The Effect of Social Facilitation on the Performance of a Math Skills Test

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Intro:

The aim for our experiment was to determine what effect the observation from audience members, my partners and I, had on the performance of high school students on a basic math skills test. This experiment is relevant and can further be studied because of the repetitive nature of audience surveillance on everyday tasks. Especially with young high school students, the facilitation of exams or tests can be either detrimental or beneficial towards their educational success. Social facilitation, a theory first developed by Norman Triplett (1898), is described as "an improvement in performance produced by the mere presence of others." (McLeod, 2011)

There are two types of Social Facilitation: co-action effect and audience effect. Co-action describes the increase in performance because of the mere presence of others doing the same task. Audience effect however is the same concept as co-action but consists of an audience instead of members cooperating in the same action (McLeod, 2011)

Our experiment is developed on John Dashiell's (1935) initial experiment on social facilitation, specifically, audience effect. The aim of Dashiell's experiment was to determine the effect of audience effect on the performance of subjects' test scores. Dashiell experimented on subjects with the presence of spectators and without the presence of spectators and analyzed the difference between the two conditions. The subjects were required to take a simple multiplication test within a certain amount of time with an audience present, and then after, take a similar test but isolated by themselves. After both conditions were tested, results showed a significant change in test scores with the increase in score when the subjects were being facilitated compared to when they were alone (Dashiell, 1935).

The replicated experiment that we had recreated shared many similarities with Dashiell's experiment on audience effect. Both consisted of a math test, however, the level of difficult or complexity differed since Dashiell utilized basic multiplication while we used more complex math equations (Refer to *Appendix 4 & 5* to see full math test). The subjects were also tested in similar conditions to the Dashiell experiment as repeated measures were used. However, the amount of time given to the subjects to complete the math test was also another aspect of the experiment that we changed because we achieved to examine percentage of questions correct over a short amount of time, disallowing the subjects to complete the entirety of the math test. This was used since the completion of the math test in both conditions would yield poor results, and therefore, designed the test in such a way where a majority people would be unable to complete it.

The operationalized hypotheses for this experiment are as followed:

Research Hypothesis: The presence of audience members observing subjects in a controlled conference room (IV) will have some influence on the percentage of questions correct on a math skills test (DV).

Null Hypothesis: The presence of audience members observing subjects in a controlled conference room (IV) will have no influence on the percentage of questions correct on a math skills test (DV).

Exploration:

The research design we used was a repeated measures design in order to determine the change in performance with the addition of the independent variable. The same subjects were required to examine the effect of audience members on a similar math test and observe the change developed as a result of the audience. A convenience sample was used to acquire the subjects for our experiment as no specific traits of subjects were required for this experiment and the subjects were easily acquirable from the population. The participants chosen were all high school students age 14-18, mostly consisted of females (3 males to 9 females), and were all volunteers from the IB program. These subjects were acquired as a result of convenience sampling from the target population of an International Baccalaureate program and the unnecessity for specific traits for this experiment.

Procedure: (Full procedure in *Appendix 3)*

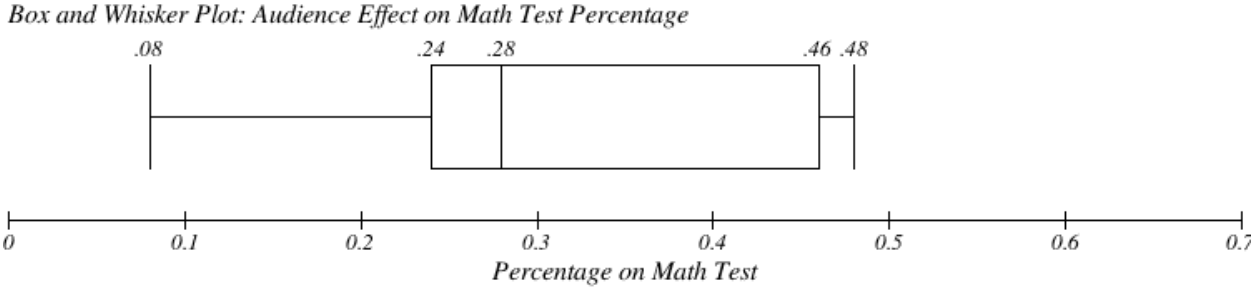
1. Acquire 12 subjects
2. Enter into room and hand out informed consent form
3. Collect form and explain experiment
4. Split group of 12 into 2 groups of 6, randomly assorting them into group 1 or group 2
    a. Random assortment by slips of paper, labelled 1 and 2, pulled from bin
5. Take group 1 outside room and read instructions to group 2 in room
6. Take control test first, audience leaves room
7. Time 2 minutes, once done enter room and collect test
8. Short break, hand out experimental test
9. Start test, audience stays in room
10. Collect test and debrief
11. Repeat steps 6-10, however, switch order of experimental and control test

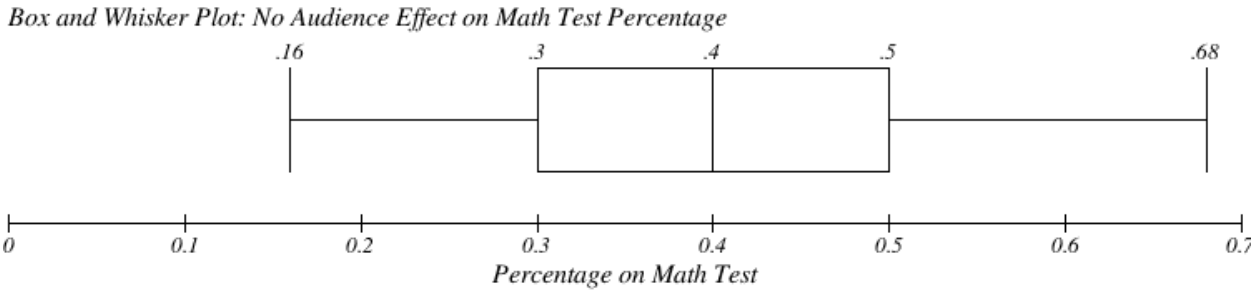
In order to yield the most ideal results from this experiment, extraneous variables like order effect and cooperation between peers need to be taken into consideration. To control for order effect, we switched the order of the two tests between group 1 and group 2 to determine if the change in score was directly correlated to the presence of audience members instead of schema with the test or based purely on experience or schema from the first test taken. To control for cooperation between peers, instructions informing them to not cooperate or communicate during the test were explained very thoroughly, and a specific seating position was used.

In addition to controlling variables, ethical considerations were also valued. Parental consent forms (*Appendix 2)* were handed out beforehand to gain the approval of experimenting on the students from the parents since some of the subjects were under the age of consent. To gain the approval and understanding of the subjects of all ethical considerations of the experiment, an informed consent form (*Appendix 1)* was given before the experiment had started, and stated that they have been informed of the nature of this research, have the ability to withdraw information, remain anonymous throughout the experiment, not be demeaned in any way, and be debriefed at the end of the experiment. All these considerations were considered and applied to the subjects within this experiment.

Analysis:

The descriptive statistics used for this experiment were median for central tendency and the interquartile range for the measure of dispersion. This was used since the median is less affected than the mean when considering outliers, and since the data was not normal, median was used to achieve more fitting results. The interquartile range was used because, similarly to the median, is less sensitive to outliers and works cooperatively with the median to create the box and whisker plots. The box and whisker plots for each condition, audience and no audience effect, are shown below:





For the plot with the presence of an audience, the median percentage on the math test is .28 (28%) and the interquartile range is .24 (24%). Now examining the plot with no presence of audience members, the median is .4 (40%) and an interquartile range of .2 (20%). Comparing the first plot with no audience effect to the plot with the audience present, there is a significant drop in the median percentage with the addition of audience members. The difference in medians between the groups is a significant drop and further supports the research hypothesis since there is an influence in score as a result of audience. To show significance of the audience members, a Wilcoxon statistics test would be used (*Appendix 6 & 7).*

The Wilcoxon test was utilized because the statistics within this test uses a comparison between two differing results of specific subjects. Furthermore, the use of repeated measures and ordinal-level variables within our experiment caused us to use the Wilcoxon test for our data.

Analyzing the z-score of the Wilcoxon statistics test, our experiment can be determined as significance. The critical value for the Wilcoxon test that is significant at the 5% level is 1.96. The z-score for our experiment, 2.06, surpasses the significance level of .05 since it lies in between the critical z scores of 1.96 and 2.326 (*Appendix 6*). The standard alpha level of .05 was used for this experiment and therefore, since the significance level for our experiment lies past the .05 mark; we can conclude there is a significant effect of audience members on the

performance of subjects on a math test. Because of this significance, we can reject the null hypothesis and accept the research hypothesis that the presence of audience members in fact does have some influence on the performance on a math test.

Evaluation:

Comparing the significant results from our experiment to the overall theory of Social Facilitation, improvements in performance of the task used as a result of the addition of audience members, developed by Norman Triplett (1898), our results vary drastically from this theory. Our results showed a decrease in performance as a result of audience members, which opposes this theory. This drastic difference in results could possibly be a result of the complexity of the physical test that was taken. In Dashiell's study (1935), the mathematical test used was a simple, one-step multiplication test, but with our experiment, we changed this simpler mathematical test to a more complex, multi-step, operational mathematical test which required more thinking. As a result of this change, this could possibly provide an explanation for the differing results as more complex tests would add another element of focus in addition to the presence of audience members.

However, although our experiment was based off this theory, our results swayed more towards a differing, but similar conceptual theory: "Social Inhibition". This theory states that because of the presence of audience members there would be a decrease in the performance of subjects' task at hand. This theory supports the results we found since the addition of audience members inhibited the performance of the subjects.

The design, sample, and procedure had many strengths, but also aspects of the experiment that were very limited. Starting with the design of our experiment, a strength with the design was the ability to utilize a repeated measures design. This allows for the significance of the experimental condition to be determined. However, a limitation of this design type is the inability to measure experience as a factor in determining the score of the math test. Even though order effect was taken into consideration, experience in the test overall could have some type of influence. A strength of the sample used in our experiment is the convenience in choosing the subjects. No specific requirements were needed to be met and each subject was from the same target population: high school. This can lead to further application within this theory and population and can be used in future contexts. However, this can lead to some limitations in terms of further application. The target population, like stated before, is from a high school, and the results extracted from the experiment are not applicable for people of different ages or from different cultures. A strength of the procedure used is the short amount of time necessary to complete the experiment. Each test is 2 minutes in length and have a short break in between. This is beneficial and convenient since results can be quickly drawn and can be repeated multiple times if need be. However, a limitation with this procedure is the extremity of the shortened time that was given. This can develop into a limitation since the amount of time to answer is so minimal and may not display an accurate or sufficient amount of data.

A modification that could have been made to improve this experiment is to adjust the monitoring of the subjects whilst the audience is not in the presence of the subjects. Many

cooperation efforts could have been attempted. However, because of no knowledge of the conversations within the room, this was not able to be discontinued. If there were to be a camera or some way to ethically monitor the subjects testing, and have new subjects if there was cooperation, then results may have been more reliable and credible for further applications.

In order to investigate a new aspect of social facilitation, a few adjustments can be made to study these things. For example, changing the test from a more complex math skills test to either a simpler one-step math skills test or a simple task, can change the experiment from a performance inhibiting-based experiment to a performance improvement-based experiment. This change would be used to determine what effect the difficulty or complexity of the task has on the performance on subjects with and without the presence of an audience. This can be observed by Dashiell's experiment in 1935 where the presence of audience members in fact increased the subject's percentage on a simple multiplication test whereas with a more complex math skills test, social facilitation would be utilized as an inhibitor rather than an assistor.

All in all, expanding off the Social Facilitation theory first developed by Norman Triplett (1898) and eventually experimented further with John Dashiell (1935), it can be concluded that social facilitation, in our case inhibition, had an influence on the performance on the math skills test. The use of audience members and a complex math test caused the social inhibition to occur rather than facilitation since the scores were much lower overall with the presence of an audience.

References:

Dashiell, J. F. (1935). Experimental studies of the influence of social situations on the behavior of individual human adults. In *A Handbook of Social Psychology* (pp. 1097-1158). Worcester, MA, US: Clark University Press.

McLeod, S. (2011). Social Facilitation. In *Simply Psychology*. Retrieved October 20, 2019.

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Appendix 1: Informed Consent Form

Consent form

• I have been informed about the nature of the research.

• I understand that I have the right to withdraw from the research at any time, and that any information/ data about me will remain confidential.

• My anonymity will be protected as my name will not be identifiable.

• The research will be conducted so that I will not be demeaned in any way.

• I will be debriefed at the end of the research and will have the opportunity to find out the results at a later date.

I give my informed consent to participating in this research.

Name: _____

Date: _____

Email: _____

Appendix 2: Parental Consent Form

September 2, 2019

Dear Parents,

I am writing this letter to inform you directly about the nature of the Psych IA Experiment Day that will be taking place on Tuesday, October 1st, 2019. All Psychology students need to be there to participate as subjects (Psych I) or as experimenters & subjects (Psych II) from approximately 2:30-4:00pm. This is an IB Psychology requirement. I am asking for volunteers from NHS and Key Club to act as participants (for service hours) in the experiments as well. Ethical guidelines require that parents give consent for their minor children in order to participate in a Psychology IA. If you agree to let your child(ren) participate in Psych IA Day, please write their name(s) below and sign and date on the line. If you have any questions or would like to review the procedural or ethical guidelines, I would be happy to email them to you. Please rest assured that IB Psychology standards are even more stringent than standard ethical requirements and your student will not be in any physical or emotional distress. Thank you for your cooperation and support for this required, albeit inconvenient, IB activity.

Sincerely,

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Please Print Name(s) of Minor Child(ren) Who Will Participate in the Psychology IA Day below:

Student Name(s): _____

Parent Signature: _____ Date: _____

Appendix 3: Standardized Instructions

Psych Experiment Outline w/instruction scripts

- Acquire 10 conveniently chosen subjects
- **Read the introduction/instructions script:**
    - **Script: Hello everyone, today you'll be participating in a psychology experiment. The task for you in this experiment will be to complete a basic math skills test. The test will be 25 questions long and you will have 2 minutes to complete the test. Afterwards, you will have a short break (1-2 minutes long), and then take a similar test that also has 25 questions to be completed in 2 minutes. We will then collect your 2 tests. After debriefing the first group, we will call in the second group to come follow the exact procedure. Do you guys have any questions?**
- **Give consent form out, read script:**
    - **Script: We're handing out a consent form that outlines your rights when participating in the experiment. You have the right to withdraw from the experiment at any time, your anonymity will be completely protected and your names will not be used, the research conducted will not demean individuals who perform poorly, you will be debriefed about the nature of the experiment after taking both tests, and you will have an opportunity to receive the results of the study if you choose. If you agree to the rules outlined above, please sign the consent slips.**
- **We read sorting script:**
    - **Script: First we need to sort everybody into 2 different groups. We have a bin here with slips that read "1" and "2," if your slip reads 1, please get up and wait patiently in the hallway, if your slip reads 2, stay in the room. Please go sit at a table by yourselves so one person is at each table.**
- **First Test Script:**
    - **Now we will begin handing out the math skills test. As stated before, there will be 25 questions to be completed within 2 minutes. In order to obtain the best results, please do not cooperate with other peers within the class and do not flip over the test until the timer has started. *Hand out test* You may begin once the timer has started, good luck!**
- Assign the 10 subjects into 2 groups of 5 – group 1 and group 2, sorted by picking slips out of a bin
    - Group 1 will go through the experimental condition first and the control group second
    - Group 2 will go through the control group first and the experimental condition second
- Keep Group 2 (n=5) in the room first, ask Group 1 to leave temporarily. Ask each individual to sit down at a table by themselves
- Hand out basic math skills test, flipped over, tell them not to flip over until said to do so

- Start the timer, remind them that they have 2 minutes to complete the test, tell them to stay quiet, leave room
- Come back, collect the tests, read break script
    - **End First Test Script:**
        - **Time. Please put your pencils down and remain silent. *Collect test* You've just completed the first math skills test. You'll have a 2-minute break to stretch before taking the second test.**
- Tell Group 2 to quiet down, read instruction script (slightly different), pass out second math test
    - **Second Test Start Script:**
        - **You will now take a similar test to the first math test that you have taken. It will be 25 questions taken over 2 minutes. Remember to stay quiet. Good luck.**
- Start the timer, stay in the room and loom around people taking the test
- Collect the second test, debrief script, reinforce right to withdraw & anonymity, tell them not to snitch on second group
    - **Debrief Script:**
        - **Congratulations you have finished the math portion of the SAT. Seriously though, you have finished completing our psychology experiment. You have just been tested on the effects of social facilitation, based off of a study by Triplett (1898). We tested you to determine whether the presence of audience members (us) would have an effect on your performance on a basic skills test. If you put your email in the consent form, we will send you the results of our study after the statistical research was conducted. Again, you have the right to withdraw if you choose to. You are now free to leave the room and the experiment is over, please do not inform any other groups about this information until the IA day is over. Thank you**.
- Shuffle Group 2 out, repeat previous steps with Group 1 (experimental group first)

Appendix 4: Sample Math Test (Form O, Control Test)

Math Skills Test

Email: _____

Name: _____

Form O

1. $5(6)-4+3$
2. $\frac{8-5(4)}{2}$
3. $2^3+4(3)$
4. $\sqrt{81}-3$
5. $9(8)+4-1$
6. $\left(\frac{7}{2}\right)-4.5$
7. $10(3)-8+6$
8. $11(5)-6+3$
9. $8(9)/4$
10. $-8+4(7)$
11. $4(6)-6+8$
12. $\frac{5+3+2(2)}{3}$
13. $12(5)+8-9$
14. $\frac{13+5}{6^2}$
15. $\frac{18+5-9}{2}$
16. $5(7)-3+9$
17. $4-9(5)$
18. $18-7(3)+4$
19. $\frac{9(6)}{3}$
20. $7(6)-5+4$
21. $3(9)+3-4$
22. $13(2)+8-5$
23. $\frac{8}{2}+7-6$
24. $\frac{(100-55)2}{9}$
25. $\left(-\frac{9}{3}\right)(-6)+5$

Appendix 5: Sample Math Test (Form X, Experimental Test)

Math Skills Test

Email: _____

Name: _____

Form X

1. $5(7) - 5 + 4$
2. $\frac{9-6(5)}{3}$
3. $3^3 + 5(4)$
4. $\sqrt{121} - 4$
5. $8(7) + 5 - 2$
6. $\left(\frac{10}{4}\right) - 3.5$
7. $11(3) - 9 + 7$
8. $\frac{9(9)+3}{4}$
9. $-9 + 5(7)$
10. $-7 + 9 + 5(7)$
11. $\frac{6+3+3(3)}{3}$
12. $13(5) + 9 - 4$
13. $\frac{16(2)}{4^3}$
14. $\frac{19+6-8}{2}$
15. $6(6) - 4 + 8$
16. $8 - (7)(4)$
17. $\left(\frac{21}{3}\right)\left(\frac{64}{8}\right) - 10$
18. $20 - (8)(4) + 7$
19. $\frac{10(5)}{2}$
20. $6(5) - 6 + 5$
21. $4(9) + 4 - 3$
22. $14(2) + 4 - 7$
23. $\frac{9}{3} + 9 - 7$
24. $\frac{(90-55)2}{7}$
25. $\left(-\frac{12}{3}\right)(-7) + 4$

Appendix 6: Significance Level Chart

Z Critical Score	1.645	1.960	2.326	2.576	3.291
Directional Test	.05	.025	.01	.005	.0005
Non-directional Test	------	.05	.02	.01	.001

Appendix 7: Inferential Statistics

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Participan	Control Condition	Experimental Condition	C-E	Absolute Value	Readjust rank	Subject number	Ranking (F)			z-score = (W-.5)		
2	1	0.4	0.32	0.08	0.08	0	5	__			(41-.5)= 40.5		
3	2	0.52	0.36	0.16	0.16	0	9	__					
4	3	0.32	0.24	0.08	0.08	0.08	1	3.5	3.5		std. = 10(10+1)(2*10+1)/6		
5	4	0.4	0.48	-0.08	0.08	0.08	3	3.5	3.5		19.62		
6	5	0.24	0.24	0	0	0.08	4	3.5	-3.5		z-score - 40.5/19.62		
7	6	0.56	0.48	0.08	0.08	0.08	6	3.5	3.5		2.06		
8	7	0.16	0.24	-0.08	0.08	0.08	7	3.5	-3.5				
9	8	0.48	0.2	0.28	0.28	0.08	11	3.5	3.5				
10	9	0.44	0.44	0	0	0.16	2	7	7				
11	10	0.28	0.08	0.2	0.2	0.2	10	8.5	8.5				
12	11	0.32	0.24	0.08	0.08	0.2	12	8.5	8.5				
13	12	0.68	0.48	0.2	0.2	0.28	8	10	10				
14									Summation				
15									41				
16									n = 10				
17													
18													
19													

Appendix 8: Raw Data

Condition and Experimental Data shown in decimal form, measured in percentage form

Participan	Control Condition	Experimental Condition
1	0.4	0.32
2	0.52	0.36
3	0.32	0.24
4	0.4	0.48
5	0.24	0.24
6	0.56	0.48
7	0.16	0.24
8	0.48	0.2
9	0.44	0.44
10	0.28	0.08
11	0.32	0.24
12	0.68	0.48