results prove two major things. The first which connects back to the known fact of how the greater the height that the ball starts falling from, the more fish food falls from the box and into the bowl is that there is a height that allows the ball to hit the fish food box and drop a decent amount of food into the bowl with the design of this feeder – 75cm. The second major thing is that when the curve at the end of the tube that the ball goes through changes, it also affects the force of the ball. At first the curve is longer and continues all the way down, touching the base of the fish feeder and then resuming its way up until it reached the fish food. The other way it was set up was that the curve was quicker and shorter so that it also shortens the distance the marble has to go against its original path. It goes up to the box before touching the base and makes the point where the marble and fish food box meet a lot closer to the end of the curve (shortened the distance the ball had to go in an upward direction). With this change, the curve is

much more effective, and more food falls into the bowl. This data and the experiment supports the hypothesis by proving that there is a specific height that allows the ball to gain enough force to hit the

box and drop a good amount of food and also by proving, based off of previous research and results, that the height affects the force the ball gains and hits with. (Kidz World 2017)

## APPLICATION

Potential and kinetic energy are only a few of the many different examples of energy that are common in everyday lives, and with a little creativity it is possible to take these ways of energy and turn them into things that the world can get the most of whether it's for plants, animals or people. Building this fish feeder shows just a teensy example of how far one can go when they have the knowledge they need. From expanding the use of renewable energy sources, to finding a possible substitute for gasoline, to preventing the destruction of natural resources. The number of ideas that these concepts can be used for are endless and with a lot of dedication and a hint of creativity, it can make a difference. One can never forget that just like the energy, every person has potential!

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# Comparing Python, Java and C++ under the Identical Command

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## Abstract:

There are thousands of programming languages in the world each made to perform a specific task. It is very important to understand their differences in order to select the most appropriate language when inventing software. This experiment runs several programming languages under identical functions to compare each language's pros and cons. The result of the experiment shows Python is comparatively worse than Java and C++ in terms of the fluency of the program, which proves the hypothesis to be incorrect. The result of the finding also teaches a lesson of to not judge a program by the simplicity of its code structure.

## Introduction:

The purpose of this experiment is to recognize that different types of programming languages are made for different purposes; some work best in creating simple programs use within the computer like Java and Python, others are meant to code robots such as C and C++. Programmers should be aware of the differences between the languages and choose the one that best fits their project.

Which programming language in the experiment causes the most harm to the computer?

If a language is generally used to program devices outside of a computer, then it will cause the most damage to the computer because these languages

tend to be realistic. For example, C++ assign specific address to store each value. However, values such as integer 1 cannot be exactly represented in the memory but is instead stores in bits such as 0.99999999451. This complexity of the program may require more memory usage, therefore causing more harm to a computer.

## Methods:

Experiment 1:

Set up a while loop for Python on Repl.it with a variable called x that has a value of 0, and for every loop it runs, it adds 1 to x and outputs x's current value. The computer use in this experiment should be an old, outdated one to maximize the difference

between the results. Restart the computer, and login onto Repl.it to set up the code. Record the percentage of memory usage before the code is run. Run the code and start a timer counting down from 60 seconds simultaneously. Once the timer reaches 0, stop the program and record the x value as well as the increase of the percentage of memory usage. Repeat the above procedures two more times then switch to Java and C++ with the same amount of experiment.

#### Experiment 2:

The computer use in this experiment should be a new, recently released one to prove the solidity of the results, showing a pattern that occur in every computer. Restart the computer and set up the identical while loop as in Experiment 1 for Python on Repl.it. Run the code and start a timer counting from 0. Once the x value reaches 300000, stop the timer and record the time. Repeat the above procedures two more times then switch to Java and C++ with the same amount of experiment.

The independent variables in the experiment are Python, Java, and C++. Dependent variables are the amount of lines output in 60 seconds, the percentage of memory usage increase, and the time it takes to output 300000 lines. The control variables in the experiment are the computer and the codes for each programming language. The computer must be control because the fluency of each program will be different if they are test with different computers, therefore causing the result to be inaccurate. The

codes also need to be control because if the languages are not performing the same function, then the comparison between the results will be irrelevant to the purpose of this experiment.

## Results:

Table 1

| Comparisons Between Python, Java, and C++                                  |                                        |                                           |                                           |
|----------------------------------------------------------------------------|----------------------------------------|-------------------------------------------|-------------------------------------------|
|                                                                            | Python                                 | Java                                      | C++                                       |
| <b>Loops ran in 60 seconds<br/>(Computer 1)</b>                            | #1. 0<br>#2. 15648<br>#3. 0            | #1. 1268419<br>#2. 1332829<br>#3. 1334199 | #1. 1572330<br>#2. 1478048<br>#3. 1451508 |
| <b>Maximum memory<br/>increased in 60 seconds<br/>(Computer 1)</b>         | #1. 11%<br>#2. 11%<br>#3. 12%          | #1. 12%<br>#2. 14%<br>#3. 16%             | #1. %16<br>#2. %16<br>#3. %17             |
| <b>Did it crash<br/>(Computer 1)</b>                                       | #1. YES<br>#2. YES<br>#3. YES          | #1. NO<br>#2. NO<br>#3. NO                | #1. NO<br>#2. NO<br>#3. NO                |
| <b>Time (in seconds) takes<br/>to output 300000 lines<br/>(Computer 2)</b> | #1. 147.29<br>#2. 177.69<br>#3. 185.71 | #1. 30.96<br>#2. 38.17<br>#3. 30.64       | #1. 19.40<br>#2. 16.83<br>#3. 18.35       |
| <b>Did it crash<br/>(Computer 2)</b>                                       | #1. YES<br>#2. YES<br>#3. YES          | #1. YES<br>#2. YES<br>#3. YES             | #1. YES<br>#2. YES<br>#3. YES             |

Figure 1- This graph shows the number of loops ran in 60 seconds of Python, Java, and C++; numbers on the left represents the number of

loops.

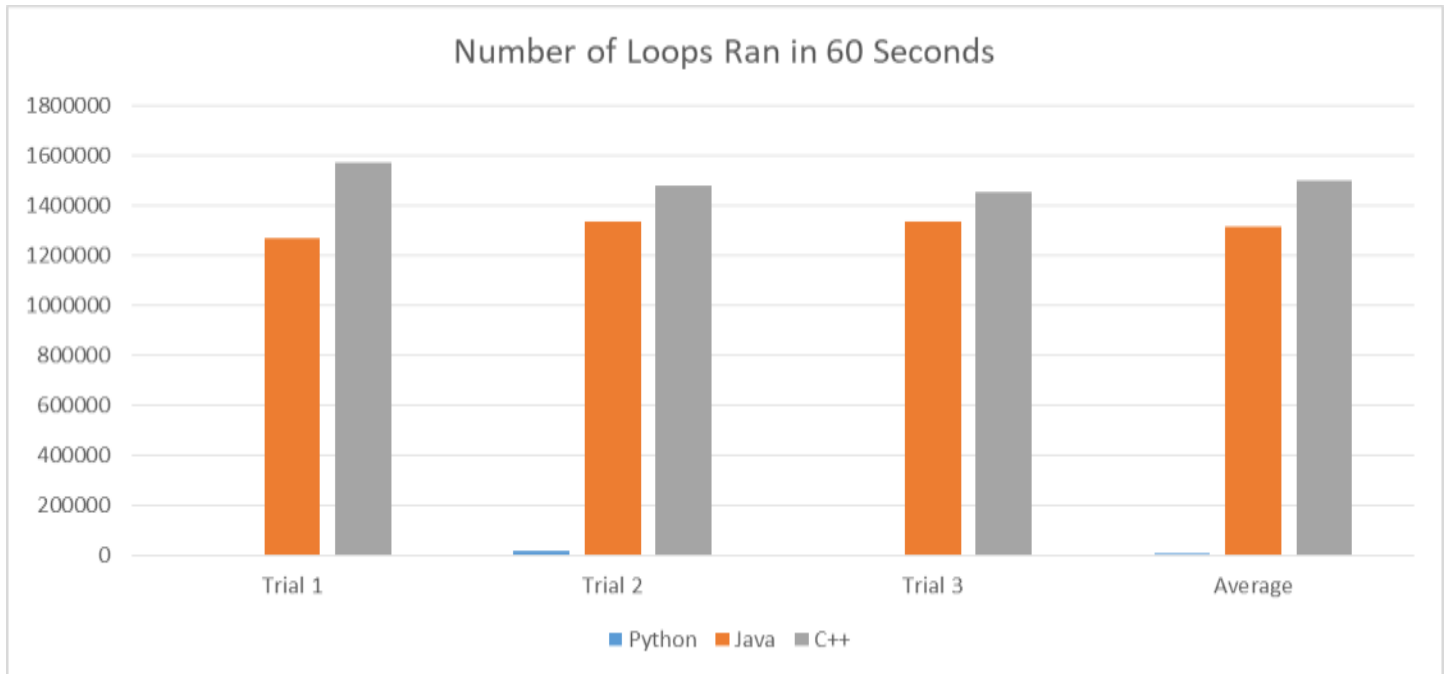


Figure 2 – This graph shows the maximum percentage of memory increase in 60 seconds of Python, Java, and C++; numbers on the left represents the number of memory increase in percent.

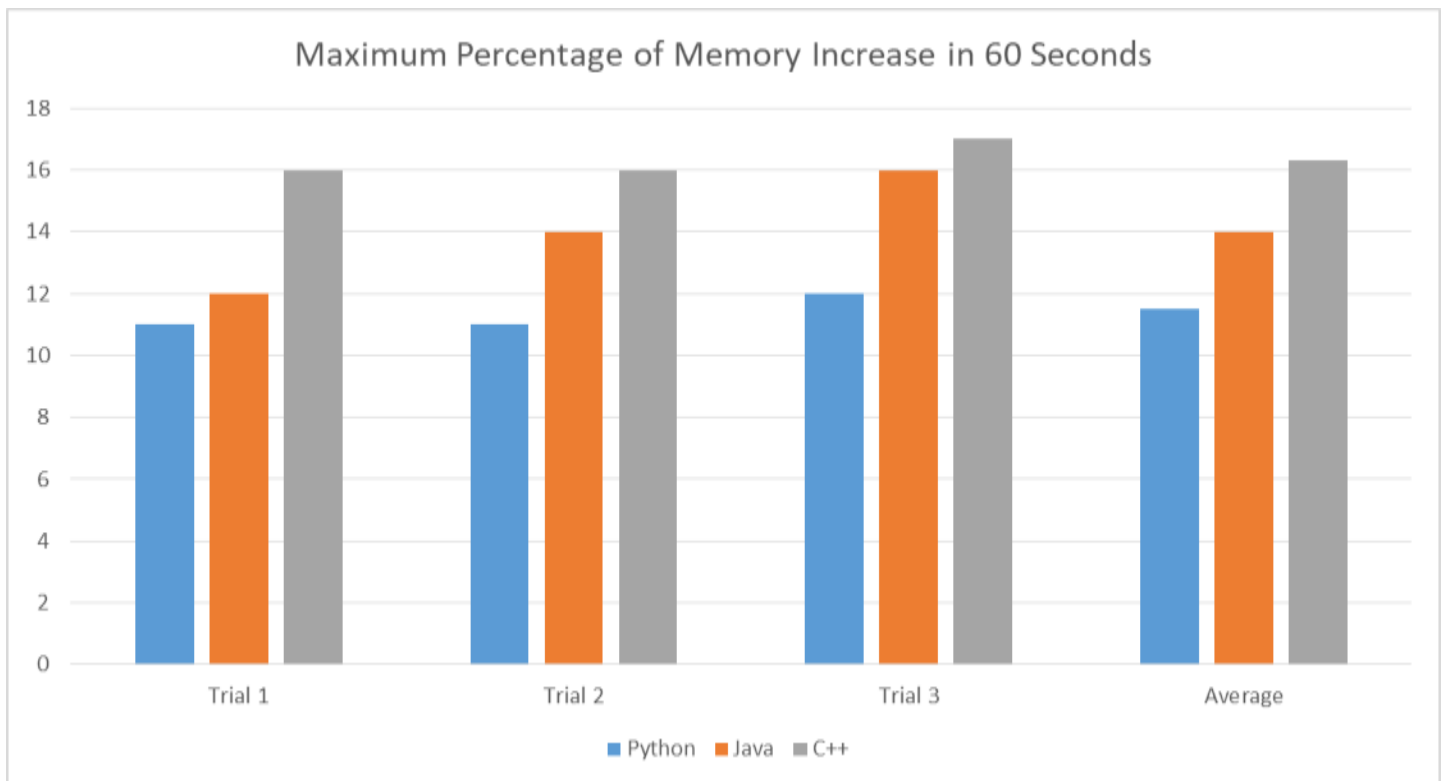
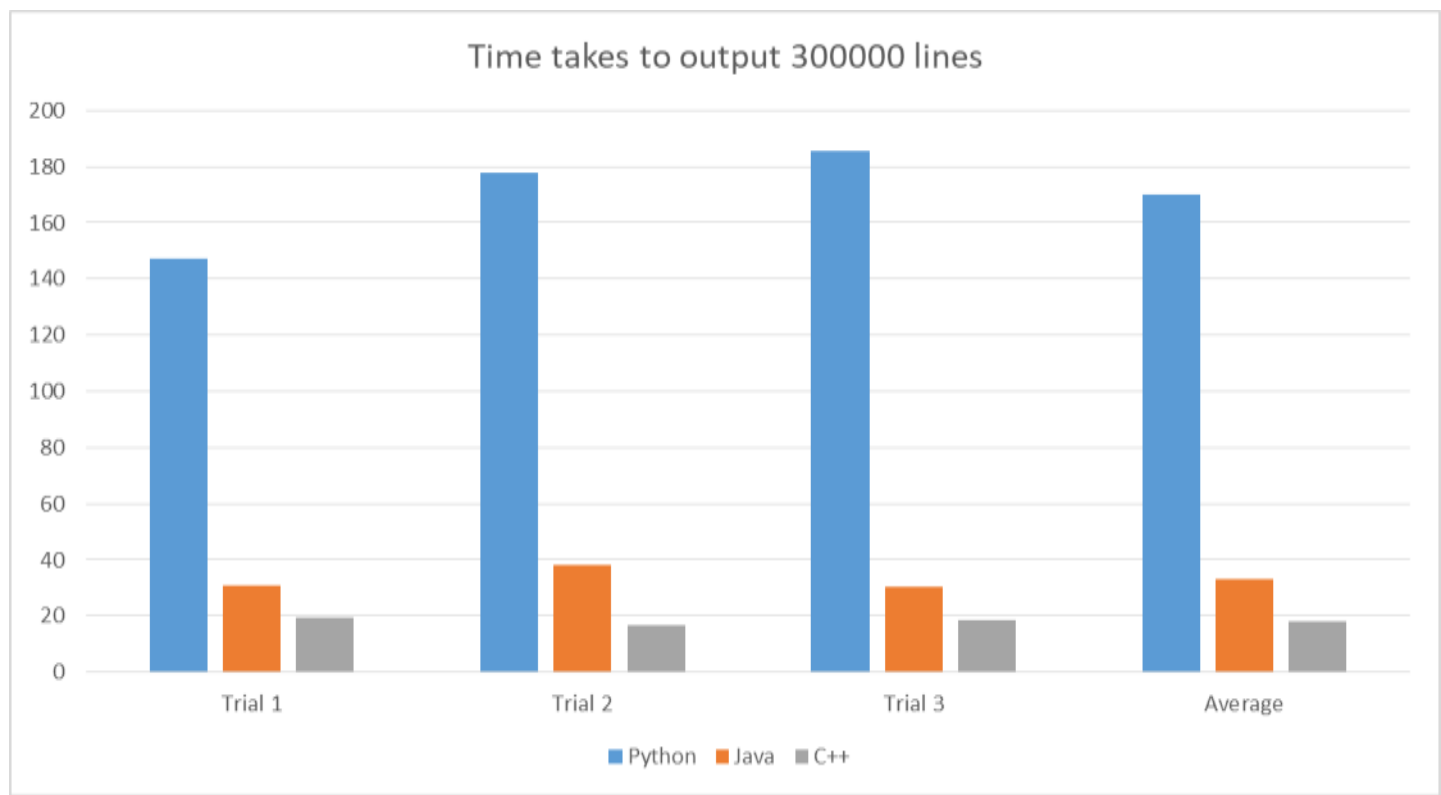


Figure 3 – This graph represents the amount of time takes to output 300000 lines of Python, Java, and C++; numbers on the left represents amount of time in seconds.



### Discussion/Conclusion:

The hypothesis is incorrect because even though C++ is mainly use to program technologies outside of the computer, the results prove that C++ in fact causes the least harm to a computer (outputs ~1500000 lines in 60 seconds fluently), while Python on the other hand, is the one who does the worst in this experiment (crashes during the trials, takes the longest to output 300000 lines). Therefore, the experiment concludes that it doesn’t matter whether if a language is targeted specifically toward computers or not. Every program is different, and

the internal interaction inside the program has no relation to its apparent code structure.

By looking at the data gathered in laptop #2, Python took a significantly longer time (2 min 45 sec) to run (300000 lines) when comparing with Java (35 sec), who was also slower than C++ (18 sec) in general. With this in mind, it made sense for Python to crash in laptop #1 while the other two languages did not, since Python in the experiment let the already struggling laptop even slower to a point it could no longer be running properly. C++ had the most memory usage (16%) in laptop #1 not because

it caused the most harm to the computer but instead it ran the most lines. Overall, although C++ used up the most memory, it causes the least harm to the computer; and with Java in the middle, Python is the program that causes the most harm to a computer.

Analysing the results gather in computer 2, Python took a significantly longer time (2 minutes and 50 seconds) comparing with Java (33 seconds) and C++ (18 seconds) when asking them to output the same amount of lines. The results gather in computer 1 makes it seem like Python uses the least memory when running (11.5%), but the fact that it crashes repeatedly makes the statement unlikely to be true, and instead, a more preferable possibility is that Python has the least percentage of memory increase in computer 1 because it does the least amount of work, on the other hand, C++ acquires the most memory usage (16%) not because it does the most harm to the computer, but instead it runs the most lines. Overall, the order of harmfulness from the greatest to the least is Python, Java, and C++, proving the hypothesis to be incorrect.

Some problems are occurring during this experiment to make errors, one is the timing of pressing the timer, which causes the results to be different in terms of few seconds, the other problem is the fact that the condition of each computer can never be the same throughout the entire experiment, because there are times when the computers just lag for no reason, or the Wi-Fi is interrupt while running the program. The above problems do

change the results by a little bit, but because the purpose of this experiment is targeting a general pattern in each program, these errors are too little to be consider.

## Application:

The information discovered in the finding is useful for computer scientists, because they can now compare the languages and pick the one that works best with their project. For example, a computer science lecturer may choose Python as a beginner language to teach his/her students, while a university student may choose C++ as the core language for his/her robotics assignment. If this experiment is continuing with more programming languages being compared, it can create a well-organized system for the entire community to view, so that every individual is able to select the most fitting language for their use of teaching, researching, or inventing, and is ultimately very beneficial.

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## **Effects of a Plant-Based Diet on the Human Body**

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### **Abstract**

The question investigated was how eating a plant based diet and omitting animal products can affect the health of the human body. The importance of this experiment is to improve a person's health and potentially decrease the chances of experiencing certain diseases such as heart disease, diabetes and other illnesses that can be related to eating habits. The experiment was conducted on three people of the same family throughout the course of three weeks. The amount of animal products consumed gradually decreased throughout the first two weeks and on the final week all foods consumed by the subjects were plant based. No significant changes were yielded and all subjects felt no difference in their health. Results could have been different and more precise if the experiment was prolonged and further measurements such as blood levels were tested.



## **INTRODUCTION**

The purpose of this project is to determine if there is a way to improve health and limit the risk of experiencing serious illnesses by changing the way a person eats. Many people are experiencing serious and life-threatening diseases such as heart disease, diabetes and cancer and these may be linked to the types of foods consumed. Processed foods and many animal products that are incorporated in the diets of many people today are generally high in saturated and trans fats and include chemicals and harmful ingredients. (Golden, 2015). Very little foods consumed have nutritional value such as a wide variety of whole grains, nuts and seeds and fruits and vegetables. These foods are very nutrient dense and full of essential vitamins, minerals and fiber that are beneficial to the human body and contain antioxidants that may lower the risk of various health problems including high blood pressure, diabetes, heart disease and obesity (Tuso, Ismail, Ha, and Bartolotto, 2013). The question is how eating whole, plant based foods and omitting animal products can improve how a person feels and their overall health. The hypothesis is that if a person follows a diet consisting of whole, plant based foods, then their overall health will be improved because these foods are more nutrient dense, and contain many essential vitamins and minerals for a healthy body. Plant based foods are low in saturated and trans fats, and are also free of cholesterol, which are factors that contribute to chronic disease (Melina, Craig and Levin, 2016).

## **METHODS**

The experiment was conducted for three weeks on three people of the same family. The weight and height of each subject were measured as well as their state of health. During the first week, one of three meals eaten was completely plant based, and any additional foods consumed contained no animal products. All foods consumed each day of the week were recorded. After the first week, the weight, height and how each subject felt physically and mentally were recorded as well as any new changes that had occurred during the first week. During the second week, two of three meals eaten were completely plant based and contained no animal products as well as any additional foods consumed. All foods consumed each day of the week were recorded. After the second week, the weight, height and how each subject felt physically and mentally were recorded as well as any new changes that had occurred during the second week. During the third and final week, all foods consumed by subjects were plant based, and no animal products

were consumed at all. All foods consumed each day of the week were recorded. After the final week, the weight, height and how each subject felt physically and mentally were recorded as well as any new changes that had occurred. The independent variable was the diet, the dependent variable was the physical and mental changes in the subject's health and the constant variable was the person being tested and their overall lifestyle. These were controlled so that the results would be more precise and true. If one person's lifestyle were to suddenly change during the experiment, the effects of the experiment may be altered from before and would not be reliable.

## RESULTS

Results show that no significant changes had occurred in any of the subjects. All subjects incorporated more whole foods, fruits and vegetables into their diets throughout the three weeks of the experiment.

| Nov. 24 | Breakfast                                                                        | Lunch                                                        | Dinner                                               | Snacks                                     |
|---------|----------------------------------------------------------------------------------|--------------------------------------------------------------|------------------------------------------------------|--------------------------------------------|
| A       | -porridge (soybeans, whole grains, nuts, seeds, red dates)<br>-whole wheat bread | -radish pastry<br>-cucumber and tahini<br>-roasted asparagus | -salmon<br>-avocado and tomato salad<br>-noodle soup | -nuts and fruits                           |
| B       | -whole wheat bread with banana and peanut butter                                 | -2 egg rolls with vegetables<br>-cucumbers with hummus       | -salmon<br>-noodle soup                              | -vegan cheesecake<br>-granola bar<br>-pear |
| C       | -same as A                                                                       | -same as A                                                   | -same as A<br>-lentil salad                          | -pear                                      |

Table 1 shows a sample of what each subject ate in one day throughout the first week.

| Dec. 1 | Breakfast                                               | Lunch                      | Dinner                                                            | Snacks                                            |
|--------|---------------------------------------------------------|----------------------------|-------------------------------------------------------------------|---------------------------------------------------|
| A      | -nuts and fruits                                        | -vegetables and hummus     | -ribs<br>-roasted cauliflower<br>-congee<br>-fermented vegetables | -nuts                                             |
| B      | -cinnamon apple morning rounds<br>-almond milk<br>-nuts | -cucumber and hummus       | -ribs<br>-roasted cauliflower<br>-congee                          | -granola bar<br>-seaweed<br>-fruit jello<br>-kiwi |
| C      | -same as B                                              | -rice and mixed vegetables | -same as A                                                        | -nuts and fruits                                  |

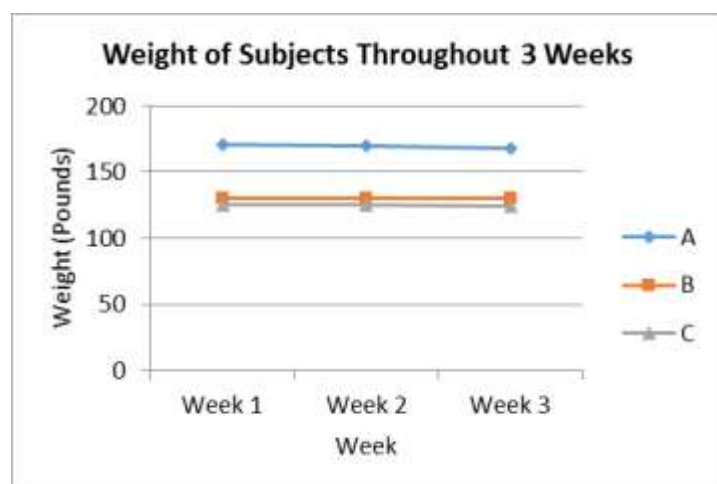
Table 2 shows a sample of what each subject ate in one day throughout the second week.

| Dec. 3 | Breakfast | Lunch | Dinner | Snacks |
|--------|-----------|-------|--------|--------|
|--------|-----------|-------|--------|--------|

|   |                                             |                                                         |                                                                                  |                                                                               |
|---|---------------------------------------------|---------------------------------------------------------|----------------------------------------------------------------------------------|-------------------------------------------------------------------------------|
| A | -sticky rice balls with nut/seed/date paste | -wrap with vegan soy meat<br>-red pepper with hummus    | -curry with carrots, potatoes, tofu, mushrooms, curry paste<br>-roasted broccoli | -granola bar<br>-BBQ quinoa chips<br>-clementine<br>-dry roasted nuts         |
| B | -same as A<br>-strawberry soymilk           | <i>Same as A, cucumber with hummus</i>                  | -same as A                                                                       | -vegan ice cream sandwich<br>-BBQ quinoa chips<br>-granola bar<br>-clementine |
| C | -same as A                                  | -congee with whole grains, beans, peanuts and red dates | -same as A                                                                       | -sunflower seeds<br>-apple<br>-dry roasted nuts                               |

Table 3 shows a sample of what each subject ate in a day throughout the third and final week.

The heights of all subjects remained the same, and Subject A and C had a slight decrease in weight-Subject A had a decrease of 3 pounds and C had a decrease of 1 pound. The weight of Subject B remained the same.



Graph 1 shows the weight change of each subject throughout the experiment.

All subjects claimed to have felt no major difference in their physical or mental health throughout the course of the three weeks, but halfway through the experiment Subject A felt more fatigue than usual. On the third week Subject A had the same energy levels as before.

## DISCUSSION/CONCLUSION

In conclusion, the hypothesis was incorrect-none of the subjects tested felt any better or any worse during the experiment. No significant physical or mental changes or improvements in their

health were experienced either. Subject A may have experienced some fatigue and a slight change in weight due to the fact that they ate very little food in the morning for many days of the week. The results were not as expected; instead of yielding health improvements and benefits, no changes were yielded at all and the reason may be because prior to the experiment, all subjects were already eating a well-balanced diet and limited the amount of heavily processed foods in their diets so the change in the way each subject was eating was not a big difference to before. Also, the amount of time tested may not have been long enough to yield any noticeable changes. Eating a plant-based diet cannot improve the health of a person right away and it may take weeks or months to experience the benefits. Improving the health of a person is not necessarily achieved by following a plant based diet but can also be from incorporating more whole, plant based foods and minimizing the amount of processed foods consumed. The experiment could be improved by prolonging the duration by a minimum of two weeks because more significant changes could have occurred during the extended period. Also, more subjects of different diets and states of health should have been tested to truly determine the effects of a plant based diet. A wider variety of tests should have been included such as blood tests and blood pressure prior, during and after the experiment. These adjustments would obtain more accurate results and changes.

### **APPLICATION**

This information can be applied to fields of study in nutrition and dietetics, so that they can find more ways of improving the health of humans through diet and a variety of foods. The information can help them determine ideal foods to consume for optimum health. It is useful to those who are seeking ways to improve their overall health, but are not sure how to find the best way to achieve this goal. Families with children can also apply this information into their daily lives by knowing which foods they should incorporate more and balancing their meals so that the children can grow up eating healthy and feeling well.

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## **Healthy Alternatives in a Cookie Changes the Way It Tastes**

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### **Abstract**

The question investigated was how can different healthy alternatives could affect how a cookie tastes. Finding the answer to this question is important because healthy alternatives is a simple answer healthy eating without having to go on a strict diet and helps lower the amount of junk food that goes in the body. An experiment was conducted where subjects were given two different types of a cookie, a healthy and unhealthy version, to try. After finishing the cookies were asked to answer questions about the difference between the two types. The results showed that people found the healthy version of the cookie less appetizing than the non-healthy version and would not choose to have the healthy version again. In conclusion, even though healthy alternatives are better for the body than the original unhealthy versions, adding them to a cookie makes it taste less tempting and did not taste better than the unhealthy version.

### **Introduction**

The purpose of the experiments was to substitute different ingredients of a cookie with healthier options to try and make it healthier, and see how the taste is affected. Healthy alternatives are very important because they can reduce the prevent chances of health issues. Eating foods that are unhealthy and that are bad for the body can

cause obesity along with heart disease, diabetes, kidney failures, and strokes (5 Harmful Effects of Junk Food). Due to the number of calories found in junk foods, it can cause blood pressure and blood sugar levels to rise and the excessive amounts of fat and lead to the clogging of arteries (What Happens When You Eat Too Many Sweets & Fast Foods?).

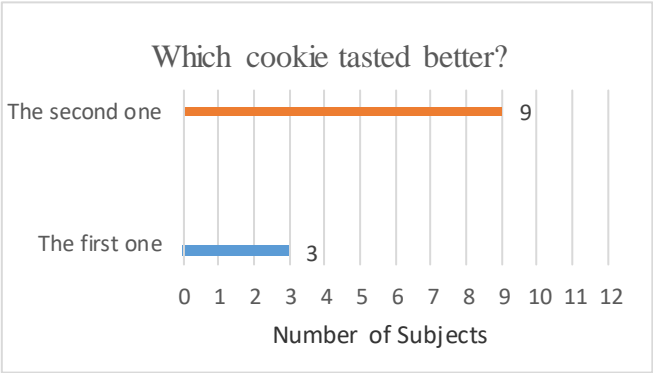
Therefore, the question that was asked for the experiments was how can different healthy alternatives affect how a cookie tastes. The hypothesis conducted from the questions was, if healthy alternatives is used in baking the cookie then it will be distasteful because foods that have a lot of sugar taste a lot better than the dull foods that have no sugar. Foods that have a lot of sugar or that are sweet light up the pleasure parts of our brain, making us enjoy foods that taste sweet (Why Sugar Makes Us Feel So Good?).

### Methods

The first step to conduct the experiment is to follow a chocolate chip recipe step by step making the first batch (The Best Chewy Chocolate Chip Cookies). Another batch needs to be made from the same recipe, however this batch will have some ingredients that will be substituted. Substitute the flour in the recipe for whole wheat flour, using the same amount used in the recipe. The butter and

oil and raisins, still using the same amounts from the recipe. Then bake the second batch as instructed in the recipe. Once both batches are done, have subjects try a cookie from the healthy alternatives batch first. Then have them try a cookie from the batch without the substitute. Have subjects answer the questions prepared for the experiment as referred to in Figure 1. Then record the answers as well as observation so they can be analyzed later.

The independent variable throughout the



experiment was the two different recipes. Even though, the same recipe was used, there was ingredients that were switched out, essentially making it two different recipes. Therefore, one recipe would be made without any alterations. The second recipe would also be from the same recipe, but it would include the substitutes of flour, butter, and chocolate chips to whole wheat flour, coconut oil, and raisins.

The dependent variable includes how the original cookie tastes compared to the one with substitutes. Each subject has their own acquired tastes that could be different from the other subjects. They also different preferred flavours that

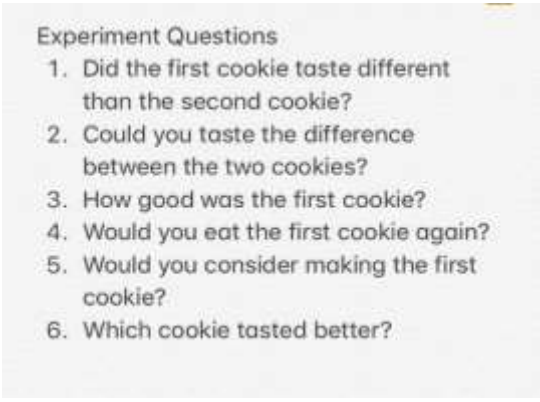


Figure 3- Questions that were asked during the experiment

chocolate chips should be switched out for coconut

light up their pleasure centers of the brain. This variable can be used for the results at the end of the experiment.

The controlled variables were the baking times and temperature, the recipes, and the oven the cookies were baked in. This makes sure that the baking process does not get changed and the cookies are made the same way These controlled variables make sure the results are accurate and that

All subjects were able to identify that was a difference in the two cookies. As shown in Figure 3 and 4.

nothing becomes altered. If these were not controlled, it could affect how the cookies tastes and it could change the overall results.

Results

After conducting the experiment, the conclusion that was drawn was that 75% preferred the taste of the unhealthy cookie over the cookie with the healthy alternatives. As shown in Figure 2.



Figure 4- Shows the number of subjects that preferred the first one (healthy alternatives version) and the second one (the unhealthy version)

Figure 4- Shows the number of subjects that could taste a difference between the first cookie (healthy alternatives version) and the second cookie (unhealthy version). Figure 3- Shows how many subjects could taste the difference between the two different types of cookies

When asked if participants would eat the first cookie (healthy alternatives version) again only 8% said yes while the rest of the participants either said no or maybe (Figure 5).

They were also asked if they would consider making the healthy alternative cookie and about 60% said no, the rest of them either said yes or maybe (Figure 6).

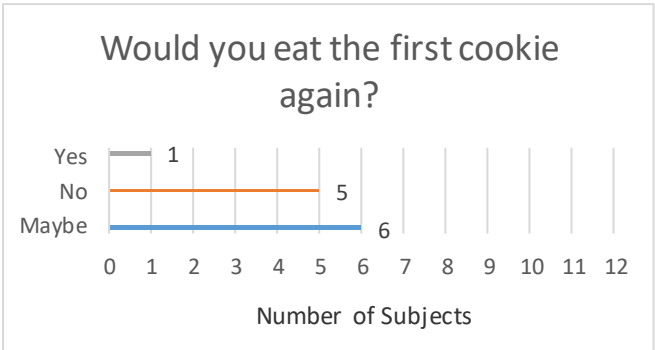
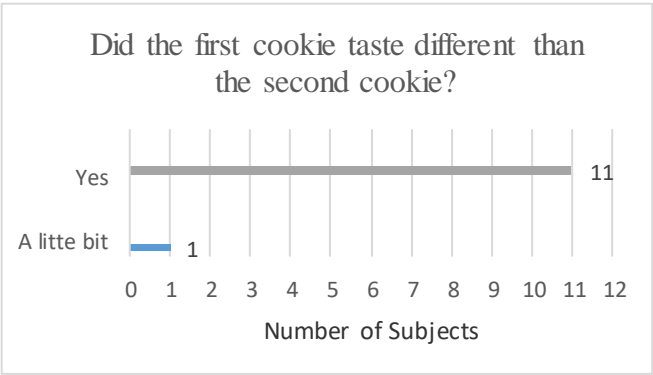






Figure 6- Shows the number of subjects that would consider making the first cookie (healthy alternatives version) again

When asked how good was the first cookie (healthy alternatives version), 58% of subjects said it was ok, about 33% found it not very good and only 8% thought it was amazing (Figure 7). The people who did not find it amazing were asked why it was not good or ok. Subject's 2,5,10, and 12 found the cookie to be very bitter and subject's 4,7,8,9, and 11 all thought the cookie was lacked a lot of sugar and just didn't taste as good as the unhealthy version.

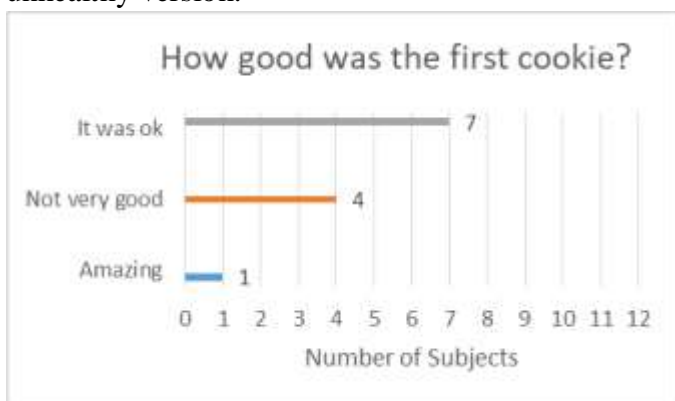


Figure 7- Shows how subjects felt about the taste of the first cookie (healthy alternatives version)

## Discussion/Conclusion

The overall results confirmed the hypothesis, that was conducted in the beginning of the experiment, was correct. From the experiment, the initial question that was asked was, how can different healthy alternatives affect how a cookie tastes. The results showed that many people could differentiate between the unhealthy version and the version with the healthy alternatives. The healthy alternatives that were used was whole wheat flour for the flour, coconut oil for the butter, and raisins for the chocolate chips; added a bitter flavour to the cookie since all the substitutes used were plant based and they are known to taste bitter. Therefore, most people found the healthy alternative version of the cookie unpleasant because of how adding the substitutes changed the overall taste and it was not at all sweet and savory like the unhealthy version.

Even though, they hypothesis was correct the results did not make a big impact. The healthy alternative version did not taste better than the healthy version because it didn't have the same amount of sugar. Another reason people found it distasteful was because people were not use to the taste of the healthier version like they are with the unhealthy version. People have been eating the unhealthier version longer than the healthier version, and their brains recognize that sweet taste and that lights up their pleasure centers. Therefore, if people were to slowly increase their intake of healthy alternatives, it would make their brain recognize and be used to the taste, making their pleasure centers light up from the healthy alternatives.

## Application

Making sure to include healthy alternatives in food ensures people to improve their diet without being on a strict diet. If healthy alternatives were used more in food and people enjoyed them, health issues would go down and would benefit everyone. It would also benefit food industries if they could include more healthy alternatives that make a difference and is good for the body, because people would buy them over the original versions. In the



end, healthy alternatives could be very beneficial for everyone if people spend more time getting use to healthy alternatives and enjoying them.

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# **Features of Baleen Whales Can Be Mimicked To Enhance Water Filtration Systems**

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## **ABSTRACT**

This study investigated how can humans sterilize dirty water more efficiently by mimicking baleen whales to improve the water crisis. Research states that baleen whales can filter feed, thus the project was examining on how features of a baleen whale influence a filtration system. People who live in undeveloped countries suffer and die each year from waterborne illnesses such as diarrhea due to the inadequate water. To investigate the question, a filtration bottle named the Whattle is made using basic materials such as paintbrush bristles, a pump, activated carbon and more. The function of each material would mimic the filtration system of a baleen whale. According to the results, water is filtered cleaner using features of a baleen whale and could remove contaminants found in dirty water. In conclusion, the results may help people get sanitary water to drink. Furthermore, the experiment proved that biomimicry is an integral step to solve human problems.

## **INTRODUCTION**

Water is an essential component every human being needs to survive. In 2004, the Asian Tsunami hit the Southeast of Asia and forced people to drink contaminated water or eventually face death. The devastating news brought upon the purpose of this project, which is to find a solution to the water crisis by improving water filtration systems. In many undeveloped countries, obtaining clean water is

impossible. Valerie Webber (2015) declares without clean water, humans can experience extreme diarrhea, nausea, vomiting and stomach cramps because the water contains viruses and other microbes, which kills cells and disrupts the cell's function. According to the Water Project, half of the world's hospitals are filled with patients suffering from waterborne illnesses (2016). By treating and

sterilizing the filthy water, people can get cleaner water. Research indicates that baleen whales contain unique features such as baleen plates and tongues that allows them to filter feed. Thus, inspiration to create a filtration device mimicking a baleen whale sprung up. This project may be the solution to the water crisis and decrease the amount of people suffering from waterborne illnesses. After gaining an abundance of knowledge, the question how can humans sterilize dirty water more efficiently by mimicking baleen whales to improve the water crisis was investigated.

If water filtration devices mimic features of a baleen whale, then water could be cleaner, because baleen whales has features that makes them able to filter their own food. According to Biologist Alexander Werth (2013), baleen whales efficiently filters out debris from their food. Furthermore, scientists have conducted flow tank experiments, which tested how baleen whales control water flow through their mouth. The scientists figured that they use small lift forces of their tongues to pass water lateral between their plates for easier swallowing (Goldbogen, J., Cade, D., Calambokidis, J., Friedlaender, A., Potvin, J., Serge, P., and Werth, A) .

## METHODS

The following procedures were followed to produce the filtration bottle, the Whattle.

To begin with, a lid was taken off from the top of the plastic bottle and the center of the lid was located. The pump from the coffee press was taken and a drill bit that has the same diameter as the metal rod on the coffee press was found. Then, a hole was drilled on the center of the lid so that the metal rod of the coffee press can fit through it. The metal rod was inserted through the drilled hole on the lid.

Next, two dots were drawn equidistant apart at the middle of the plastic bottle. The bottle was turned to the opposite side and the same steps were repeated as before. The two dots were aligned with the other

two dots from the other side of the plastic bottle.



Figure 1 illustrates how the copper wires were inserted through the middle of the bottle.

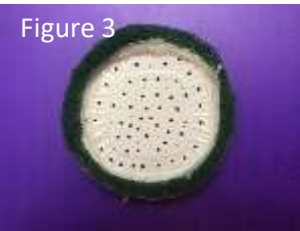
Then, the four dots were drilled using a drill bit the same diameter as a copper wire. Two pieces of copper wire were inserted through each pair and are parallel to each other. To ensure safety, the plier was used and it bended the copper



wire around the circumference of the plastic bottle so that no copper wire is poking outwards. Hot glue was used to seal the four holes to ensure no water is leaking. Figure 1 shows how the copper wire is supposed to be constructed in the bottle.

To make the filtration system, a gauze pad was taken and sewed into a circular pouch. The circular pouch was filled with activated carbon filter and the opening was sewed closed to make sure nothing falls out (Figure 2).

In addition, two circles were cut out with the same diameter as the plastic



c plate using scissors. The needles on one of the circle and larger noles were drilled in the other. A sponge was used, and a circle was cut with a larger diameter than the plastic circles cut out from before. From the circular sponge, a circle of the same diameter as the plastic circle was cut. The sponge was hot glued to the circumference of plastic circle with drilled holes (Figure 3).

Moreover, two circles with the same diameter as the plastic bottle was cut out from a barbecue net. The bristles on the paintbrush were then cut off and a

Figure 3 and 4 depicts the filtration features created.



Figure 2 portrays the appearance of the circular pouch sewed with activated carbon.

cut out from the barbecue net circle. The other circle cut out from the barbecue net was placed on top of the bristles and this assembly was sewed altogether using a needle and thread (Figure 4). The bristles sticking out the metal circle was trimmed.

The plastic circle with drilled holes and sponge was inserted into the plastic bottle so that it lays just above the copper wire. The activated carbon pouch was put on top of the plastic circle with drilled holes. A thick elastic band from a thermos container lid was hot glued to the circumference of the plastic circle with needle-made holes. This circle was

inserted on top of the pouch. Lastly, the barbecue net and paintbrush bristle assembly were put on top of the plastic circle with needle-made holes. The lid and coffee press were put back onto the top of the bottle. The finished product looks like Figure 5.



To test how efficient the Whattle would filter, dirty water mixed with mud and leaves was poured into the filter. The dirty water was pumped and observations were noted. Paintbrush bristles were then taken out of the filter and dirty water was put in the bottle once again. Observations and differences was noted once more after the water was pumped.

Figure 5

Figure 5 portrays the innovation's appearance after following the procedure.

paintbrush bristles. The dependent variable was the cleanliness of the water. The controlled variable in this experiment was the Whattle and type of water

used to filter. These variables were controlled to ensure that the experiment gave accurate results and it was not biased in any way.

## RESULTS

After constructing the Whattle (Figure 5), experiments were conducted to study whether baleen features influenced filtration systems.

The experiment was repeated several times to verify that the results were accurate. After several attempts, the Whattle proved that it could filter water much cleaner using features of a baleen

whale. The main baleen mimicked function is the paintbrush bristles in the Whattle. Figure 7 shows the comparison of how the dirty water looks like before and how it filtered with and without the paintbrush bristles.

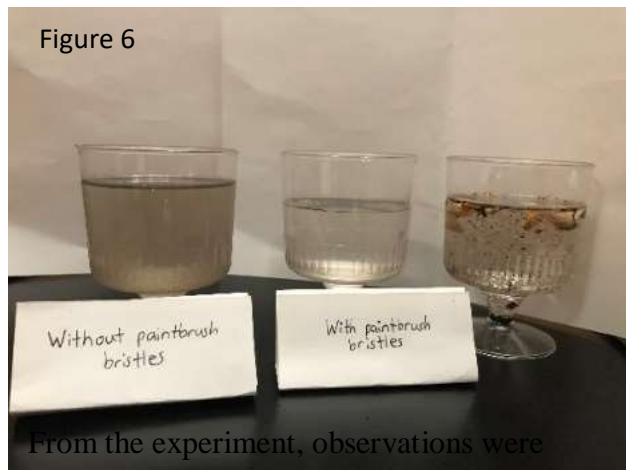


Figure 6

From the experiment, observations were gathered as shown in Table 1. The observations conclude that baleen features filter dirty water much cleaner than without baleen features.

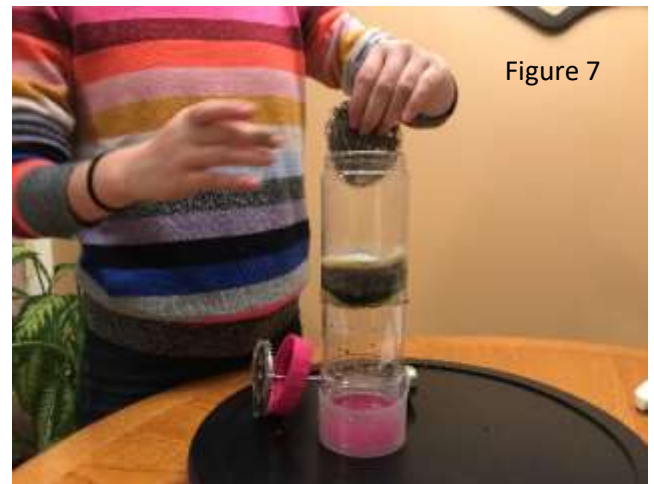


Figure 7

Figure 6 shows the difference in water quality using baleen features. The paintbrush bristles and without bristles were taken away from the filter.

When the paintbrush bristles were taken away, an obvious observation of the speed of filtration was noticed. As seen on Table 1, the filtration process is slower when paintbrush bristles were added to the Whattle.

Furthermore, the results shown from Figure 6 depicts the original water seemed to look even dirtier when it was filtered without paintbrush bristles. On the other hand, the original water was filtered crystal clear using the paintbrush bristles.

Table 1

| Filtering with paintbrush bristles    | Filtering without paintbrush bristles |
|---------------------------------------|---------------------------------------|
| -Clean water is produced              | -A muddy colored water is produced    |
| -Filtering process is a little slower | -Filtering process is a little faster |

Table 1 shows the observations recorded during the experiment.

|                                                                                          |                                                                                                       |
|------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|
| -Large sediments were filtered right away in the very beginning of the filtering process | -Large sediments were filtered, however smaller sediments easily flowed through the filtering process |
| -The coffee press pump made the filtering process a little faster                        | -The coffee press pump made the filtering process go faster as well                                   |

Figure 8

## DISCUSSION/CONCLUSION

The hypothesis is correct. In the hypothesis, it states that the addition of a substance mimicking the baleen whale would filter water much more efficiently. Scientists set forth that the smaller the holes in the filter, the better they would filter out dirty sediments, bacteria and viruses (2016).

However, the small holes would make the filtering process much slower. Baleen whales use their tongues to make filtering process faster by applying pressure.

a pump

Using this feature, was added to the

Figure 9 shows the pump used to speed up the filtration process.

Figure 9

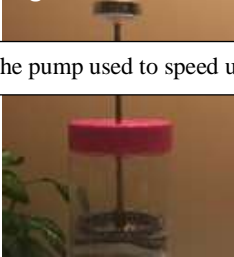
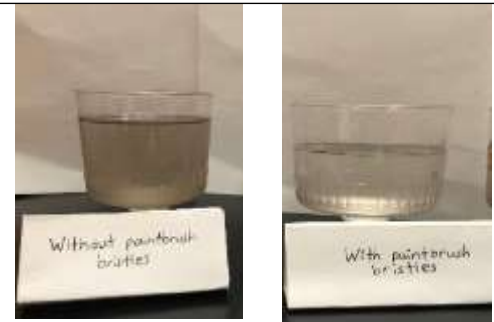


Figure 8 demonstrates a closer look to the water filtered after the experiment with the Whattle.

top of the filter (Figure



9). This not only speeds up the process of filtering, but also, made sure that the Whattle filters pure water.

Furthermore, the addition of paintbrush bristles would mimic the feature of baleen plates. Baleen plates produces a mesh-like strainer for the whale to catch its prey while it filters out water. Paintbrush bristles are similar to baleen plates. To make the paintbrush bristles work more like baleen plates, it was overlapped in layers to create the mesh-like strainer so that it functions just like baleen plates. This experiment validates that mimicking baleen whales could help us to improve water filters.

When the paintbrush bristles were taken out of the filter, the water was not filtered as clean as when the paintbrush bristles were used. Since baleen plates are tightly packed together, the paintbrush bristles were mimicked to have smaller pore holes. The paintbrush bristles kept the small sediments out of the water as it filtered. When the paintbrush bristles were taken away, the pore holes were enlarged (Figure 10). This would've made the water seem much dirtier than the original dirty water. The paintbrush bristles created a large difference and filtered the water much cleaner when it was added to the filter.

Figure 10



The most significant result is when the dirty water was filtering with the baleen feature of paintbrush bristles, it was able to filter small and large sediments found in the contaminated water

right away. On the contrary, when the paintbrush was not used, smaller sediments easily flowed through the filtering process because the pore holes were enlarged without the baleen features. This result proves that baleen features can efficiently filter out dirty water. Furthermore, the pump was observed to filter the dirty water much faster by applying pressure. The experiment shows that the Whattle can be trusted and distributed to areas lacking clean water sources. People could use it to get sanitary water to drink from.

Despite, the results proved the hypothesis to be correct, some possible errors might have occurred and affected the results. From Figure 6, the dirty water that was filtered without baleen features was much dirtier than the original dirty water. The dirty pollutants could have slipped pass the filtration system as it was not as secure. This might have been the reason why the water looked dirtier than the original water. If this experiment was repeated, hot glue would fill in any cracks in the bottle.

Furthermore, since the dirty water is mixed with dirty sediments such as mud and leaves with debris, the pump might have crushed the mud into smaller sediments which allowed it to pass through the filter. If the pump was excluded from the

Figure 10 gives a visual representation of the pore holes being enlarged as the baleen feature, paintbrush bristles, were taken out from the Whattle.

experiment without using paintbrush bristles, then the results might have been more accurate.



## Application

This project proves the importance of biomimicry. People should discover nature's beauty and capture its creativity to turn it into something amazing that may better the world. Biomimicry is everywhere so not only the baleen whales can be mimicked, but other animals also include unique features that can

be mimicked from. This valuable project may be the solution to the water crisis in undeveloped countries and help those in need. This information could be applied to the field of biology and water treatment facilities for them to improve with this idea and save those suffering from waterborne illnesses.

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## **The effects of diet versus mental state**

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### **Abstract**

The purpose of this study is to compare the effects of state of mind and diet on health to see which one has a greater effect. This is important because it can change the way sick people are treated. It could mean that a cure to chronic diseases and one of the best ways to prevent heart attack can be just by changing how happy someone is. To test the effects of the diet versus the mental state an experiment was conducted. The participants would take a survey and go on a one-week diet and then they would retake the survey to see how it changed. The participants expressed through the second diet that physical health got better but mental health got worse and stress levels stayed the same. Using the information from the study, the result for the previously posed question is that diet has a greater effect on physical health. Although the experiment showed that diet had a greater effect on physical health the fact that mental health was rated lower indicated that the perception of being healthy is the true determinant of health.

### **Introduction**

This project tries to test the ideology behind the saying ‘mind over medicine’; food, depending on what we eat can be used as medicine; for example, honey to soothe a sore throat or chia seeds for high cholesterol. But what if there was a better way to treat the human body and still get to eat the stuff that actually tastes good. According to the Mayo clinic a positive mental state comes with an increased life span, lower rates of depression, lower

levels of distress, greater resistance to the common cold, better cardiovascular health and reduced risk of death from cardiovascular disease. With all those benefits mental state has shown to be very powerful so does state of mind have a greater effect on health than diet. For the purpose of the experiment the hypothesis was that if state of mind has a greater effect on health than diet, then the state of health should stay the same after a new diet.

Methods

To test the hypothesis an experiment was conducted, the experiment required a minimum of four participants preferably with diverse age ranges and mixed genders. Also, a Survey and a Writing utensil, the SCICAN Instruction sheet provided and two tables to record the results. To begin conducting the experiment start by creating two tables, on a sheet of paper, one named ‘before diet results’ and one named ‘after diet results’, the rows will represent the question number and the columns will represent each candidates’ answers. This table will be used to tally the survey results collected. Then each candidate will take the survey provided before starting the experiment, once the surveys are collected record the results of each question in the ‘before diet results’ table. Next each candidate will be given the diet instructions and one week to complete the diet, candidates will then re-take the survey provided one day after the last day of their diet, once the second survey is collected, record new results in the ‘after diet results’ table.

Results

*\*numbers inside the table is a tally of how many people answered what*  
Table 1.

BEFORE DIET RESULTS:

| Question # | Answer/<br>Rating |
|------------|-------------------|
|------------|-------------------|

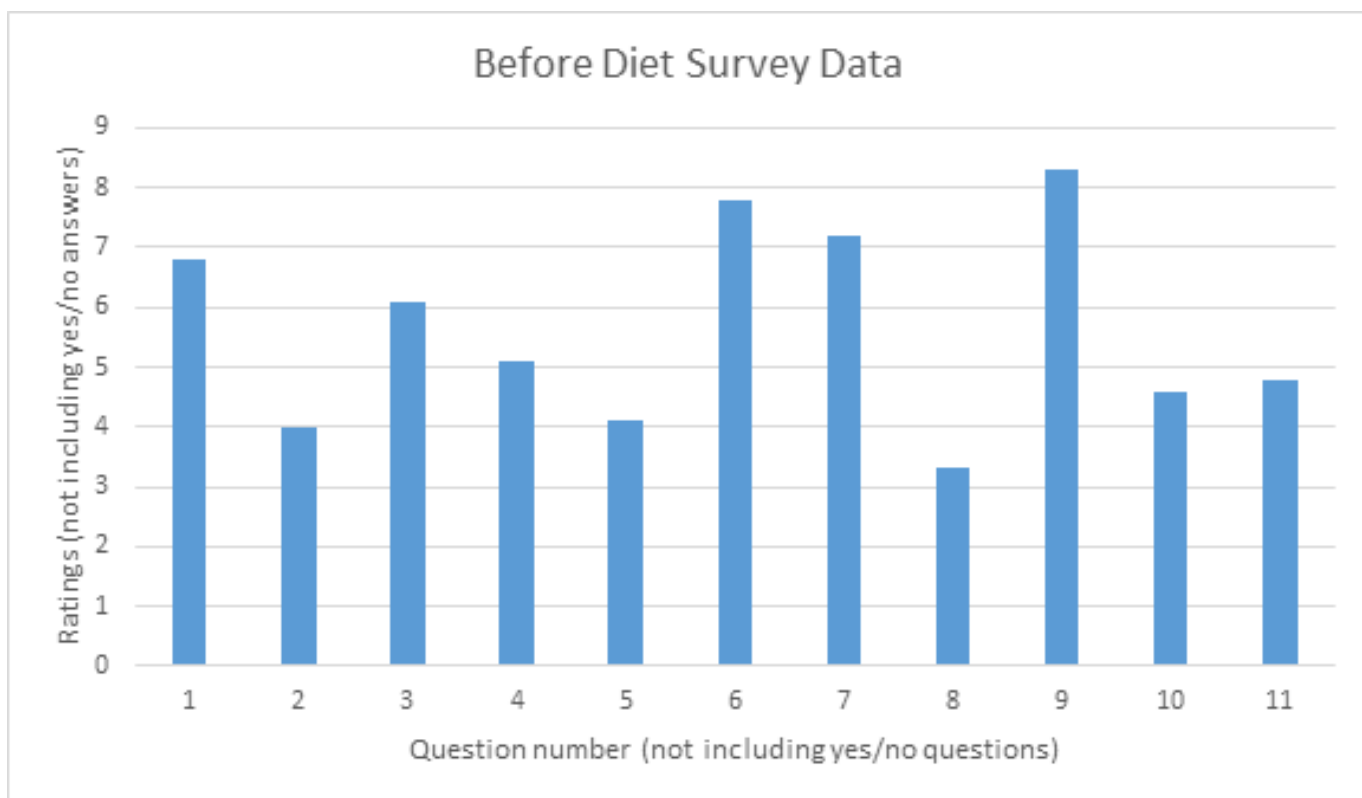
The independent variable during this experiment is the diet, the dependent variable is how the candidates rate their physical and mental health and the control variable is the survey. The survey had to be controlled because it was a record of each of the participants’ results and by not changing any of the questions it showed if there were any significant changes after the diet.



Figure 1.

|    | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Yes | No | Average |
|----|---|---|---|---|---|---|---|---|---|----|-----|----|---------|
| 1  |   |   |   |   |   | 2 | 3 | 1 |   |    |     |    | 6.8     |
| 2  | 1 |   | 1 |   | 3 | 1 |   |   |   |    |     |    | 4       |
| 3  |   |   |   | 1 |   | 2 | 3 |   |   |    |     |    | 6.1     |
| 4  |   |   | 2 | 1 | 3 | 1 |   |   |   |    |     |    | 5.1     |
| 5  | 1 |   | 2 |   | 1 | 1 | 1 |   |   |    |     |    | 4.1     |
| 6  |   |   |   |   | 1 |   | 1 | 2 | 1 | 1  |     |    | 7.8     |
| 7  |   |   | 1 |   |   |   | 2 | 2 |   | 1  |     |    | 7.2     |
| 8  |   | 1 | 2 | 3 |   |   |   |   |   |    |     |    | 3.3     |
| 9  |   |   |   |   |   |   | 2 | 2 |   | 2  |     |    | 8.3     |
| 10 |   |   |   |   |   |   |   |   |   |    | 6   |    | yes     |
| 11 |   |   | 1 | 1 | 3 | 1 |   |   |   |    |     |    | 4.6     |
| 12 |   |   | 1 | 1 | 3 | 1 |   |   |   |    |     |    | 4.8     |

Figure 2



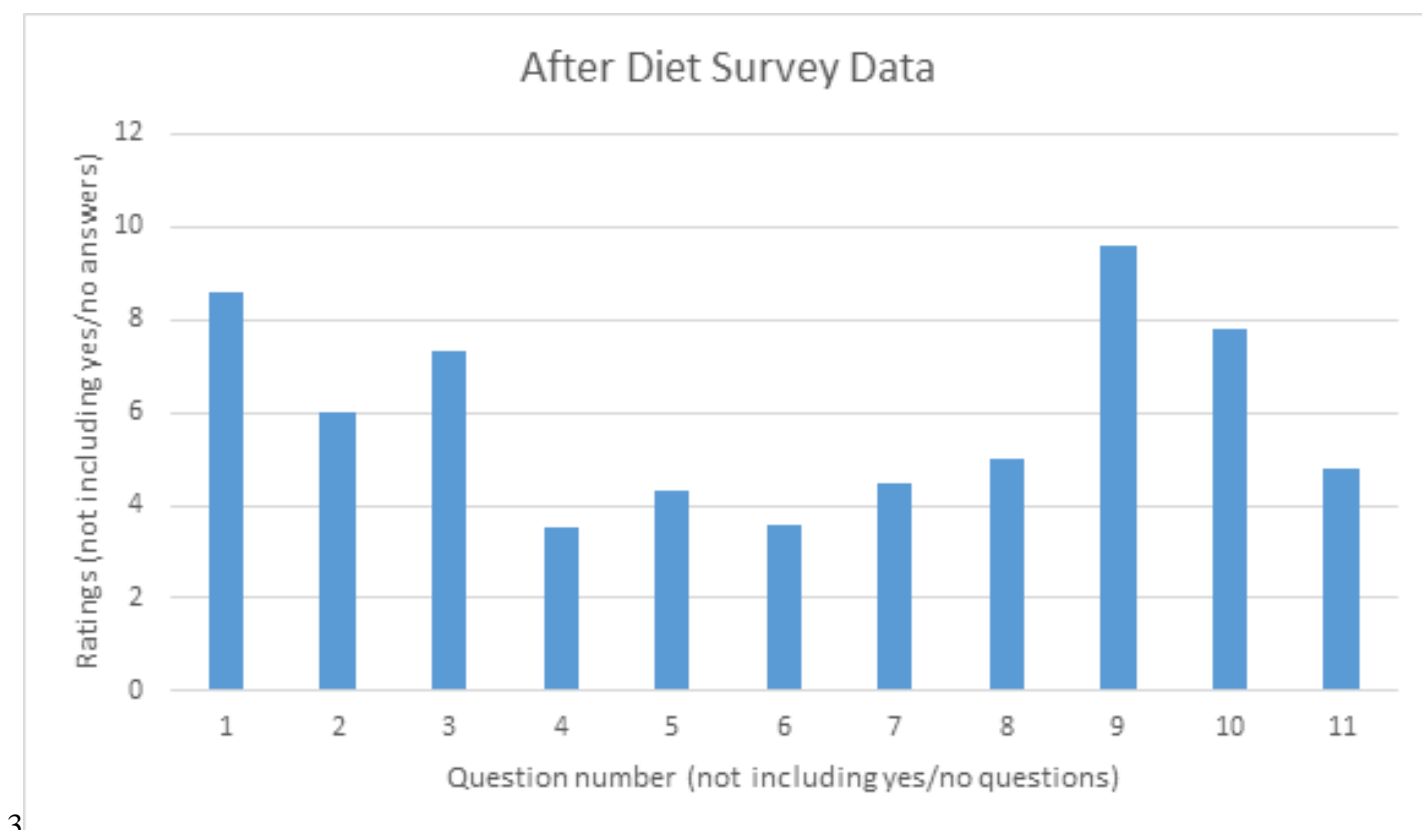
## AFTER DIET RESULTS:

Table 2.

Question #      Answer/Rating

|    | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Yes | No | average |
|----|---|---|---|---|---|---|---|---|---|----|-----|----|---------|
| 1  |   |   |   |   | 1 |   | 3 | 2 |   | 1  |     |    | 8.6     |
| 2  |   |   |   | 3 | 1 | 3 |   |   |   |    |     |    | 6       |
| 3  |   |   |   | 1 |   |   | 2 | 2 |   | 1  |     |    | 7.3     |
| 4  | 1 |   | 2 | 1 | 1 | 1 |   |   |   |    |     |    | 3.5     |
| 5  | 1 | 1 |   | 1 | 1 |   | 2 |   |   |    |     |    | 4.3     |
| 6  | 1 |   | 2 | 1 | 1 | 1 |   |   |   |    |     |    | 3.6     |
| 7  |   |   |   |   | 1 | 3 | 1 |   | 1 |    |     |    | 4.5     |
| 8  |   | 3 |   | 2 | 1 |   |   |   |   |    |     |    | 5       |
| 9  |   |   |   |   |   |   |   |   |   |    | 6   |    | Yes     |
| 10 |   |   |   |   |   |   |   |   | 2 | 4  |     |    | 9.6     |
| 11 |   |   |   |   | 1 | 1 | 1 |   | 1 | 2  |     |    | 7.8     |
| 12 |   |   | 1 | 1 | 2 | 2 |   |   |   |    |     |    | 4.8     |

Figure



## **Conclusion**

In conclusion, the hypothesis was incorrect; the experiment indicates that diet has a greater effect on physical health than a person's mental state. This is evident because after the diet the average rating for physical health increased by 1.8 out of 10 and the average stress rating stayed the same.

During the analysis of the data it was also evident that the average rating for mental health got worse after the diet. It went from approximately 8.2 out of 10 to approximately 7.6 out of 10. Also, the average rate for physical health got better, the average rose from approximately 6.8 out of ten to 8.6 out of ten; the average rating for a candidate's diet got better from 6.1 out of ten to 7.3 out of ten and stress levels stayed the same with both surveys having an average of 7.2. During the first survey, the individual ratings for most candidates' stress levels differed by 1 from their physical health, even the average only differed by 0.4, this suggested that the quality of a person's physical health can be closely determined by how much they are stressed. But after the second survey the individual ratings for physical health increased and the average stress ratings stayed the same which suggests that a person's diet has a greater effect on their physical health. This is because people associate physical health with a good diet so even though some people hate the taste of healthy food people ate it in hopes of becoming healthier; it's more about the perception of the action and that is why people seemed to rate mental health lower after the diet. The use of the stress ratings is important because it, along with some other rates give a good idea of the people's mental state when contributing to this experiment.

## **Application**

This information could be valuable in medicine because it could change the way people with chronic illnesses are treated. For example, along with the medicine maybe there would be a therapy session to go with it. A lot of times people who develop chronic conditions will develop depression as well and that could actually make them worse; according to Dr. Lissa Rankin people can actually heal themselves just by being positive. This experiment could also open up many doors in the field of neuroscience. The power of the human brain is beyond the capacity of

humans to understand and this experiment is just one more example of that. In neuroscience an experiment could be held to see if it's possible to make someone like the things that are good and eliminate the problem with unhealthy eating.

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(Figure 1)

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**One's past experiences impact One's present decisions**

**Majd Hailat**

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**Abstract**

Do humans have free will and the ability to make decisions without being influenced by their surroundings? To answer this question, something that would dramatically affect someone's life had to be chosen, and the chosen experience was divorce, there also had to be something that would challenge and test someone's ability to make a decision based on morals. One could set up a bill with high value and have test subjects with divorced parents walk past it, and afterwards have an actor follow them to see if they would return the bill. Most test subjects with divorced parents decided not to return the bill and admit they had seen a bill on the ground at all. Most of the test subjects without divorced parents returned the bill, this in return proves that ones past experiences affect ones present decisions. With this information, we can only acknowledge the fact that ones mistakes does not define that person, but is a reflection on their past. This information should in result have humans more understanding of each other.

**Introduction**

The purpose of this research is to determine if people have free will and if one is able to control one's thoughts. One may hypothesize that people do not have the ability to freely make decisions out of pure understanding of the world, instead our feelings and past experiences greatly affect the outcome of our decisions. Answering this problem is crucial because if we find the roots of people's decisions and what causes one to behave in certain ways rather than just referring back to the ancient human believe that if one does something wrong it is straight up ones fault and that person should be punished, we may be able to understand and physiologically alter our beliefs and ones bad decisions as they are happening or maybe even before they happen. This in result would

**Introduction Continued**

create a more peaceful world because if our society can understand the human mind and what causes people to behave the way they do we could prevent murder and find better ways to deal with the emotions and thoughts that causes people to act that way. This would also create a more understanding world, if not world maybe a more understanding and more justice full court system and school system.

If we do not have free will and all our actions are based on previous actions, thought and feelings that pop into us because of our surroundings, then one could find more effective means of punishments and ways to prevent people from repeating their actions and creating a moral fear rather than a fear of jail to stop us from doing bad.

**Introduction Continued**

This is because if we know what causes affects us and influence us into doing bad, then we could use psychological means of dealing with these thoughts and

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feelings, and having one more aware of his thoughts and actions. If one was to ask anyone “do you want a good life or bad life” the answer will certainly always be good. If one ask someone if they think living in jail is a good life or bad life the answer will certainly be bad life. Then why do people still go to jail, I mean no one wants to go to jail, therefore we are not completely free in our decisions. Our feelings and thoughts influence our behaviour and these feelings and thoughts come from pervious experiences.

## Methods

Research either in a school or neighborhood or any other social place where one can run this experiment, the research should be to find children between ten and fifteen years of age who had their parents divorced. One can find out whose parents have been divorced by asking people around friends or family if they know anyone in the neighbourhood or the

place you are conducting this experiment if any of

the children around has had their parents divorced.

Afterwards, research the times that the children with

divorced parents leave their home (I.e. to walk to their friend’s house) and the path they take. Set up a bill with a high value preferably a one-hundred-dollar bill in the path they take. Stabilize the bill with a rock or stone keeping the bill clearly visible but

## Methods Continued

making sure it will not fly away by the wind. Hide behind a bush or green electric box and wait for the test subject to pass by the bill, if the test subject doesn’t even pick up the bill but clearly acknowledges it mark it down

as I they didn’t steal the bill, if the test subject takes the bill walk behind the test subject as if you were just casually walking in the area and ask if he or she has seen a bill, if the test subject replies with *no*, mark it down as if they stole. If the test subject returns the bill mark It down as if they didn’t steal. The independent variable is the bill placed on the ground, the dependant variable was wither the test subjects stole the bill or not. Finally, the controlled variable was the test subjects, this variable had to be controlled because the experiment needs people with divorced and non-divorced parents.

## Results

The results were as expected, in this case all test subjects with divorced parents stole the bill, though not all test subjects were expected to steal.

Only one of the test subjects without divorced parents stole the bill. Test subjects with divorced parents were expected to steal and test subjects without divorced parents were not expected to steal which was proven true with this experiment.

(figure 1) This proves the original hypothesis to be true, that past experiences and feelings greatly affect present choices. The information gathered shows no correlation between when the test subjects parents

## Results Continued

were divorced and wither or not they stole the bill. Though the kids with parents divorced earlier were theoretically expected to steal the bill less often, because there is a higher chance that they would have forgot or at least it would have meant less to them, and would not



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have been as significant as having one parent getting divorced not too long ago.

Though the information shows no correlation between the age of the parents' divorce, there is a slight connection between whether the test subject was a male or female, the one female that stole the bill looked around before taking the bill and the males not as often also the results show that males stole the bill more often and that no male did not steal the bill.

Figure 1- This table shows the age of the test subject whether or not their parents are divorced, if they stole the bill or not the age when their parents got divorced and finally their gender.

| Age | Parents Divorced or not | Stole the bill or not | Age of child when parents got divorced. | Gender |
|-----|-------------------------|-----------------------|-----------------------------------------|--------|
| 15  | divorced                | Yes                   | 6                                       | Male   |
| 15  | divorced                | yes                   | 12                                      | Female |
| 15  | Not divorced            | Yes                   | --                                      | Male   |
| 16  | Divorced                | yes                   | 7                                       | Male   |
| 15  | Not divorced            | No                    | --                                      | Female |
| 15  | Not divorced            | No                    | --                                      | Female |

## Discussion/Conclusion

Yes, the hypothesis was correct, that our surroundings affect our actions and behaviours, and that every previous incident or event that has happened in our lives affects our decisions and our thoughts/feelings. To answer the initial question asking

if we have free will and whether or not we control our thoughts, no we do not make decisions out of the blue based on if we are good or bad people

but that previous experiences heavily affect our choices, this was proven because the people with the divorced parents stole the bill much more often than the people that did not have their parents divorced.

The results show that people with divorced parents have a higher chance of stealing the bill than people with non-separated parents. All ages were the same except for the error of having a 16-year-old mixed with the other 15 year olds. Males also seemed to have stolen the bill more frequently as well, though this could have just been a lack of data, because there was not enough data to justify that males steal more

than females.

These results relate to the original question by proving that the age and gender do not have as big of an impact to committing crimes as one's past does. Research has been done in previous years where a test subject would read an article that states that cheating on an exam is not necessarily a bad thing and it encouraged the idea of cheating, there was

## Discussion/Conclusion Continued

another group of test subjects that read an article stating that cheating was a very bad thing and it exaggerated the fact that cheating was wrong, these test subjects were called in weeks after to write an exam where the answers were simple to obtain but the instructor told them clearly to not look at the answers. Evidentially the group that

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read the article stating cheating was wrong looked at the answers much more often than the group that read the article stating cheating was wrong.

This information shows that your actions can be altered by experiences and information given to you not necessarily long ago. This information also proves that people's decisions and moral structure may be altered by something as small as an article, so what if it was a friend you look up to, that would indeed make a much larger impact on your decisions and morals. This fact has been acknowledged in schools and families, the fact that you should select good friends that will guide and show you the right way.

### **Application**

This information could be very affective if everyone was to accept it which is near impossible, this is

### **Application Continued**

because we have lived our lives with the idea that all our decisions and mistakes are our free decision, which is correct to a certain point. That is where the struggle to have most people understand begins, but in an ideal world this information would be useful

because in school systems instead of punishing a student, we should punish a student and find the

reason that caused the outcomes of his actions and have other students understand that these experiences/ feeling lead to this type of behaviour

and just by acknowledging this information we may be able to understand ourselves more and control our actions more.

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There's No Such Thing as Free Will.

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Kevin, T. (No specific publication date posted) Internet Encyclopedia of Philosophy, Free Will.

<http://www.iep.utm.edu/freewill/>

because we have lived our lives with the idea that all our decisions and mistakes are our free decision, which is correct to a certain point. That is where the struggle to have most people understand begins, but in an ideal world this information would be useful

## **The Effects of Running on the Mental Health and Study Habits**

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### **Abstract**

In this study, the purpose of this experiment was to inquire the benefits of consistently running compared to any other physical exercise. The question investigated was ‘how does running affect the mental health and study skills?’. Stress is a world-wide prevalent issue among all ages, and finding the solution to this is very critical. An experiment was formed to inquire how consistently running impacted one’s stress level and study skills. The data was gathered from 15 different people through a stress tracker journal that was filled out daily at two different occasions. They did it daily before running, playing a sport or not doing any physical exercise and after doing the exercise. The stress level written for each category, was then averaged and data was compared to subjects participating in other sports (physical activity) and subjects that didn’t participate in any physical exercise. The results for assessing the participants’ study skills were gathered through a survey which was filled out before and after the 2-week study to ensure accurate results. The outcome of the experiment answered the initial question, running has a great advantage on the mental health, and a moderate benefit on one’s study habits by relieving stress and improving many academic skills needed in the everyday life.

### **Introduction**

The purpose of this experiment was to inquire the benefits of consistently running compared to any other physical exercise.

It is vital to inquire on this topic, as stress is increasing globally among all ages and finding a solution to it is required to lead a productive life (Running competitor). To move forward in this fast-paced world, running will

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play a pivoting role in reducing mental stress, and enhancing mental abilities during the education years.

The question researched was how does running consistently affect a person's mental health and study skills.

The hypothesis for this investigation is, if people run more often, their mental health



and study habits will increase

because running produces an endorphin rush, which in return reduces pain, combats stress, relaxes the mind, and even increases the neurons in hippocampus in the brain which is the control centre of memory and knowledge (Rodalewellness). Not only does running decrease a person's stress, but also improves and sharpens the brain. Some benefits on the brain directly impacted by running are, quick recall, improved focus, decision making, planning, organizing, and juggling mental tasks are all easier to accomplish (Team Airia).



(Figure 1) on the left shows a girl running on a bridge. Image retrieved from google images. (Figure 2) on the right shows a high-school runner racing at provincial championships (OFSAA) at Petawawa, Ontario.

## Methods

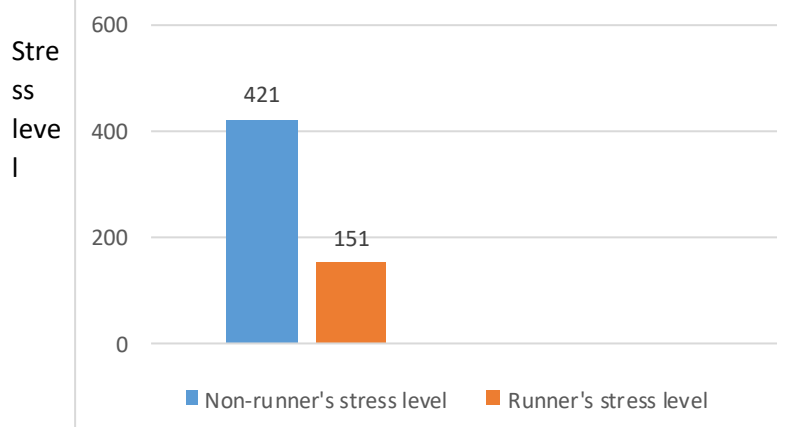
The experiment was done under a two-week study for participants who were either consistently running, playing different sports, or not exercising at all. This

study was done by a stress tracking journal to accumulate accurate results. To collect data for this study, 15 participants were chosen, five subjects who consistently ran, five subjects who played different sports other than running and five subjects who did not participate in any physical exercise. All participants were asked to rate their stress from 0-10 (0 being no stress, 10 being the most stress) daily for 2 weeks before and after the participating in exercise. To collect data for study habits, the same participants were asked to fill out a study habits questionnaire. The subjects answered questions based on academic skills such as testing/reading, time management/ procrastination, concentration/memory, test anxiety, information processing and motivation/attitude. For constant runners, stress level was written down twice daily, on a scale of 1-10 (no stress is 0, highest stress is 10) and stress triggers (homework, exams, competitions, etc.) for that day in 'Stress Reduction Journal'. This was done prior to running and filled out again after running. 'Stress Journal Questionnaire' was filled out after the 2 weeks of marking down stress levels and stress triggers in 'Stress Reduction Journal'. The level of stress reduction in 'Stress Reduction Journal' was observed and how it was changed before and after running. The different options regarding the study habits were chosen in 'Study Habits Questionnaire' to find out how they were affected. Finally, all types of journals and questionnaires were compared to find out how running affected the mental health and study habits among the participants who played different sports or none at all. Subjects were asked to repeat steps 1-7 if they played other sports and substituted running for the sport they play. If no sports were played, stress level was marked down after getting home from school/ work and just before sleeping.

(Figure 3) shows the stress level of participant consistently running for 2 weeks (421) compared to participant who did not exercise (151)

In this study, three types of variables were kept into consideration. The dependent variable for this study is the amount of stress decreased after a run/other sports and the decrease or increase in study habits such as concentration, memory, and efficiency. These are dependant variables because they change depending on the participants physical activity. The independent variables were identified as the different type of participants. The participants in the study were changed so the results gathered for this experiment would be precise and more accurate, rather than gathering limited results. The constant variable throughout this study is the survey, the number of participants, and length of experiment. These factors were kept constant to keep a complete record of their stress level and study habits during the period of experiment. Another reason they were kept as controlled variables, was to ensure the accuracy and reliability of this procedure.

Decrease in stress level after running for 2 weeks



## Results

At the end of the study, the data was collected and analyzed. After the stress levels and study skills were accumulated, the data suggests that after running for two weeks consistently, a person's mental health increased, study habits improved and stress decreased dramatically. Participants reported different stress levels in this two weeks study according to the scale, minimum stress level was 0, and maximum stress level was 1400 in total. As an added average, the five runners' stress level was 421 before running, and it declined markedly to 151 after two weeks of running. The participants engaging in other sports had a moderate reduction in stress from 354 to 253. As expected, the stress level in the 'no physical activities group' remained almost unchanged, declining only marginally from 357 to 335. Results gathered in the study skills, were similar to the data in the stress reduction questionnaire (highest skills- 32, least skills - 0). The participants 'consistently running' achieved an average of 26-29, participants in other sports group scored an average of 24-27, and the 'none physical activity group' reached a score of 21-24.

## Discussion/Conclusion

After analyzing the data collected, the hypothesis was proven correct. The initial purpose was to determine the impact of running on a person's academic abilities and mental health. Two problems were encountered through this process. Although this questionnaire was done appropriately, some participants responded to the questionnaire to the best of their recall abilities, in case they filled out the questionnaire at a different time (later). Another problem was the different workloads of

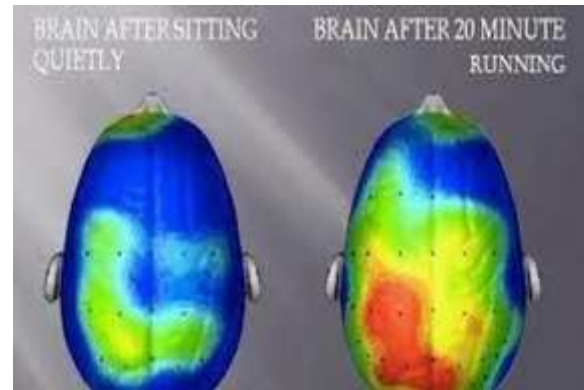
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assignments on different days. Participants having smaller homework to finish on certain days, noticeably felt less stressed as compared to the heavier homework days, regardless of their physical sports participation. Comparing the three groups (runners, other sports, no physical activity), academic skills seemed to be improved more in runners followed by other sports activities and stayed the same in the no physical activity group. The more marked improvement was observed in concentration/memory, motivation/attitude, test anxiety, and information processing. Whereas academic skills like writing and testing/reading improved only moderately. The time management/ procrastination skills were the most varied result collected. For future applications, this experiment could be done differently by expanding the time understudy, from two weeks to a few months to improve reliability, and increasing the number of participants. To gather data more accurately, for future this experiment could be done differently by gathering data from participants who had roughly the same amount of stress triggers such as homework, assignments, or projects to begin with, so the results will be accurate for all participants.

### Application

Running can play a beneficial role in different aspects of life. It can be incorporated in many different areas such as stress reduction, physical health improvement, increased academic skills such as increased focus and concentration, and prevention of chronic medical diseases. Running will specifically help those who are

prone to stress. It will also help a group of patients suffering with mental illnesses such as generalized anxiety disorder, depression, impulse control, addiction disorder, and substance use and abuse. Alleviating stress can minimize and prevent these mental illnesses besides impacting the physical health in a positive manner. In order to increase the students' academic grades, running



can  
be  
used  
to

improve study habits and eventually the overall school performance.

(After sitting still)      (After running for 20 minutes)

(Figure 4) shows more brain activity on the right when the participant ran for 20 minutes, compared to when participant sat still for 30 minutes. Image retrieved from <http://newsroom.gehealthcare.com/week-3-getfit-update-campaign-gains-momentum/>)

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### **Missing Consecutive Basketball Shots in Relation to Shooting Slumps**

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#### **Abstract**

The question that was asked was whether missing a few consecutive shots in basketball can cause a shooting slump. The study was conducted by watching NBA players play and investigating the pattern of their shots made/missed. From the results gathered, it can be derived that if a player misses 3 or 4 consecutive shots, it causes a difference in their playing ability and they continue to miss for a while. Therefore, from these results and the analysis, it can be confirmed that missing a few consecutive shots in basketball can indeed caused a shooting slump.



## Introduction

This project is about missing basketball shots and how they can cause shooting slumps. Researching and experimenting with this problem is important because it can help players who miss their shots often. It can help the player by letting them know how they can change their playstyle or mindset if missing their first shot negatively impacts their game. An example of why this is important is when Stephen Curry, one of the greatest shooters of all time, had a string of games last season where he shot very poorly and, so he needed to improve upon his shooting (Silverman, S (2017, September 11<sup>th</sup>) Does Your Body Angle Affect Your Basketball Shooting?).

The question that is asked is whether missing a few consecutive shots in basketball can cause a shooting slump for the rest of that game. A “shooting slump” is defined as a period of time in which a player misses every single shot that they take. The amount of shots missed for it to be classified as a shooting slump is 4 or more because that makes it a larger and more reliable sample size. Also, if a player misses a shot while playing basketball, then their performance in that time frame will be negatively affected as well. This is because if you shoot poorly, then your muscle memory of making shots and the memories of having the ball fall through the net will not be there. This is backed up by the fact that muscle memory makes it so that an action that you do very often is imprinted in your mind. However, if you don’t make shots for a while, then your muscle memory will be messed up.

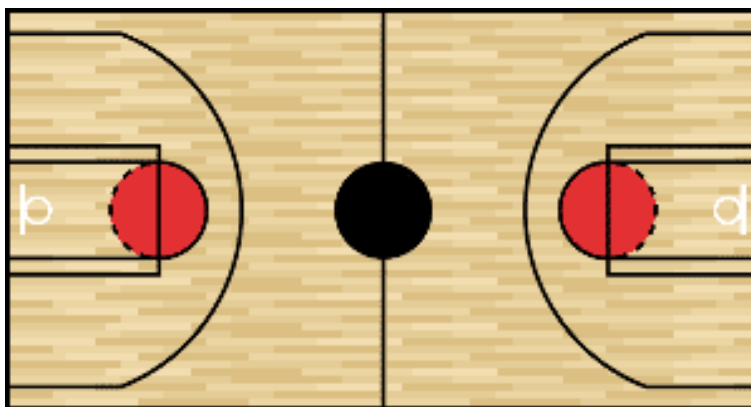
## Methods

The procedure for this experiment is conducted through a manner of steps. First, a list of NBA players that want to be studied must be made. Then, a game in which that player is playing in must be watched to determine their shooting patterns. Afterwards, every time the chosen player makes or misses a shot, it must be recorded. At the end, the shooting patterns of the players can be looked at and compared.

The independent variable that will be used in this experiment is the chosen player. This is because every player has a different average for points per game, rebounds per game, assists per game, etc. Also, every player has a unique playstyle. Some players can be very aggressive

defenders, great shooters or all-around formidable athletes. Finally, some players can hit a lot of shots depending on their height compared to their defensive matchup, their own skill or their team's ability to get them good, open shots.

The dependent variable in this experiment will be the shooting percentages of the player, the amount of shots per game they take, the ability of the team of they're playing on, the quality of the shots they are taking and the ability of the opposing team on defense. The controlled variables will be the basketball (all the same size), the size of the court (all NBA courts are the same size) and the nets (all the same height).



|    | A                | B                      | C                      | D                 | E          | F            | G                                                              | H | I | J |
|----|------------------|------------------------|------------------------|-------------------|------------|--------------|----------------------------------------------------------------|---|---|---|
| 1  | Player Name      | Team                   | Opponent               | Total Shots Taken | Shots Made | Shots Missed | Pattern of Missed and Made Shots (Made Shots=X,Missed Shots=O) |   |   |   |
| 2  | James Harden     | Houston Rockets        | Utah Jazz              | 25                | 19         | 6            | XXXXXXXXXXOXXXXXXXO                                            |   |   |   |
| 3  | James Harden     | Houston Rockets        | Memphis Grizzlies      | 25                | 11         | 14           | OXOXOXOXOXOXOXOXOXOXO                                          |   |   |   |
| 4  | James Harden     | Houston Rockets        | Cleveland Cavaliers    | 21                | 8          | 13           | XOXOXOXOXOXOXOXOXOXO                                           |   |   |   |
| 5  |                  |                        |                        |                   |            |              |                                                                |   |   |   |
| 6  | LeBron James     | Cleveland Cavaliers    | Houston Rockets        | 24                | 15         | 9            | XXXXXXXXXXXXOXOXOXOXOXO                                        |   |   |   |
| 7  | LeBron James     | Cleveland Cavaliers    | Washington Wizards     | 34                | 23         | 11           | XXXXXXXXOXOXOXOXOXOXOXOXOXOX                                   |   |   |   |
| 8  | LeBron James     | Cleveland Cavaliers    | Atlanta Hawks          | 17                | 10         | 7            | OXXOXOXOXOXOXOXOX                                              |   |   |   |
| 9  |                  |                        |                        |                   |            |              |                                                                |   |   |   |
| 10 | Bradley Beal     | Washington Wizards     | Portland Trail Blazers | 37                | 21         | 16           | XOXOXOXOXOXOXOXOXOXOXOXOXOXOXOX                                |   |   |   |
| 11 | Bradley Beal     | Washington Wizards     | Utah Jazz              | 15                | 4          | 11           | OXOXOXOXOXOXOXOX                                               |   |   |   |
| 12 | Bradley Beal     | Washington Wizards     | Detroit Pistons        | 11                | 4          | 7            | OXOXOXOXOXO                                                    |   |   |   |
| 13 |                  |                        |                        |                   |            |              |                                                                |   |   |   |
| 14 | Paul George      | Oklahoma City Thunder  | Chicago Bulls          | 15                | 4          | 11           | OXOXOXOXOXOXOXOX                                               |   |   |   |
| 15 | Paul George      | Oklahoma City Thunder  | San Antonio Spurs      | 16                | 5          | 11           | OXOXOXOXOXOXOXOXOXO                                            |   |   |   |
| 16 | Paul George      | Oklahoma City Thunder  | New Orleans Pelicans   | 17                | 9          | 8            | XXXOXOXOXOXOXOXOXO                                             |   |   |   |
| 17 |                  |                        |                        |                   |            |              |                                                                |   |   |   |
| 18 | Kyrie Irving     | Boston Celtics         | Brooklyn Nets          | 20                | 8          | 12           | OXXOXOXOXOXOXOXOXOXOXO                                         |   |   |   |
| 19 | Kyrie Irving     | Boston Celtics         | Golden State Warriors  | 16                | 4          | 12           | XOXOXOXOXOXOXOXOXO                                             |   |   |   |
| 20 | Kyrie Irving     | Boston Celtics         | Atlanta Hawks          | 12                | 10         | 2            | XXOXOXOXOXOX                                                   |   |   |   |
| 21 |                  |                        |                        |                   |            |              |                                                                |   |   |   |
| 22 | Andrew Wiggins   | Minnesota Timberwolves | Dallas Mavericks       | 15                | 7          | 8            | XOXOXOXOXOXOXOX                                                |   |   |   |
| 23 | Andrew Wiggins   | Minnesota Timberwolves | Detroit Pistons        | 18                | 11         | 7            | XOXOXOXOXOXOXOXOXOXO                                           |   |   |   |
| 24 | Andrew Wiggins   | Minnesota Timberwolves | Charlotte Hornets      | 14                | 5          | 9            | XXOXOXOXOXOXOXO                                                |   |   |   |
| 25 |                  |                        |                        |                   |            |              |                                                                |   |   |   |
| 26 | Donovan Mitchell | Utah Jazz              | Brooklyn Nets          | 15                | 5          | 10           | OXOXOXOXOXOXOXOXO                                              |   |   |   |
| 27 | Donovan Mitchell | Utah Jazz              | Orlando Magic          | 9                 | 4          | 5            | XOXOXOXOX                                                      |   |   |   |
| 28 | Donovan Mitchell | Utah Jazz              | Philadelphia 76ers     | 19                | 6          | 13           | OXOXOXOXOXOXOXOXOXO                                            |   |   |   |
| 29 |                  |                        |                        |                   |            |              |                                                                |   |   |   |
| 30 | Kyle Kuzma       | Los Angeles Lakers     | Phoenix Suns           | 23                | 11         | 12           | OXXOXOXOXOXOXOXOXOXOXOX                                        |   |   |   |
| 31 | Kyle Kuzma       | Los Angeles Lakers     | Denver Nuggets         | 11                | 7          | 4            | XOXOXOXOXOXO                                                   |   |   |   |
| 32 | Kyle Kuzma       | Los Angeles Lakers     | Chicago Bulls          | 15                | 7          | 8            | XXXXXOXOXOXOXOXO                                               |   |   |   |
| 33 |                  |                        |                        |                   |            |              |                                                                |   |   |   |
| 34 | CJ McCollum      | Portland Trail Blazers | Memphis Grizzlies      | 17                | 8          | 9            | OXOXOXOXOXOXOXOXOX                                             |   |   |   |
| 35 | CJ McCollum      | Portland Trail Blazers | Philadelphia 76ers     | 14                | 1          | 13           | OXXOXOXOXOXOXOXOXO                                             |   |   |   |
| 36 | CJ McCollum      | Portland Trail Blazers | Brooklyn Nets          | 19                | 10         | 9            | OXXOXOXOXOXOXOXOXOXOX                                          |   |   |   |
| 37 |                  |                        |                        |                   |            |              |                                                                |   |   |   |
| 38 | Robert Covington | Philadelphia 76ers     | Houston Rockets        | 8                 | 2          | 6            | OXXOXOXO                                                       |   |   |   |
| 39 | Robert Covington | Philadelphia 76ers     | Atlanta Hawks          | 15                | 7          | 8            | XXXXXOXOXOXOXOXOXO                                             |   |   |   |
| 40 | Robert Covington | Philadelphia 76ers     | Indiana Pacers         | 13                | 8          | 5            | XOXOXOXOXOXOXOXOX                                              |   |   |   |

Table 1. A table which shows the data collected from NBA players and their shooting stats as well as their pattern of misses/makes.

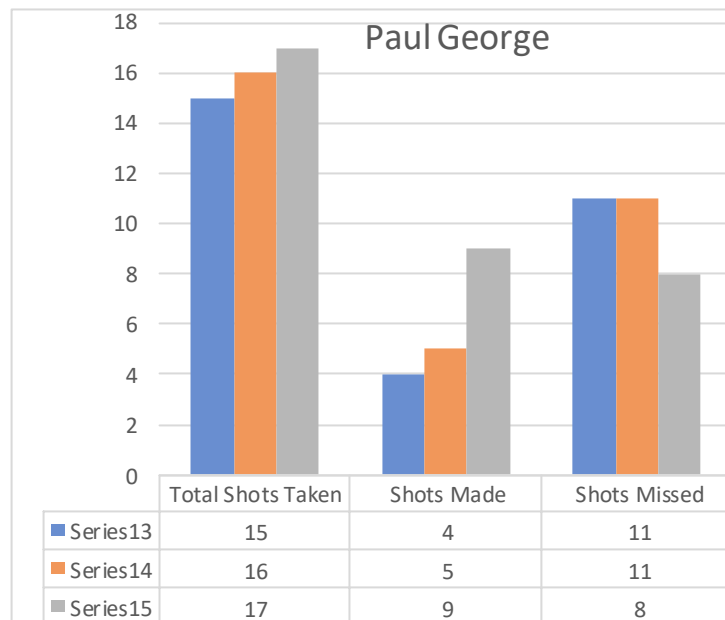


Figure 1. The numbers of misses per attempts of the NBA player Paul George

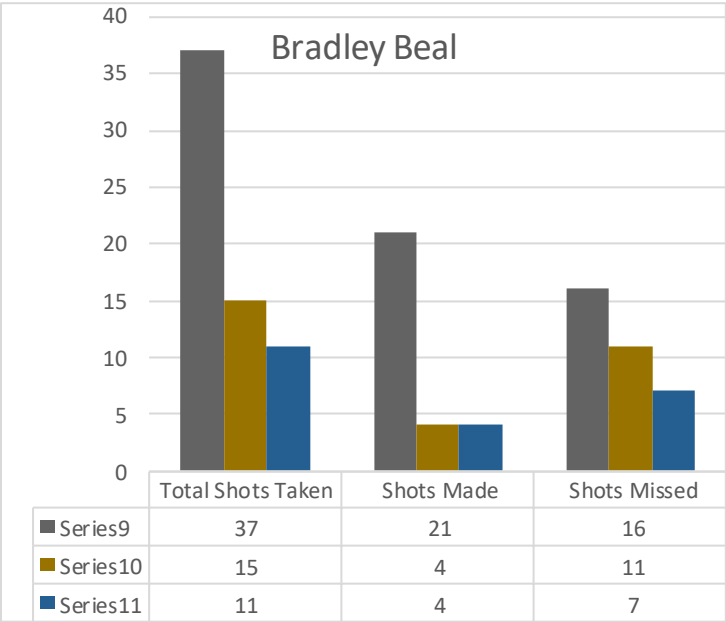


Figure 2. The numbers of misses per attempts of the NBA player Bradley Beal

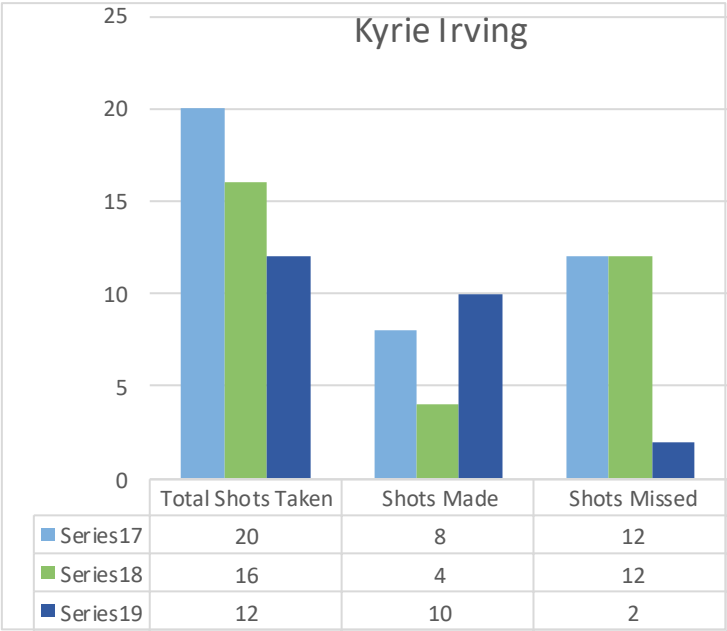


Figure 3. The numbers of misses per attempts of the NBA player Kyrie Irving

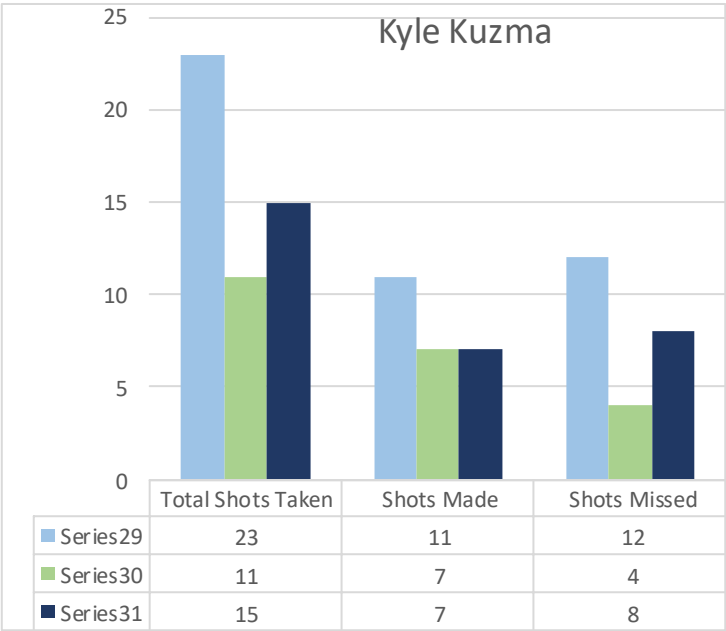


Figure 5. The numbers of misses per attempts of the NBA player Kyle Kuzma

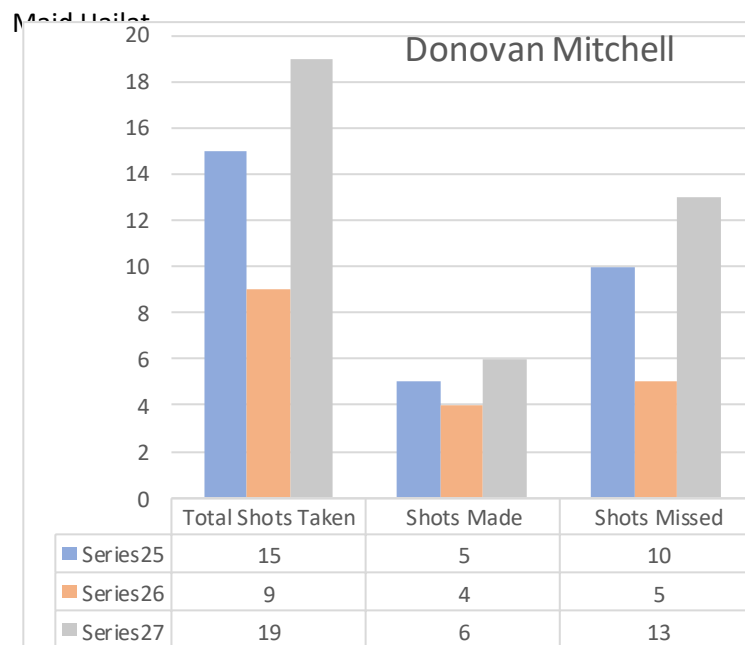


Figure 4. The numbers of misses per attempts of the NBA player Donovan Mitchell

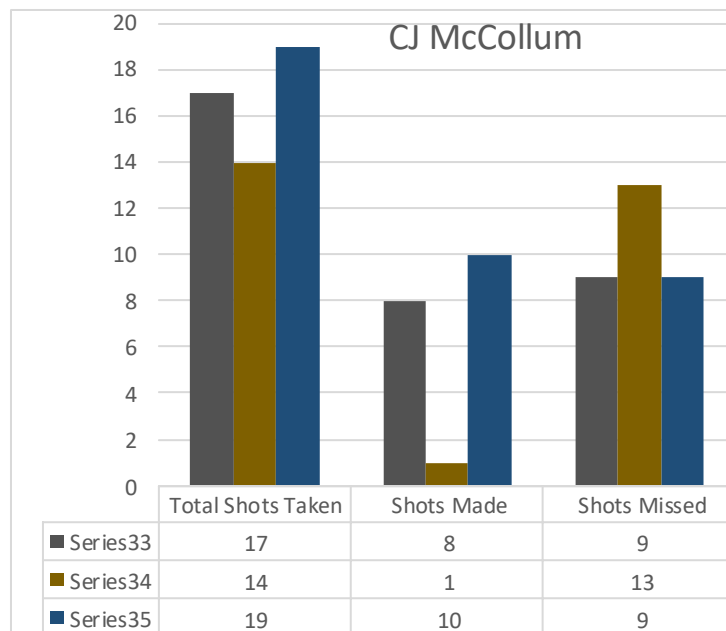


Figure 6. The numbers of misses per attempts of the NBA player CJ McCollum

## Discussion/Conclusion

In the end, the hypothesis of the question of whether missing a few consecutive shots in basketball can cause a shooting slump was proven to be correct. This is proven in the data which is highlighted in Figure 2. James Harden proves the hypothesis when he missed a few shots in a row against the Cleveland Cavaliers and ended up finishing the game with 6 consecutive misses. It is also evident in Paul George's performances against the Chicago Bulls and the San Antonio Spurs. In the first game, he missed a few shots and ended up missing a grand total of 9 consecutive shots and in the second game, a similar situation occurred, and he missed

6 consecutive shots. However, the game in which I found this most evident in is in CJ McCollum's game against the 76ers, in which he missed 7 consecutive shots, made one shot and missed another 5 shots. This relates to the question because it provides an answer to the question of whether missing a few consecutive shots can cause a shooting slump. It relates to the hypothesis because it proves that it is correct and that missing a few consecutive shots indeed causes a shooting slump. However, it also shows that this doesn't occur often to players that are at an elevated level such as James Harden and LeBron James. They can be considered as outliers.

| Player Name  | Team                  | Opponent               | Total Shots Taken | Shots Made | Shots Missed | Pattern of Missed and Made Shots (Made Shots=X, Missed Shots=O) |
|--------------|-----------------------|------------------------|-------------------|------------|--------------|-----------------------------------------------------------------|
| James Harden | Houston Rockets       | Utah Jazz              | 25                | 19         | 6            | XXXXXXXOXOXOXXXXXDOO                                            |
| James Harden | Houston Rockets       | Memphis Grizzlies      | 25                | 11         | 14           | OXXOXOXOXOXOXOXOXOXOXO                                          |
| James Harden | Houston Rockets       | Cleveland Cavaliers    | 21                | 8          | 13           | XOXOXOXOXOXOXOXOXOXOXO                                          |
| LeBron James | Cleveland Cavaliers   | Houston Rockets        | 24                | 15         | 9            | XXXXXOXOXOXOXOXOXOXOXO                                          |
| LeBron James | Cleveland Cavaliers   | Washington Wizards     | 34                | 23         | 11           | XXXXXOXOXOXOXOXOXOXOXOXOX                                       |
| LeBron James | Cleveland Cavaliers   | Atlanta Hawks          | 17                | 10         | 7            | OXXOXOXOXOXOXOXOXOXOX                                           |
| Bradley Beal | Washington Wizards    | Portland Trail Blazers | 37                | 21         | 16           | XOXOXOXOXOXOXOXOXOXOXOXOXOX                                     |
| Bradley Beal | Washington Wizards    | Utah Jazz              | 15                | 4          | 11           | OXXOXOXOXOXOXOXOXOXOX                                           |
| Bradley Beal | Washington Wizards    | Detroit Pistons        | 11                | 4          | 7            | OXXOXOXOXOXOXOXOXOXOX                                           |
| Paul George  | Oklahoma City Thunder | Chicago Bulls          | 15                | 4          | 11           | OXXOXOXOXOXOXOXOXOXOXOX                                         |

### Application

Table 2. The highlighted rows indicate the most evident examples of shooting slumps

This information could be useful for fields of study such as ~~neurology to explore the~~ mental aspect behind this problem. Also, it could be used in the fields of study of biology to study whether the problem has something to do with the muscle movements of the player. This information could also be used by the general public or the scientific community to show that shot selection really is crucial and if you miss one shot, it could turn out to a disaster. These results ultimately fit into the big picture of the NBA because these players could use the information gathered on them to improve their game and not get into as many shooting slumps.

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## **How does practicing affect your natural handwriting?**

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### **Abstract**

The question that started this whole experiment was to find the answer to if practicing will make any significant differences to our natural handwriting. If people are not satisfied with how their writing looks, then this would provide them with a chance. To see if there was an affect, in a set period of time participants were asked to practice their handwriting in pen and pencil. The handwriting would then be compared and analysed to see if there were any differences. The results showed no significant or major changes in the participants handwriting. according to the results it can be concluded that practicing your handwriting makes no significant difference.

### **Introduction**

Handwriting is a huge part of our daily routine and sometimes people aren't satisfied with it. If people are willing to change how they write, then this

experiment will allow them to see if it's possible. There was a study that was done that indicated that personality is linked to handwriting. If people change the way they

write it can be possible that it can affect your personality in a good way. Another study showed that people are quick to judge and that includes how they perceive other's handwriting. If people want to be perceived in some way, then changing their handwriting can help.

The big question is how practicing will affect natural handwriting. If people practice their handwriting then there will be a significant change because if they have the will and determination to do it, the brain will most likely accept these changes. It has been proven that the reason that people's

handwriting can change no matter the age is because they have the will to do it. If we reverse this process, then in theory you can change your handwriting. When you write something down the brain sends electrical impulses to the hand muscles. When people do things frequently then the brain will remember them, and it will slowly morph into everyday habits. Hard practice and practice go a long way when doing something. There are lots of situations where practice show improvement.

### **Methods**

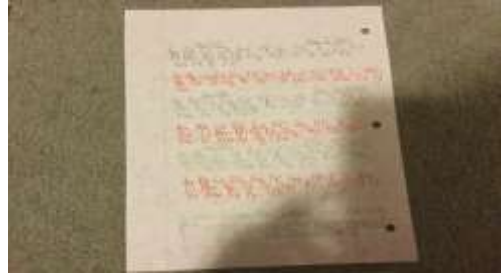
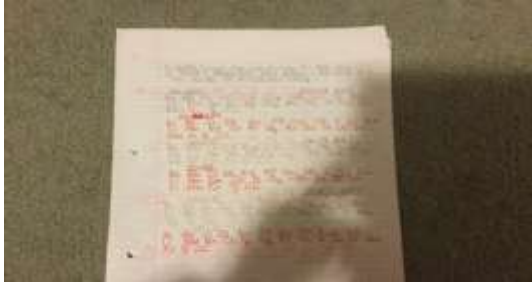
The experiment was conducted in a period of 21 days. Participants were asked to write down an initial sentence to give a base line of what their handwriting looked like naturally. Then they were asked to write down the alphabet two times once a day in both pen and pencil to see if different utensils made a difference. The participants were also asked to time themselves to see if time had any factor in how participants would write. Participants were also asked not to erase anything since the raw data was preferred. On the last day of the experiment participants were asked to rewrite the base sentence again to be

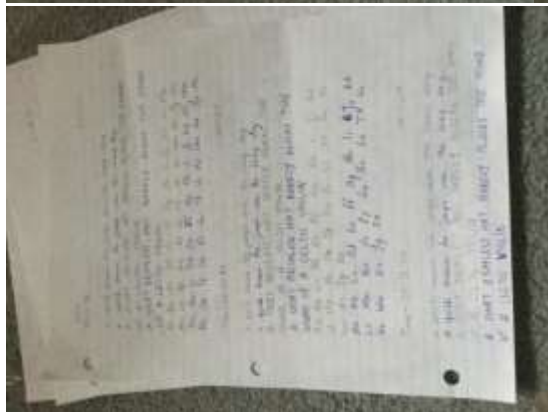
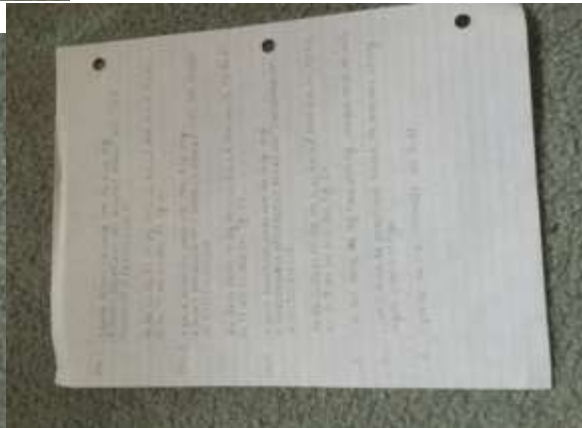
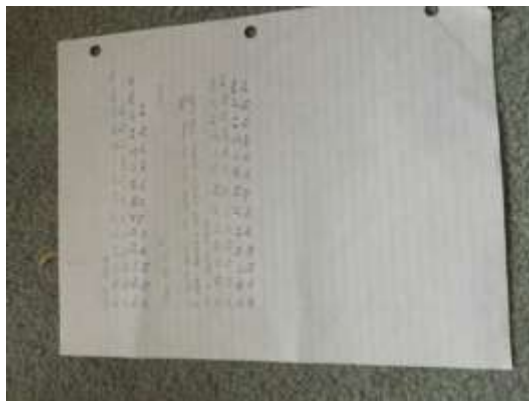
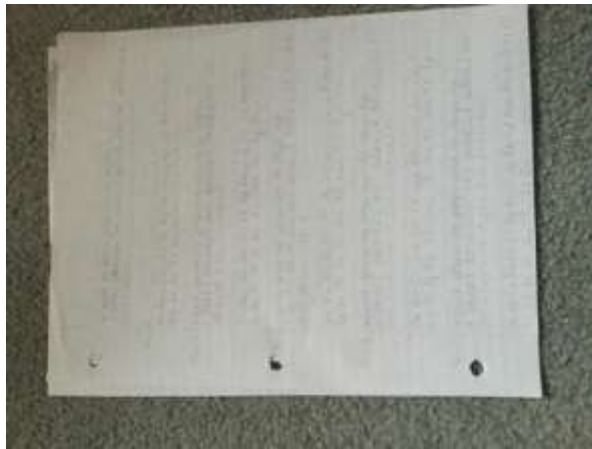
compared to the first time the sentence was written down. The participants are asked to keep all the papers safe and then hand them in on the designated day. The handwriting was then analysed and compared. The participants were then asked to answer a few questions to find out how they felt about the experiment. The dependent variable is the handwriting that each participant produced. It was what needed to be measured to answer the big question to see if practicing affects how the person's handwriting turned out. The independent variable of this experiment is the utensil that the participants used and the time it took to write things

down. Those were changed to see how it would affect the outcome of the participants' handwriting. The controlled variable was the practice and the initial

sentence because it was to give all participants an equal footing to do the experiment, so there were no advantages or disadvantages

## **Results**





| Question                                                       | Answer                              | Answer                                 | Answer                 |
|----------------------------------------------------------------|-------------------------------------|----------------------------------------|------------------------|
| 1. Do you think your handwriting changed in anyway? If so how? | Style didn't change, but got neater | Did not think handwriting changed much | Handwriting got neater |
| 2. Did the practice help?                                      | It might've                         | Didn't think it helped                 | Found it helpful       |

|                                                                                                                                       |                                                                                                                    |                                                                         |                                                                                      |
|---------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| <b>3. Did you find writing with a different utensil help you and make anything easier or do you prefer the one you regularly use?</b> | <b>Prefer pencil and didn't help, but it depends on what surface is being written on and what is being written</b> | <b>Didn't think it was helpful and prefer the utensil normally used</b> | <b>Didn't think writing with different utensil helpful and prefer the normal one</b> |
|---------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------|--------------------------------------------------------------------------------------|

The pictures on the left is the handwriting that participants started out with and the pictures on the right is the handwriting once they were done the writing practices. There were side by side comparisons to see if there was any difference between the two. The table contains the answers of the questions that were asked.

### **Discussions/Conclusion**

My hypothesis was not correct if people practice their handwriting then there will not be a meaningful change. According to the data collected people did not think that practicing handwriting changed anything. According to experts It is completely up to the person who is writing and how they are growing and developing or if they have physical or mental changes, so there are other factors that can affect how handwriting is changed and not just will. There was a lot of demanding work and practice that went with this experiment and it didn't really help. This might not morph

into people's daily handwriting since nothing significant happened. There wasn't a wide range in age, so it is not clear if the same results would happen in different age groups. The answer to the question "how will practice your handwriting affect your daily handwriting" according to my data is that it doesn't do a lot to affect your daily handwriting.

The analysis if the handwriting is quite subjective, so this analysis is according to personal views. Analyzing the practice that was done not much change was noticed from the beginning of the test and the ending. All results show that the most this test did was make the handwriting neater and according to data collected participants did not think that this test helped. Although according to experts it usually takes 30 days to show any significant difference in handwriting. Also, it is mentioned that to change your handwriting people must be willing to change it, and the participants might not have had the will to change

anything. Also, other factors were not taken into consideration like mood and others. This experiment went on for only three weeks, so maybe if it was extended there would be a more significant difference such as slating, change in size etc. The timing of the practices also went down as time, as weeks progressed, but it was not in a steady consistent flow downwards sometimes the time would rise back up from time to time by one or two seconds, but that is to be expected. The use of pen did not help or change anything in the daily handwriting of people according to data.

### **Application**

This information can be used by people who want to change their handwriting and want to know if practicing can help in anyway. Handwriting is directly linked to the brain, so the data that was collected may help in the psychology of handwriting. It might also spread awareness to the importance of handwriting since it's been dying with the more technological advances in our society. Also, it could show how practicing things repeatedly may not always have the affect that you think it does.

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### **What is the best way to get faster**

#### **(ABSTRACT)**

The purpose of this experiment was to find the best way to gain speed. This project is important because athletes will be able to utilize this information to help them and people alike. To do this, there was a comparison between two workouts to determine which one was better. One of them was custom made, and the other was professionally made. Subjects would test these workouts, by using them and then switching them later to see which one had improved more. The results that were determined were that the custom-made workout had better results than the professional workout. 4/6 of the subjects had better results than the 2/6 that improved more in the other workout. The custom workout was better than the professional workout.

**(INTRODUCTION)**

Many student athletes, professional athletes, and people alike try to achieve a goal when they exercise. The biggest question on their mind is “how to improve or get better”. This is important to these people because for student athletes; they need to get better to help win team games or independent sports. For professional athletes they would want to be the best and achieve new human heights. For athletic people, they could use this to help them, do better if they participate in marathons. When you exercise your muscle fibers get damaged and so your body tries to repair it with a cellular process. The muscle fibers are formed with new muscle proteins and, so that increases muscle mass and strength.

For those who are more focused on the running aspect of fitness, they try to get faster and increase their endurance. Then the real question is (“What is the best way to get faster?”) In the shortest and most efficient way possible. That’s where this project comes in. So, to find what is the best way to get faster, this project compares a professional workout to a custom workout.

If changing the method of training by rearranging and adding more exercises such as core exercises, arm exercises, calve exercises, and back exercises, than this should increase speed for running because these exercises focus more on the movements of body while running. With more exercises the results should be better due to the increase of intensity.

**(METHOD)**

To start this experiment initially there are supposed to be a minimum of 6 or more subjects, with even numbers. The total amount of subjects are then

separated into two groups, one that focuses on the professional workout first then the other group focuses on the custom-made workout. Record the



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subjects start times after placed into groups. Group one, follows the custom-made workout according to (Figure 1). Group two, then follows the professional workout according to (Figure 2). Once both groups finished their start workouts, group 1 then follows (Figure 3) track workout, and group 2 starts their track workout (Figure 4). Once a all workouts are

finished, continue the next day and record the data again. Continue this project for at least a minimum of 2 weeks or more, for both workouts. The independent variables are the two workouts. The dependent variable is the end speed of the subjects. The controlled variables are the weather, clothes, location, and equipment (timer).

(FIGURE 2)

1. Squats – 15 reps
2. Barbell Squats – 4 sets of 10 reps
3. Leg Press – 3 sets of 6 reps
4. Calf Lifter – 4 sets of 10 reps
5. Wall Squats – 1 min with a weight of 50-80 max of carry
6. Dead Lift – 5 sets of 6 reps
7. High knees – 1 min

(FIGURE 1)

1. Do Power Cleans - 5 sets of 5 reps
2. Do Barbell Squats - 3 sets of 6 reps
3. Do Bench Press - 3 sets of 6 reps
4. Do Plate and Bodyweight Complex Finisher - 3 supersets of the following:
5. Do Chin-ups - 10 reps
6. Do Jump Squats w/plate - 12 reps
7. Do Hanging Knee raise - 20 reps
8. Do Reverse Lunge w/knee drive - 8 reps on each leg
9. Do Dips - 10 reps
10. Do Sled Drag (40 ft.)

(Figure 3)

1. Skips - 50m
2. Backward Skips - 50m
3. High Knees - 50m
4. Butt Kicks - 50m
5. Backward runs - 50m
6. Leg swings (front and back) - 10 reps

#### Track training session I

##### **Conditioning Run**

8 x 200m. After each sprint, walk back to the start. Rest 2 minutes. Target time for each 200: 30 seconds or under.

#### Track training session II

##### **Race Modeling Run**

250m

150m x 2

Rest 90 seconds in-between reps and 8 minutes between sets.

(Figure 4)

1. Lunges – 50m
2. Sigon squats -1 min
3. Reaching toes – 30 secs

#### Track training session I

##### **Conditioning Run and Endurance Run**

2 x 800m. After each run, walk back to the start. Rest 10 minutes. Target time for each 800: 3 mins or under.

#### Track training session II

##### **Race Modeling Run**

250m

150m x 2

100m

**RESULT** Rest 3 mins in-between reps and 8 minutes between sets.

Table 1 "Experiment 2" Professional (Part 1)

### Distances

| Subjects | Number of Weeks | 400m         | 200m          | 100m          | Percentage of improvement       |
|----------|-----------------|--------------|---------------|---------------|---------------------------------|
| Baquer   | 0               | 1:56:41 mins | 38.23 seconds | 15.68 seconds | 11.1% Increase in speed in 400m |
|          | 1               | 1:48:29 mins | 37.56 seconds | 15.23 seconds | 3.7% Increase in speed in 200m  |
|          | 2               | 1:43:47 mins | 36.78 seconds | 14.24 seconds | 9.1% Increase in speed in 100m  |

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|       |   |              |               |               |                                 |
|-------|---|--------------|---------------|---------------|---------------------------------|
| Mitch | 0 | 1:09:08 mins | 33.76 seconds | 14.87 seconds | 11.7% Increase in speed in 400m |
|       | 1 | 1:04:87 mins | 34.56 seconds | 14.24 seconds | 2.6% Increase in speed in 200m  |
|       | 2 | 1:00:98 mins | 32.87 seconds | 14.04 seconds | 5.5% Increase in speed in 100m  |
| Aria  | 0 | 1:37:24 mins | 42.67 seconds | 16.98 seconds | 11.2% Increase in speed in 400m |
|       | 1 | 1:29:28 mins | 40.23 seconds | 16.36 seconds | 6.5% Increase in speed in 200m  |
|       | 2 | 1:26:26 mins | 39.89 seconds | 15.97 seconds | 5.9% Increase in speed in 100m  |

m=meters

Table 1 shows, all three subjects that tested the professional workout achieved around 11% increase in speed in 400m. In 200m, subjects have achieved an increase of 3.7%, 2.6%, and 6.5% in speed. In 100m, the three subjects have achieved increases of 9.1%, 5.5%, and 5.9%.

Table 2 "Experiment 2" Professional (Part 2)

### Distances

| Names | Number of Weeks | 400m          | 200m          | 100m          | Percentage of improvement       |
|-------|-----------------|---------------|---------------|---------------|---------------------------------|
| Roger | 0               | 1:01:25 mins  | 30:78 seconds | 13.97 seconds | 8.1% Increase in speed in 400m  |
|       | 1               | 59:45 seconds | 29:89 seconds | 13.47 seconds | 7.6% Increase in speed in 200m  |
|       | 2               | 56:98 seconds | 28:43 seconds | 13.49 seconds | 3.4% Increase in speed in 100m  |
| Felix | 0               | 1:00:24 mins  | 35:24 seconds | 16.11 seconds | 5% Increase in speed in 400m    |
|       | 1               | 1:00:89 mins  | 32:56 seconds | 15.65 seconds | 11.9% Increase in speed in 200m |
|       | 2               | 57:18 seconds | 31:03 seconds | 14.98 seconds | 7% Increase in speed in 100m    |
| Majd  | 0               | 2:06:72 mins  | 47:78 seconds | 18.67 seconds | 5.1% Increase in speed in 400m  |
|       | 1               | 2:05:98 mins  | 45:43 seconds | 18.42 seconds | 11% Increase in speed in 200m   |
|       | 2               | 2:00:23 mins  | 42:48 seconds | 18.03 seconds | 3.4% Increase in speed in 100m  |

Table 2 shows, the next three subjects that tested the professional workout have achieved 8.1%, 5%, and 5.1% increase in speed in 400m. In 200m, subjects have achieved 7.6%, 11.9%, and 3.4% increase in speed. In 100m, subjects have achieved 3.4%, 7%, and 3.4% increase in speed.

Table 3 "Experiment 1" Custom (part 1)

### Distances

| Names | Number of Weeks | 400m         | 200m          | 100m          | Percentage of improvement      |
|-------|-----------------|--------------|---------------|---------------|--------------------------------|
| Roger | 0               | 1:13:51 mins | 35.43 seconds | 15.54 seconds | 10% Increase in speed in 400m  |
|       | 1               | 1:10:56 mins | 32.65 seconds | 15.03 seconds | 8.5% Increase in speed in 200m |
|       | 2               | 1:05:36 mins | 31:98 seconds | 14.29 seconds | 8% Increase in speed in 100m   |

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|       |   |              |               |               |                                 |
|-------|---|--------------|---------------|---------------|---------------------------------|
| Felix | 0 | 1:23:93 mins | 45:34 seconds | 17.43 seconds | 22% Increase in speed in 400m   |
|       | 1 | 1:15:27 mins | 40:21 seconds | 17.02 seconds | 15.9% Increase in speed in 200m |
|       | 2 | 1:05:29 mins | 38:12 seconds | 16.57 seconds | 4.9% Increase in speed in 100m  |
| Majd  | 0 | 2:27:23 mins | 50:87 seconds | 23.3 seconds  | 10% Increase in speed in 400m   |
|       | 1 | 2:19:53 mins | 52:24 seconds | 19.79 seconds | 4% Increase in speed in 200m    |
|       | 2 | 2:12:24 mins | 48:24 seconds | 19.31 seconds | 17% Increase in speed in 100m   |

Table 3 shows, all three subjects that tested the custom workout achieved 10%, 22%, and 10% increase in speed in 400m. In 200m, subjects have achieved an increase of 8.5%, 15.9%, and 4.9% in speed. In 100m, the three subjects have achieved increases of 8%, 4.9%, and 17%.

Table 4 "Experiment 1" Custom (part 2)  
Distances

| Names  | Number of Weeks | 400m          | 200m          | 100m          | Percentage of improvement       |
|--------|-----------------|---------------|---------------|---------------|---------------------------------|
| Baquer | 0               | 1:38:78 mins  | 35.89 seconds | 14.20 seconds | 11.2% Increase in speed in 400m |
|        | 1               | 1:32:65 mins  | 35.12 seconds | 14.03 seconds | 5.5% Increase in speed in 200m  |
|        | 2               | 1:27:47 mins  | 34.23 seconds | 13.77 seconds | 3% Increase in speed in 100m    |
| Mitch  | 0               | 58:78 seconds | 32.08 seconds | 13.78 seconds | 6.7% Increase in speed in 400m  |
|        | 1               | 57:45 seconds | 30.69 seconds | 13.67 seconds | 9.3% Increase in speed in 200m  |
|        | 2               | 54:89 seconds | 28.98 seconds | 13.39 seconds | 2.8% Increase in speed in 100m  |
| Aria   | 0               | 1:23:21 mins  | 38.34 seconds | 15.45 seconds | 7.2% Increase in speed in 400m  |
|        | 1               | 1:19:45 mins  | 37.98 seconds | 15.49 seconds | 1.5% Increase in speed in 200m  |
|        | 2               | 1:17:24 mins  | 37.76 seconds | 15.05 seconds | 2.5% Increase in speed in 100m  |

Table 4 shows, the next three subjects that tested the custom workout have achieved 11.2%, 6.7%, and 7.2% increase in speed in 400m. In 200m, subjects have achieved 5.5%, 9.3%, and 1.5% increase in speed. In 100m, subjects have achieved 3%, 2.8%, and 2.5% increase in speed.

## DISCUSSION/CONCLUSION

The hypothesis was correct with the results that if changing the method of training by rearranging and adding more exercises such as core exercises, arm exercises, calve exercises, and back

exercises, than this should increase speed for running because these exercises focus more on the movements of body while running. With more

exercises the results should be better due to the increase of intensity.

The best way to get faster is to use the custom workout, because the custom workout focuses more on the movements of the body and during the experiment, it showed better results that 4/6 of the subjects improved more. The custom workout also showed the highest amount of improvement with 22% in 400m.

These results relate to the original question because they indicate and show an increase in speed which showed improvement. The custom workout results had better progress than the professional workout results.

The data does support my hypothesis, due to the better increased speed results from most subjects, by adding more essential exercises the better balanced the body is.

My results are consistent with other investigators because other investigators have

similar procedures and have the similar idea of balancing the exercises and doing more full body.

For problems and errors that may have affected the experiment, were the weather conditions, the subject's efforts and the subject's diets. The weather conditions would affect the results because the temperatures would tire out the subjects more quickly or tighten the muscles up more. In hot summer temperatures, the subjects would sweat more and get dehydrated. In cold winter temperatures, the subject's muscles would freeze and tighten up and slowing down the circulation in the body, making them run slower. For the subject's diets, having a bad diet could lead to bad energy requirements, poor performance, low hydration levels, and bad macronutrient needs. The amount of effort is also important because it affects the accuracy of the end results, by not going to the full potential. If these problems or errors had not happen, then in the experiment results would have been received faster and the potential increase in speed should have been greater.

## APPLICATION

**How would this information be applied to other fields of study?**

This information would be applied to other fields of study such as other sports, myology and kinesiology. In other sports they could see where and how to use speed to their better advantage. In football for example, they could use this study to help their players run faster and get into their positions quicker. In myology and kinesiology, this information can be used to see, how to train the muscle the most efficient way possible and see how efficient the muscle is used.

**How would the general public or scientific community use this information?**

The use of this information would help the general public by helping parents help their kids train for their special sport. In the scientific community they could see the most efficient way to train.

**How do your results fit into the big picture?**

These results can help any future athlete globally trying to achieve athletic goals. This is a very universal workout experiment where any sport can use it to train and get better.

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## YOUTUBE

<https://www.youtube.com/watch?v=IVXKnsM0Z1s&t=11s>

# The Holistic Qualities of Music and Their Influence on the Appreciation of Music

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## Abstract

The purpose of this experiment was to find out the most influential qualities of music, in order to determine what causes people to like the songs they like, and why. The plan for completing this experiment was to conduct a survey that would present songs and question the subjects on the qualities of the songs. The subjects would answer questions related to how influential the qualities of music were in the liking of the song, as well as how influential each quality was in relation to all the others. The results proved to be thorough, showing that “melody” was the most influential quality in the process of forming an opinion for a song, being chosen exactly 40% of the time over the other 5 options by the subjects. “Rhythm” was the second most influential quality, being chosen about 20.667% of the time by the subjects as the quality that influenced the subject’s opinion on the song the most. “Beat and meter” was a close third, at being chosen about 18.667% of the time. “Tempo” was the most influential at 8% of the time, where as “harmony” was the most influential at 6.667%, and “pitch” was the most influential only 6% of the time. These results show that a listener’s opinions on a song are influenced the most by the melody, which is proven by trends in the current industry of music, as melody-driven pop songs are popular. These results imply the most important factor in the forming of an opinion of a song is the melody, the rhythm, and the beat – in that order.

## Introduction

The purpose of this experiment was to get a better understanding for the appreciation of music, and to attempt to make sense of 'good' music, which is inherently subjective, in a way that results in answers that can be quantified and are objective. In early April of 2017, a scientific article was published that discussed various properties of sound and music, and their effects on creating an aesthetic musical experience for the listener (Brattico et al., 2017). This experiment is an attempt to expand upon the effects of the qualities of music on the experience that is created for the listener.

The question that was formed from this study was the following: What qualities of songs impact the appreciation of the songs by the listener the most? If

the way to find the most impactful qualities of songs was to get feedback from many listeners on songs, then creating a survey that provides concise, accurate results on the influence of specific qualities of music, as well as the whether the song is liked or disliked thanks to the most important quality, should be possible. This should be possible because providing questions for specific criteria to collect specific data should be easy to do with surveys, as the surveys can make very specific questions easy to answer by putting them into the format of multiple choice, or numerical scale.

## Methods

In order to conduct this experiment, holding a survey would be the most ideal way to collect results effectively. Before holding the survey, multiple subjects who agree to complete the survey need to be obtained (preferably at least 10 or more subjects). Each song quality must have its own section, wherein there must be at least two songs that demonstrate the opposite ends of each quality (i.e. for the quality 'tempo', one song with the primary quality of tempo would have a fast tempo, and one song would have a slow tempo). The survey must allow for the subjects to describe which songs they liked, why they liked them, and what

quality of the song impact their opinion the song the most. Once the survey is organised into sections by quality, get the subjects to complete the survey. Once all subjects are done surveying, collect the data and organise it in a readable format (i.e. excel sheets). Once the data is organised, cross-reference the data from all songs to find out what qualities are the most influential from all songs. Additionally, it should be noted which songs are liked or disliked the most, in order to determine exactly how the most influential quality of the song affected the song: whether a quality causes dislike or appreciation more. The primary quality that



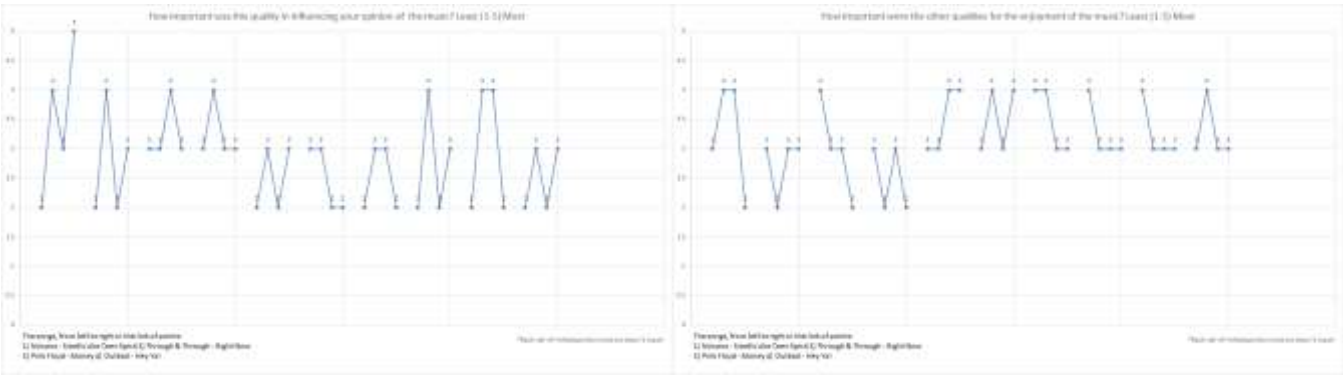
the song is associated with (see the example of the quality ‘tempo’ from the other column) should also have it’s influence on the song recorded – this should determine whether a quality that is very prevalent in a song is necessarily the most impactful factor of that song or not. A simple number scale is fine for these questions , as they allow for the results to be quantified easier. A number scale for these questions could just be from 1 to 5, where 1 meant that the quality was the least impactful / the song was greatly disliked by the subject, and 5 could mean that the quality was the most impactful / the subject greatly liked the song. Just a

multiple choice for choosing the most influential non-primary quality should suffice, and should make analysing data easier. These are all the steps needed to make and collect the results. The independent variable in this experiment is the song that is changed: many songs will be chosen, but only one variable changes – the song that is played. The dependent variable is what the subjects rate the songs they hear. The control variable is the fact that all subjects are listening to and rating the same songs (i.e. if there are 20 subjects, they will all listen to the same selection of songs).

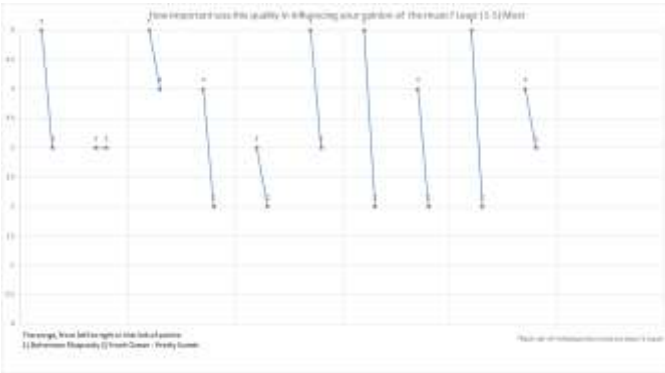
Results

The results proved to be thorough, showing that “melody” was the most influential quality in the appreciation of a song, being chosen exactly 40% of the time over the other 5 options by the subjects. “Rhythm” was the second most influential quality, being chosen 20.667% of the time. “Beat and meter” comes third, being chosen about 18.667% of the time. “Tempo” was the 4<sup>th</sup> most influential, being chosen 8% of the time. “Harmony” was the 5<sup>th</sup> most influential, at 6.667%, and “pitch” was the least influential at being chosen only 6% of the time. These percentages were calculated by taking all of the times that specific quality was chosen

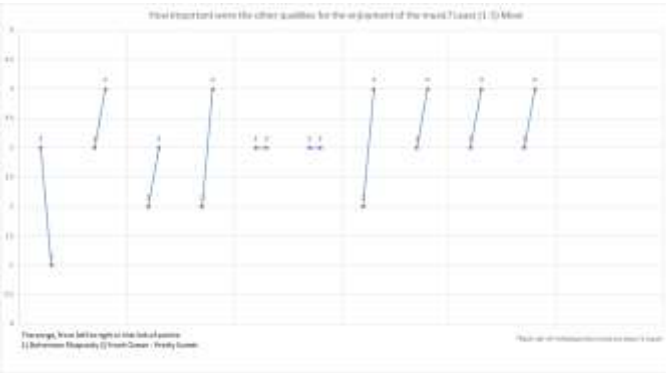
as the songs most influential quality, divided by the number of times the subjects were asked about which quality was the most influential. This shows the percentage that that specific quality was chosen as the most influential, on average. The results showing how much the main associated quality affected the subject’s appreciation of the song on a scale of 1 to 5 are shown below, along with the results for how much all of the qualities that are not the main associated quality affected the appreciation of the song (on a scale of 1 to 5 as well).



Results for the influence of ‘beat and meter’ on  
songs where ‘beat and meter’ is the primary quality

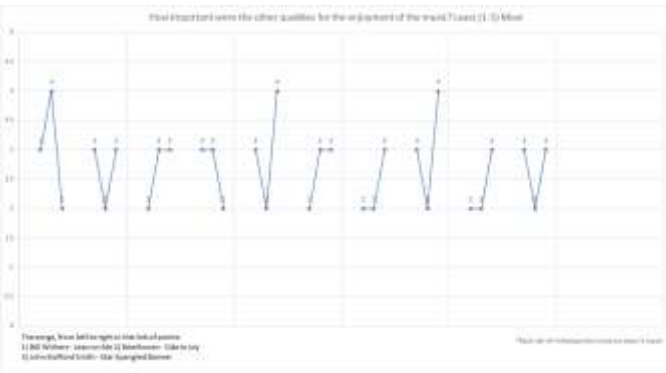
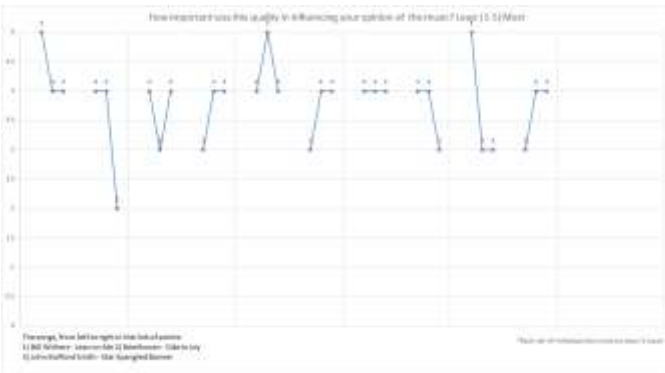


Results for the influence of other qualities on  
songs where ‘beat and meter’ is the primary quality

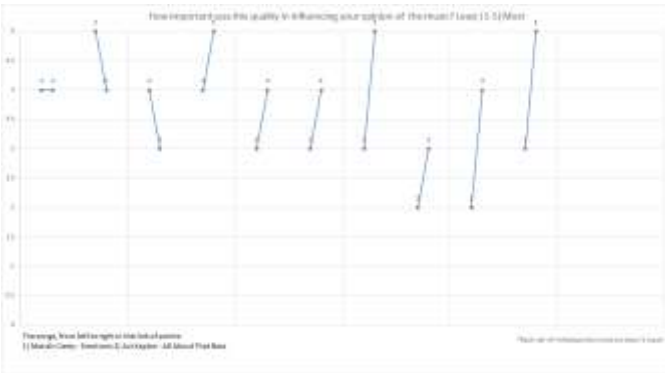


Results for the influence of ‘harmony’ on songs where ‘harmony’ is the primary quality

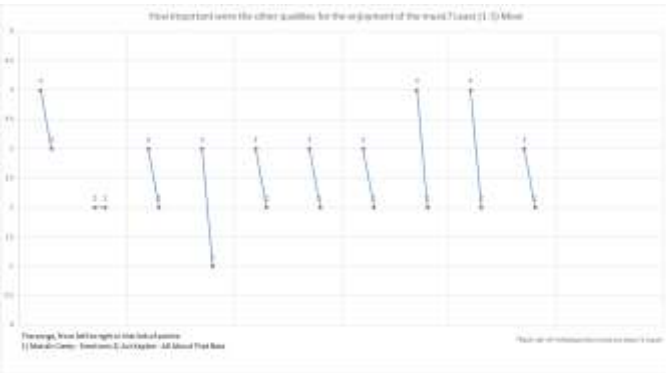
Results for the influence of other qualities on songs where ‘harmony’ is the primary quality



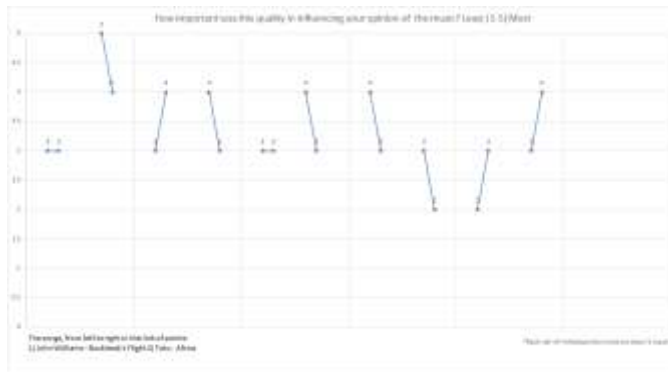
Results for the influence of ‘melody’ on songs where ‘melody’ is the primary quality



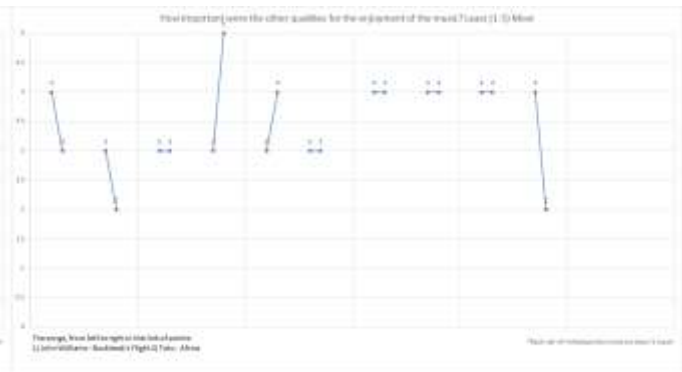
Results for the influence of other qualities on songs where ‘melody’ is the primary quality



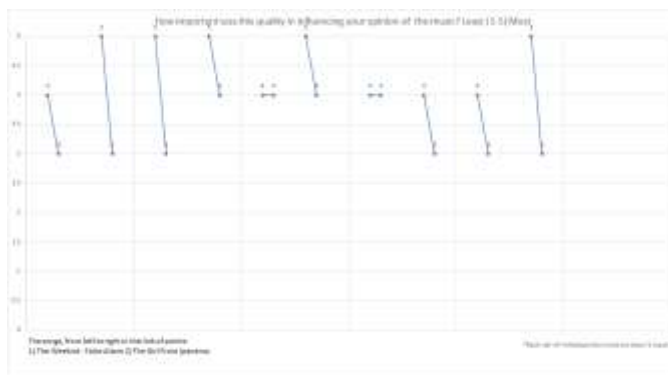
Results for the influence of 'pitch' on songs  
where 'pitch' is the primary quality



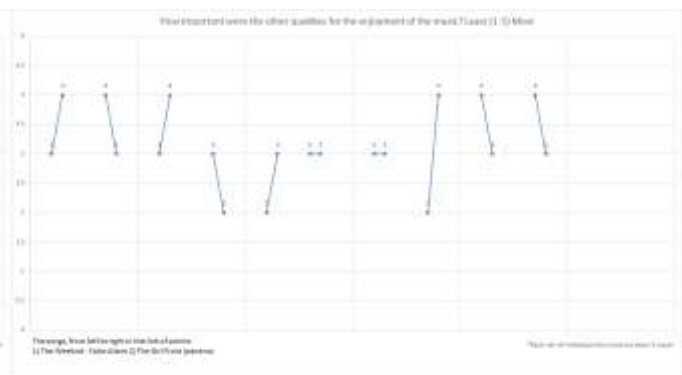
Results for the influence of other qualities on  
songs where 'pitch' is the primary quality



Results for the influence of 'rhythm' on songs  
where 'rhythm' is the primary quality



Results for the influence of other qualities on  
songs where 'rhythm' is the primary quality



Results for the influence of 'tempo' on songs  
where 'tempo' is the primary quality

## Discussion/Conclusion

The hypothesis that was initially stated was proven to be correct: a survey was created that was able to determine the most influential qualities of music, while also showing which qualities of a song are the most important, and how much the song was liked. The results were clear, and showed how important each quality was in comparison to each other. For example, the quality 'melody' was the most influential quality 40% of the time – this knowledge was contrived from

Results for the influence of other qualities on  
songs where 'tempo' is the primary quality

the survey results, and helped to illustrate which qualities were the most important, and when held in comparison with the influence of other qualities (in terms of percentage), can show the importance of the other qualities in relation to one specific quality. The most significant results were the top 3 most influential qualities of a song: 'melody', 'rhythm', and 'beat and meter', in that order. While melody was significantly the most influential, rhythm and beat and meter were

almost equally important in terms of helping a subject form an opinion on a song. These results help to answer the original question exactly, by showing which qualities of music are the most important, through displaying the most influential qualities for the appreciation of a song by a subject. The scientific article mentioned in the introduction suggested that properties such as tempo had a fairly significant influence on the preference and liking of music, where slow tempo would be associated with sadness, and fast tempo would be associated with happiness – and would also be rated more positively than songs with slow tempo (Brattico et al., 2017). However, this suggestion was not mirrored in these results, as the quality ‘tempo’ was noted to be the most influential about 8% of the time. Another notable difference between the expectations for ‘tempo’ was that only the song with fast tempo were noticed to be disliked by subjects– the song with slow tempo was consistently liked, and never disliked. There were some problems and sources of error in this experiment. More

songs could have been used for each section quality. More songs would’ve helped to remove the risk of subjects already having opinions on the songs used, that might be based off of things unrelated to the actual qualities of the song. Having more clear examples of songs for less obvious qualities (like the difference between ‘rhythm’ and ‘beat and meter’) may have helped to prevent any confusion from the subject in regards to what quality they were actually rating on the survey, so that they wouldn’t accidentally judge a quality thinking it represented a different quality of the song. If these problems did affect the results, then being more thorough in the music choice would result in more accurate results. Another possible source of error would be localised taste: since the subjects are all Canadian-based, the responses to the qualities of music might be different than the responses of someone living in a foreign country who has a musical taste of songs that sound very different from the West. The clear solution is to survey many people, world-wide.

### Application

This information can be used in other fields of study, such as psychology. A in-depth analysis of how the brain physically reacts during listening to a song, as well as how a brain actually ‘enjoys’ a song, can use these results from this experiment as reference, because the results provide information about what qualities are most important, and they influence a person’s opinion on a song. This information (or at least the methods used) could help to prove why or how a certain quality

of a song affects your brain physically, and what changes music can cause to the brain, since the results also describe how a quality influences how someone appreciates a song. In the broad scope, these results cannot be relied upon outside of the western world, as music influences world wide are different than the music styles in the West. This experiment resulted in answers from subjects who had only been immersed in westernised music. To get an accurate representation of

the rest of the world, a wider range of subjects must be used. If this is done, then the results would be globally accurate, and could be reliably used in research. These results can still be used in the western world, specifically for people who intend to create music that panders to people's preferences based off of the qualities of music that this experiment's data deems the most influential. People who make music could look at the collected data and make their songs around the most influential qualities, resulting in (hopefully) songs that are hits. If more subjects take the survey, and there is a wider range of subjects in terms of their experience with music, then the data collected and analyzed from this experiment will become more accurate, and could be used for more things reliably.

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Tina Nguyễn

SNC2DN, Vincent Massey Secondary School - Windsor, On

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**ABSTRACT**

Throughout this project, the question that is being researched is on different genres of music and how it can affect teenagers physically and mentally. This is important to be researched because this can show the importance of music by emotions and movements as well as the benefits. To display the results of the question being asked, a survey is given in which students listen to four different samples of popular songs. Afterwards, the participants were asked to describe how they feel and what they would be doing (actions). There were six options under emotions and five options for actions and the participant would fill out which answer best suits them. According to the results which were displayed in circle graphs and separated by song, action, and emotion, some of the participants results did correspond with that specific genre of the song (people chose to happy and would be singing or dancing while listening to upbeat melody), but other results did not correspond with the song. These results showed up this way from the brain, mainly affected by the nucleus amygdala and accumbens (NA) and the neurotransmitter dopamine. These parts help choose the kind of emotion while listening to music, but since everyone's brain functions differently, this can change since people don't always have the same opinions.

**INTRODUCTION**

This project is based on music. Music has influenced peoples' emotions many times; from crying while listening to a depressing song or

dancing to an upbeat melody. The purpose of this is to show how music can help a person express themselves more and show their personality. A person's emotions and movements are very powerful and by listening to a song, it can affect

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both things. Music can also be beneficial to people, by helping to reduce stress levels or just being positive. This is because of the power of listening to music.

The question for this project is how does music affect teenagers physically and mentally. Many teenagers have been affected by music many times, especially with today's technology like YouTube and Spotify. Since teenagers' brains have matured a lot from a child and functions better than elder and adults, teenagers are the perfect audience to listen to music to.

### METHODS:

The method used to answer this question is by conducting a survey. In this survey, there will be 4 songs with different genres. The genres that are chosen are pop, ballad, rock, and classical. The songs are *Despacito*, *Too Good for Goodbyes*, *Welcome to the Jungle*, and *Symphony No.9*. There will be 2 tables that will be drawn or typed out. The 1<sup>st</sup> table should have 5 emotions listed which are happy, sad, angry,

The hypothesis that is being stated for the question being asked is if the rhythm is corresponding with the type of genre of music, then the emotion and movement will relate to the genre. An example of this is listening to song about happiness and the person feels happy and wants to dance. Studies show that this can be caused by the brain. The brain helps distinguish the emotion a person feels which can also relate to the body by giving signals and responding to it.

surprised, confused, and another option called *Other* in the first column and in the second column in the first row, write *Tallies* as the title so the results can be recorded. Do the same with the second table but have 4 different actions which are dancing, singing, studying, and doing nothing and an option called *Other*. The 2 tables should look something like this:

Example of the 1<sup>st</sup> table

| Emotion   | Tallies | Action        | Tallies |
|-----------|---------|---------------|---------|
| Happy     |         | Dancing       |         |
| Sad       |         | Singing       |         |
| Angry     |         | Studying      |         |
| Surprised |         | Doing Nothing |         |
| Confused  |         | Other         |         |
| Other     |         |               |         |

Example of the 2<sup>nd</sup> table

After making the charts, start asking 12 people who are the ages of 13-18. Let each person listen to the 4 songs. Ask the participant how they feel about each song and what kind of action they feel like doing while listening to the song. Tally each option the participant chose for both tables. If the participant chose *Other*, then tally it and write down in brackets their emotion and/or action.

The independent variable for this survey are the participants responses. Not all of responses will be the same so it is changed on purpose. The dependent variable is also the response for each person. Since every participant's responses are different, this

will determine the hypothesis to the original question by seeing any trends. The controlled variables are the 4 song choices, the 2 tables and the options on the tables, the questions being asked for each participant, and age group. These lists of variables do not change because the survey results should be fair to each person, so they should have the same charts, songs, and questions being asked.

The age group will always be teenagers since the question is being asked the age group, therefore it wouldn't change.

- 2 Table 1 (below): These are the participants results (emotions and action) for the upbeat song, *Despacito* (black coated rows) and the sad song, *Too Good for Goodbye* (yellow coated rows)

### RESULTS:

| Emotion       | Tallies   | Emotion       | Tallies                                                    |
|---------------|-----------|---------------|------------------------------------------------------------|
| Happy         |           | Happy         |                                                            |
| Sad           |           | Sad           |                                                            |
| Angry         |           | Angry         |                                                            |
| Surprised     |           | Surprised     |                                                            |
| Confused      |           | Confused      |                                                            |
| Other         |           | Other         | (tired),  (thoughtful),  (bored),  (calm, tired),  (funny) |
| Action        | Tallies   | Actions       | Tallies                                                    |
| Dancing       |           | Dancing       |                                                            |
| Singing       |           | Singing       |                                                            |
| Studying      |           | Studying      |                                                            |
| Doing Nothing |           | Doing Nothing |                                                            |
| Other         | (throwing | Other         | (sleeping),  (eating),  (crying)                           |



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|  |                                  |  |  |
|--|----------------------------------|--|--|
|  | pillows),  (tapping), (shopping) |  |  |
|--|----------------------------------|--|--|

Table 2 (below): These are the participants results for the rock song *Welcome to the Jungle* and the classical piece *Symphony No.9*

| Emotion       | Tallies                  | Emotion       | Tallies                                      |
|---------------|--------------------------|---------------|----------------------------------------------|
| Happy         |                          | Happy         |                                              |
| Sad           |                          | Sad           |                                              |
| Angry         |                          | Angry         |                                              |
| Surprised     |                          | Surprised     |                                              |
| Confused      |                          | Confused      |                                              |
| Other         | (disgusted), (weird)     | Other         | (annoyed),<br> (calm), (dramatic), (excited) |
| Action        | Tallies                  | Action        | Tallies                                      |
| Dancing       |                          | Dancing       |                                              |
| Singing       |                          | Singing       |                                              |
| Studying      |                          | Studying      |                                              |
| Doing Nothing |                          | Doing Nothing |                                              |
| Other         | (scream),       (ignore) | Other         | (covering my ears)                           |

Figure 1  
Percentage of people feelings: Despacito

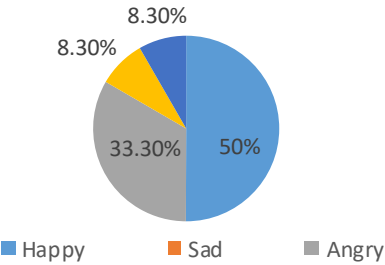


Figure 2  
Percentage of people's action while listening to the song: Despacito

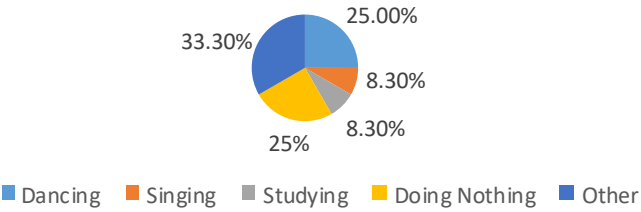


Figure 1 and 2 (above) shows the participants results for *Despacito* (left: emotions, right: movements) in percentage

Figure 3  
Percentage of People Feelings: Too Good For Goodbyes

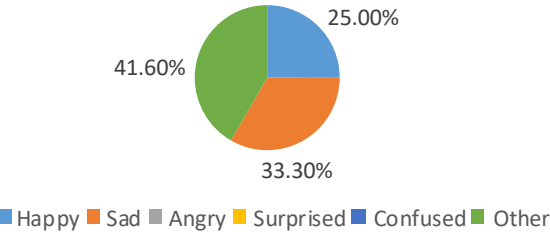


Figure 4  
Percentage of people's action while listening to the song: Too Good For Goodbyes

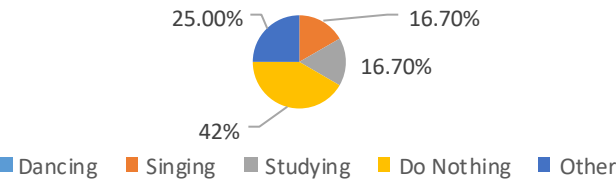


Figure 3 and 4 (above) shows the participants results for *Too Good for Goodbyes* in percentage

Figure 5  
Percentage of People Feelings: Welcome to the Jungle

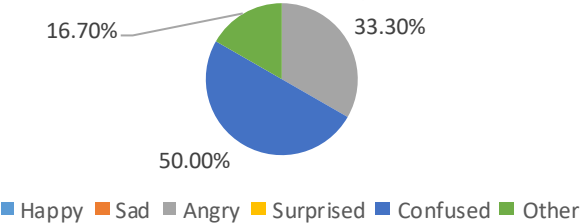


Figure 6  
Percentage of people's action while listening to the song: Welcome to the Jungle

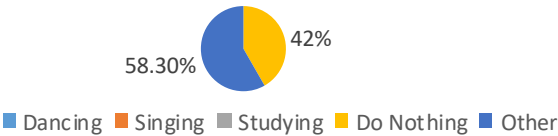


Table 5 and 6 (above) shows the participants results for *Welcome to the Jungle* in percentage

Table 7  
Percentage of People Feelings: Symphony No.5

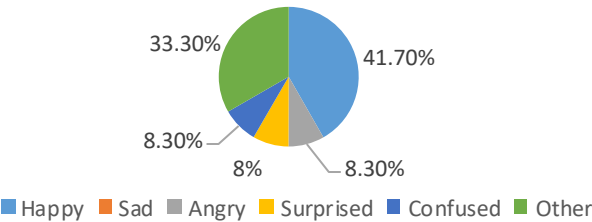


Table 8  
Percentage of people's action while listening to the song: Symphony No.5

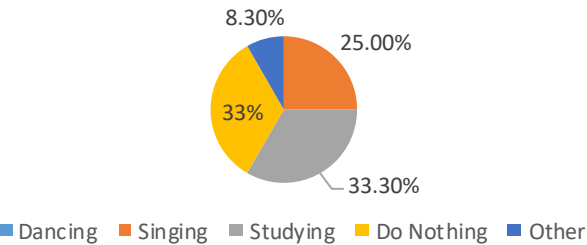


Table 7 and 8 (above) shows the participants results for *Symphony No.9* in percentage

### **DISCUSSIONS/CONCLUSION:**

Some of the parts of the hypothesis are correct. By looking at the charts and results, some people's emotions corresponded to the genre of music. But the actions and emotions didn't really correspond with other songs. The results that stood up most of the participants that made my hypothesis correct were that half of the participants (50%) were happy while listening to an upbeat melody, half of the participants felt confused (50%) while listening to the rock song, and people would be studying or doing nothing (both options were 33.3%) while listening to classical music.

The most shocking results that contradicted the hypothesis was how most people didn't feel sad while listening to the ballad song and the highest percentage of action while listening to the upbeat song is the option *Other*. These results came out like this because what's affecting a person's emotions and movements is caused by the brain. Two parts of the brain that effect this is the called the nucleus amygdala and accumbens (NA) and the neurotransmitter dopamine (resources from *How Music Affects the Brain for the Better*, As a person is listening to music the nucleus amygdala and the nucleus accumbens helps decide what emotion suits to the type of music. The neurotransmitter dopamine releases and increases and will give signals to the body. An example of this happening is getting goose bumps when listening to a song in the person's opinion. The nervous and endocrine system will help respond to the body which gives of

body movements. Scientists have said that the beat and melody of the music also identifies the emotions. Songs with fast tempo, high pitched voices that a major sounding melody are attributed to happy music which releases happy emotions and actions. Sad songs are the opposite of happy which and give out sad emotions. There will be a higher percentage that the genre of music does correspond with a person's emotions and body movements.

Some of the results before did not come out the way it did. This is also because of a person's own way of functioning in their brains. People have different opinions and different tastes in music. Not everyone's brains all function the same way, so a person won't give out the exact emotions to what another person is feeling. This is how people's taste in music is different. For example, a metal rock song could be a relaxing and pleasant to someone but another person might think it's a song to release out their anger.

The errors from the project that affected my results are mostly because of the song choices. The songs have not been the best choices of music because some of the songs are overrated. Songs like *Despacito* is a song that has been playing on the radio for quite some time that people might no longer like; even though they should be feeling happy. Some of the songs might have not been good for a person to correspond with others of people results that didn't relate to the genre of music.

### **APPLICATION:**

Using music to help a person release their emotions is using music every day, everywhere at any time a person feels like it. Studying to classical music, working out to dubstep, and relaxing while having an acoustic playlist are examples to make a person happy. An occupation which helps people problems by listening to music is being in music therapy (Reference from About Music Therapy. (n.d.).)

. Studies shows that music can make anyone happy in their own way and help increase their memory (from a part of the brain called the hippocampus). People who work in music therapy help relax others with disorders, health, emotional and mental problems so they can feel happy and interactive by using music.

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## **Effect of Water Temperature on Speed and Exhaustion Levels in the Pool**

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### **Abstract**

The question investigated was: how does water temperature affect speed and exhaustion levels in the pool? This topic is relevant because athletes – specifically swimmers in this case – want to maximize workouts and train to the best of their ability. The experiment done was to compare swimming 50 meters 8 consecutive times in a 29°C (warm pool) and in a 25°C (cold pool). Then, to observe the time taken (seconds), as well as exhaustion levels (level 1-10). The times recorded ultimately increased. The more exercise and physical movement the body is put through, the more tired and slower the body movements will be.

### **Introduction**

The purpose of this project is to differentiate the effects of sprinting in a warm pool vs a cold pool. This project is significant because athletes – specifically swimmers are always looking for ways to improve and maximize workouts. Many swimmers think that hotter pools slow them down, believing that it doesn't remove the sweat they

generate, causing the feeling of overheating and exhaustion (Cornerstones). There are different temperature mandates for different aquatic activities such as diving, water polo, and recreational swimming. If there are different rules/regulations for different temperatures for different sports/activities, then there must be different effects on the body from different pool temperatures (Livestrong.com).

The question asked is, “How does pool temperature affect speed and exhaustion levels in swimming?” If there are different rules/regulations for pool temperatures for different sports/activities, then temperature *does* affect speed and strokes of swimming, because the FINA regulations must be established not only for the most efficient workouts, but for the health and safety of swimmers.

Table 1

Methods

The swimmer wears a silicone cap, goggles, and FINA approved swimwear.

The swimmer starts in a 29°C, 25 metre pool. The swimmer warms up with a 100 metre relaxed swim, that doesn’t need to be recorded. The swimmer pushes off the wall in streamline position and sprints 50 metres Freestyle (Front Crawl), with the choice of performing a flip turn, but must do the same procedure when repeated, to ensure fair results. Another person times the swimmer using a stopwatch. The swimmer records the time taken in seconds, and their exhaustion level on a scale of 1-10 in a table in the “Warm Pool” sections (Table 1). The swimmer rests for 1 minute and hydrates

during this time. Procedure is repeated 8 times.

Repeat the above instructions in a 25°C, 25 metre pool, and record the results in the “Cold Pool” sections (Table 1)

Conduct entire experiment at least one more time, for more stable results.

The independent variable is the temperature of the pool. It is being changed through this experiment. The dependent variables are the recorded times, and the exhaustion levels of the swimmer. These are being measured and observed. There are many controlled variables. As mentioned earlier, the silicone cap, goggles, and swimsuit are a few. Another controlled variable is the swimmer, because if the swimmer is changed throughout the experiment, then the results will not be accurate as not all swimmers have the same speed or endurance. The swimmer must swim the same stroke throughout the experiment, as different strokes cause the swimmer to travel through the water at different speeds. The swimmer must have the same rest time and swim the same distance every time,

| Each 50 m Swam | Time (seconds) Taken in a “Cold” Pool | Exhaustion Level (1-10) | Time (seconds) Taken in a “Warm” Pool | Exhaustion Level (1-10) |
|----------------|---------------------------------------|-------------------------|---------------------------------------|-------------------------|
| 1              |                                       |                         |                                       |                         |
| 2              |                                       |                         |                                       |                         |
| 3              |                                       |                         |                                       |                         |
| 4              |                                       |                         |                                       |                         |
| 5              |                                       |                         |                                       |                         |
| 6              |                                       |                         |                                       |                         |
| 7              |                                       |                         |                                       |                         |
| 8              |                                       |                         |                                       |                         |

because if the swimmer gets more/less of these, it

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will affect their exhaustion levels and speed in the next swim. The swimmer must hydrate every time so that there is not interfering with possible outcomes.

## Results

### Data Comparison #1:

#### Results of the First-Time Experiment Performed

| Each 50 m Swim | Time (s) Taken in a "Cold" Pool | Exhaustion Level (1-10) | Time (s) Taken in a "Warm" Pool | Exhaustion Level (1-10) |
|----------------|---------------------------------|-------------------------|---------------------------------|-------------------------|
| 1              | 34.78                           | 1                       | 35.71                           | 3                       |
| 2              | 35.20                           | 1                       | 35.96                           | 3.5                     |
| 3              | 35.09                           | 2                       | 36.05                           | 4                       |
| 4              | 35.73                           | 3                       | 36.83                           | 4                       |
| 5              | 36.18                           | 3                       | 36.51                           | 5                       |
| 6              | 36.25                           | 3.5                     | 36.79                           | 7                       |

Data from Table 2 interpreted into Fig. 1.

Comparing time taken to swim 50 m in a 29°C pool vs a 25°C pool.

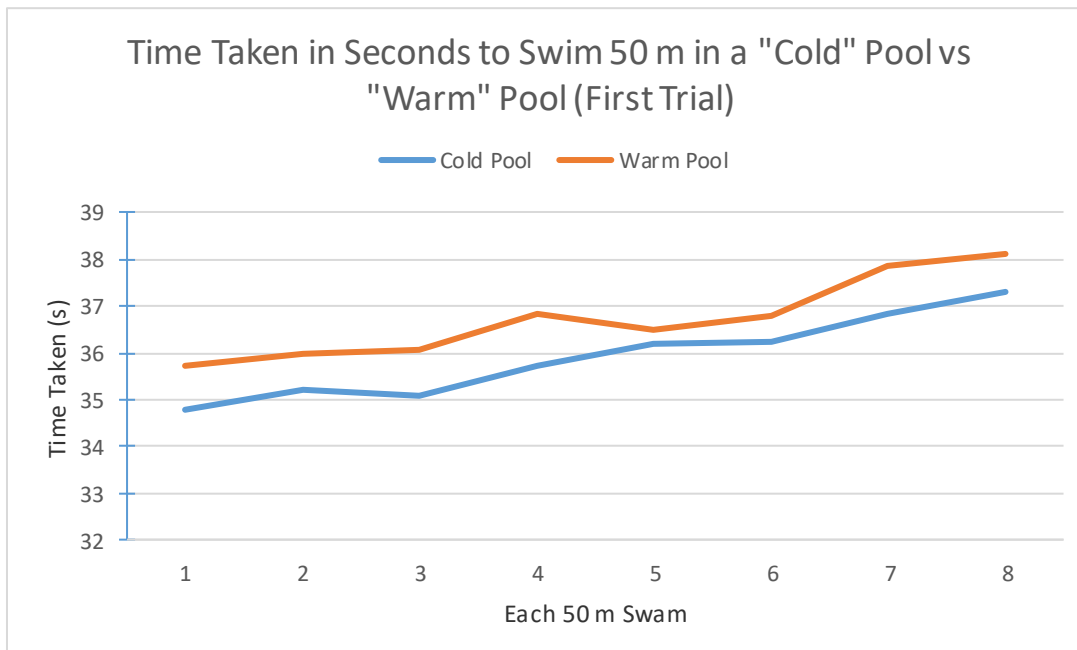


Figure 8

|   |       |   |       |   |
|---|-------|---|-------|---|
| 7 | 36.82 | 4 | 37.84 | 7 |
| 8 | 37.31 | 5 | 38.12 | 8 |

Table 2

### Data Comparison #2:

#### Results of the Second-Time Experiment Performed

| Each 50 m Swim | Time (s) Taken in a "Cold" Pool | Exhaustion Level (1-10) | Time (s) Taken in a "Warm" Pool | Exhaustion Level (1-10) |
|----------------|---------------------------------|-------------------------|---------------------------------|-------------------------|
| 1              | 34.29                           | 1                       | 35.39                           | 2                       |
| 2              | 35.64                           | 1                       | 35.31                           | 2.5                     |
| 3              | 35.16                           | 2                       | 35.89                           | 3                       |
| 4              | 35.98                           | 2                       | 36.67                           | 4                       |
| 5              | 36.30                           | 3                       | 36.86                           | 5                       |
| 6              | 36.79                           | 4                       | 37.03                           | 6.5                     |
| 7              | 37.06                           | 5                       | 37.57                           | 7                       |
| 8              | 37.15                           | 6                       | 37.64                           | 8                       |

Table 3



Data from Table 2 interpreted into Fig. 2

Comparing exhaustion levels in a 29°C pool vs a 25°C pool.

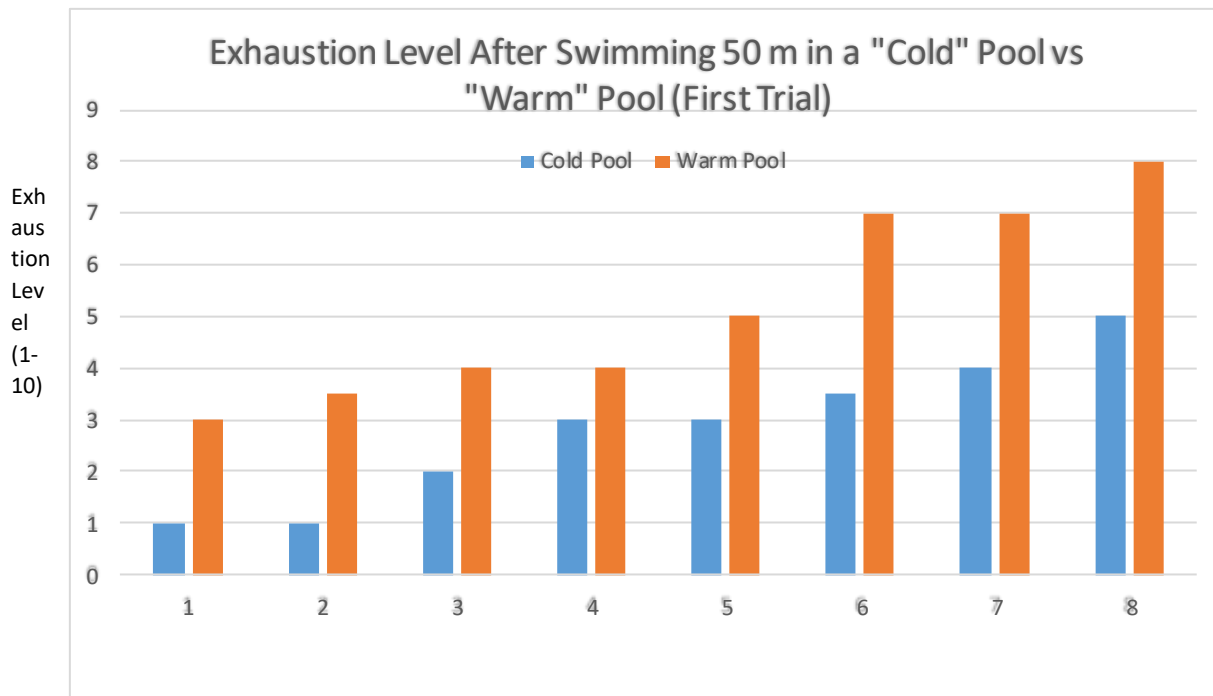


Figure 9

Data from Table 3 interpreted into Fig. 3.

Comparing time taken to swim 50 m in a 29°C pool vs a 25°C pool.

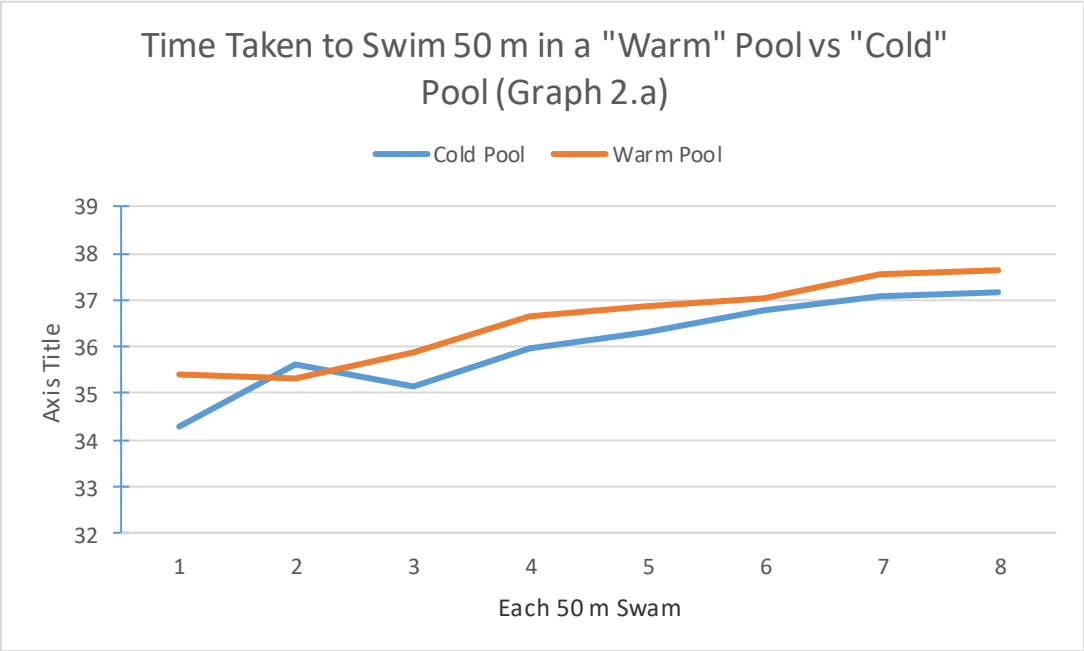
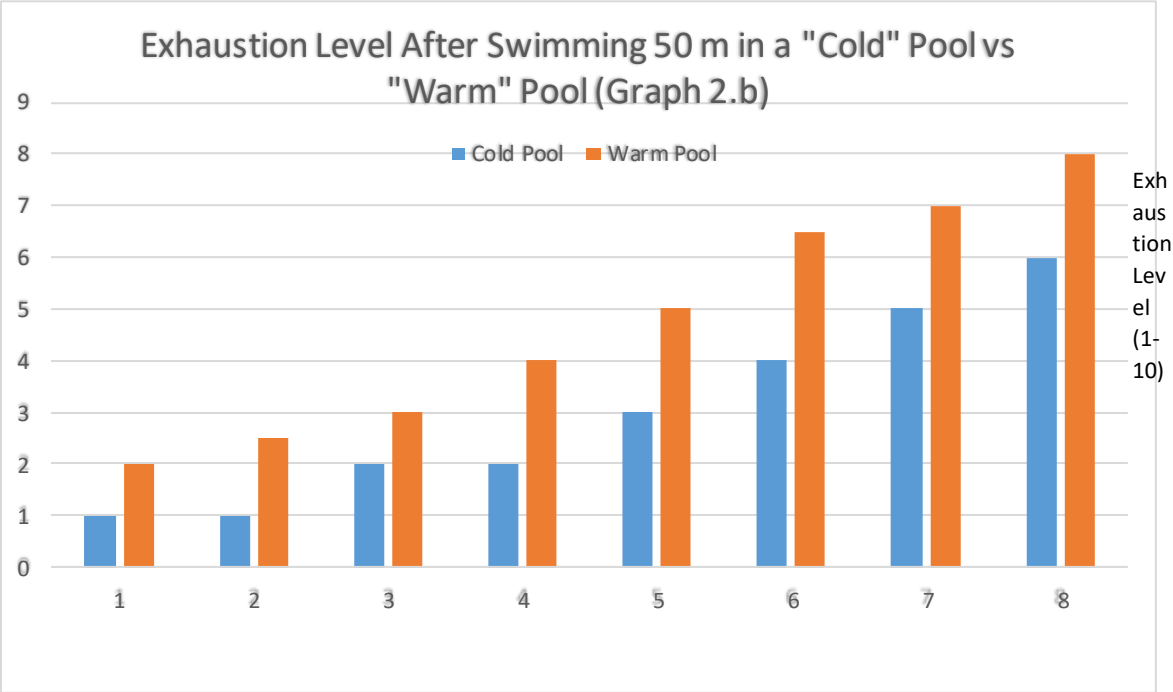


Figure 10

Data from Table 2 interpreted into Fig. 2

Comparing exhaustion levels in a 29°C pool vs a 25°C pool.





### **Discussion/Conclusion**

Hypothesis was correct. In general, not only does “cold” water allow swimmers to swim faster, swimmers also don’t get as tired as quickly as they do in “warm” pools. In both “cold” and “warm” pool experiments, the times taken to swim 50 metres ultimately increased. This is consistent with what other scientists have reported and this was expected, as it is known that the more exercise and physical movement the body is put through, the more tired and slower the body movements will be.

However, there were a few outliers in the experiments where the succeeding 50 metres swim was faster. There are many factors that could’ve caused this, such as starting the stopwatch too soon/stopping the stopwatch too late; pushing off the wall with less force than before; or having an exterior factor (pool equipment or person in the way) while trying to perform the experiment. These are all *controlled* variables.

The data collected supports the hypothesis. The “warm” pool experiment exhaustion levels after each 50 metres swim were always at least 1.5 times higher than the “cold” pool exhaustion levels after each 50 metres swim. The most significant result was how high the exhaustion levels were already within the first few repeats of the experiment, specifically in the “warm” pool.

Given the conclusions, competitive swimmers should always train and compete in “cold” or 25°C pool. It will especially benefit long distance swimmers, because not only will they swim faster, but their exhaustion levels will not rise as quickly as they would in a “warm” or 29°C pool. This allows them to swim for longer distances.

If warranted, the next step in this study should be finding out what stroke (Freestyle, Backstroke, Butterfly, and Breaststroke) is best for swimming long distances. This could be experimented by having a swimmer swim each stroke for as long as they can in a 25°C, 25 metre pool; stopping when they are too tired.

There could’ve been sources of errors when timing the swims. A way to solve this could be to have two people timing, each with stopwatches. When recording, the average time between both stopwatches can be used. This could help with collecting more precise data and is also convenient if one timer is faulty.

### **Application**

This information can be applied to other cases of study in sports. In track or cross country, it is possible that if the temperature outside is cooler, then the runner will run faster and be less exhausted than if they were in warmer temperatures. This information can also be applied to those who do triathlons or lifesaving sport. In competitive swimming, coaches will use this information when choosing what pools to train at, to maximize swimmers' workouts. These results are overall beneficial to swimmers who wish to swim faster, longer, and conserve their energy.

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### **Difference in the Perception of Time after Constantly Playing a Video Game for a Set Amount of Time**

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### **Abstract:**

The experiment was about the difference in time perception after constantly playing a video game for a set amount of time. The experiment has six volunteers come and perform a single task requiring complete focus for sixty minutes while the others would play for thirty. Once the two groups of three volunteers compared it was found that they both volunteers always preserved that twenty of the sixty minutes hadn't gone by, with two exceptions. This implies that five times out

of six you will see a significant speed up in time if you remain focused on a single task for any given amount of time.

### **Introduction:**

This experiment is to find out if someone will have a changed perception of time if they are focused on something else, and remain focused on that thing entirely. This project is important because it helps us realize how dangerous it is to play for a very long time, and just how much time we really waste compared to how much time we say we do. Is it possible that playing a game for a long period of time much of a certain video game can trick the brain into believing more time passed than the amount of time that passed in reality? If six people were made to play the same fast paced video game for different amounts of time, then the person who played for longer would believe that a large amount of time, because the players perception of time will be faster matching the game they had just played.

### **Method:**

Setup the game and leave it on and ready for the volunteers. Tell the first volunteer to relax explain the following; They are going to play the EFPG for a while, and are not allowed to leave or check the time. The person conducting the experiment will arrive once you're done to ask you a series of questions. Tell them that they must reply with 100% honesty. Tell them they can start. Start the stopwatch the second the volunteer begins playing. Monitor them playing for the first 10 minutes. Afterward leave the room and allow them to play alone. This allows the volunteer to become immersed in the game, providing better and more exact results. Once 30 minutes have passed, return to the room and have the volunteer stop. Once done, turn everything off and sit across from the volunteer the pencil and paper to record results. (this process should only take a maximum of 3 minutes). Begin with asking the volunteer to tell you how much time has passed and record their answer. Repeat the previous steps once more with two more volunteers. Once complete, repeat steps 1 through 12 again with 3 more volunteers, but this time allow the volunteers to play for 60 minutes instead. The Control variables in this experiment are the lack of clocks or time (so the volunteers can't know how much time passes), an arm chair 3 cookies f the

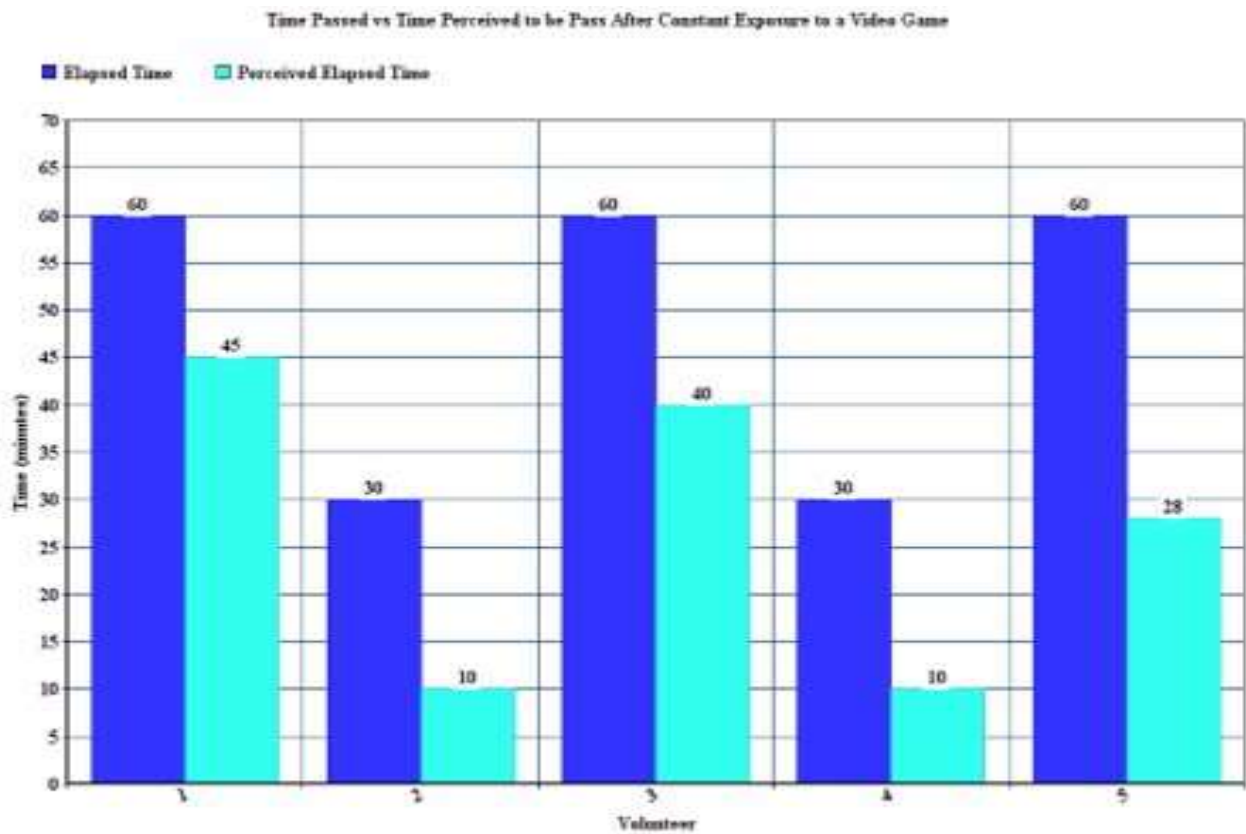
same type, 500ml of clear water (So the volunteer is comfortable and not distracted), headphones, game controller, solitude (To keep them from being distracted by external forces).

## Results:

Table 1

| Volunteer | Amount of Real Passed | Amount of Time the Volunteer Perceived Passed |
|-----------|-----------------------|-----------------------------------------------|
| 1         | 30 minutes            | 50 minutes                                    |
| 2         | 60 minutes            | 45 minutes                                    |
| 3         | 30 minutes            | 10 minutes                                    |
| 4         | 60 minutes            | 40 minutes                                    |
| 5         | 30 minutes            | 10 minutes                                    |
| 6         | 60 minutes            | 38 minutes                                    |

Figure 1



The information found in Table 1 is translated into Figure 1 with the exception of my first volunteer, who played for thirty minutes and perceived that the elapsed time was fifty minutes. This was a problem because the volunteer spent a lot of time fidgeting and moving around, and admitted to being distracted throughout the experiment, so their data was considered to be an "outlier" and was not included into either Table 1 or Figure 1.

### **Conclusion:**

Based off of the data, it seems that this experiment did indeed answer my hypothesis which was "If six people were made to play the same fast paced video game for different amounts of time, then the person who played for longer would believe that a large amount of time, because the players perception of time will be faster matching the game they had just played." Even giving me more information than wanted, showing me that the subject indeed went through time, an acceleration of around twenty minutes each time. For example, the third volunteer which played for thirty minutes ended up perceiving that ten minutes had passed. Another case subject six which played for sixty minutes which ended up perceiving that thirty-eight minutes had passed. The experiment should have had more tests, or had more volunteers to help provide better results to make finding correlations easier. For example, The experiment could have had two more volunteers play for ninety minutes to see if the time always dilates twenty minutes again, or if it increases with play time.

### **Application:**

This information would be very helpful in other fields of study because it helps to prove how powerful the brain is, showing that it's strong enough to make you believe that time itself can change, speed up and slow down whenever they want to. I think this could be used in Neuroscience which is the study of the human brain, and it could be used to prove that the human brain could be tricked into believing something, making that thing seem real to the subject.

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