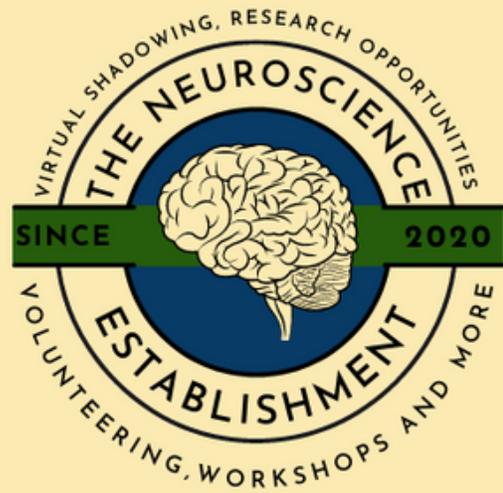


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Traumatic Brain Injuries and Increased Dementia Risk -
Written by Sophia Panos

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How Pitch Variations in Background White Noise Affect Short Term Memory Recall in College-Aged Students - Written by Kristen Hall

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The Effect of BMI on Self-Perception - Written by Sarah Gallardo



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Table of Contents

How Pitch Variations in Background White Noise Affect Short Term Memory Recall in College-Aged Students - Written by Kristen Hall	2
Traumatic Brain Injuries and Increased Dementia Risk - Written by Sophia Panos	10
The Effect of BMI on Self-Perception - Written by Sarah Gallardo	17
Erasing and Altering or Implanting Human Memories - Written by Arya Deshmukh	24
The Impacts of Mentorship to High School Students - Written by Justine Paragas	32
Unfolding the Reality of the Pandemic: A Comparative Study of Changes in Mental Health Before and During the Pandemic - Written by Khushboo Shukla, Shourya Kashyap	39

How Pitch Variations in Background White Noise Affect
Short Term Memory Recall in College-Aged Students

Kristen Hall

ABSTRACT

This study is intended to explore the effect of pitch variations in white noise on the short-term memory recall of college-aged students who study two sets of new material. Participants were asked to memorize and then write down information from two provided sets of material: two neuroanatomy charts and a list of names with corresponding birthdates. While they studied the material and filled in blank copies, individuals in the experimental groups listened to white noise with different levels of pitch variations. Most participants correctly remembered eight to ten anatomy labels and two or three sets of names and dates, but there was no discernable difference in memory recall between the three groups. It is therefore concluded that white noise does not affect short-term memory recall in young adults.

INTRODUCTION

College students are constantly finding new ways to study. Studies have shown that students who study in shorter increments are likely to do better than their peers who study for hours-long periods.¹ It has also been shown that interleaving practice, or studying related but not identical problems, is useful for mathematical concepts.¹ Currently, scientists are trying to determine the effect of music and background noise on study habits. It is largely understood that while random background noise can be distracting while studying and recalling information², music or white noise that blocks out other random sounds can improve memory recall in 48 hours.³ Additionally, it has been found that classical music stimulates the brain in such a way to motivate learning because it activates the reward center⁴, suggesting that students who listen to classical music may study more effectively because it is more enjoyable.

But, the effect of pitch variations within white noise on short-term memory has not been exclusively researched. This experiment was intended to explore the effects of white noise containing different levels of pitch variations on college students' memory recall over twenty

minutes. If students are exposed to new study material while listening to white noise, it is hypothesized that white noise containing greater pitch variations will have a positive effect on short-term memory recall because it will block out other distracting noise and stimulate the brain's reward center.

METHODS

A total of three experimental groups were tested in this experiment—Control, No Pitch Variation, and Pitch Variation—with four participants per group. These group titles corresponded to the background noise that each participant listened to during the tests. The control group did not listen to any soundtrack. The No Pitch Variation group listened to a recording of a box fan, while the Pitch Variation Group listened to a recording of a daytime rainforest with birds and insects. Participants were tested in a standard dorm room to simulate a common study environment. All lights except for a single, warm-light desk lamp were turned off and blinds were drawn to limit light levels and outside noise. Interruptions were also limited; only one participant was allowed in the room at a time, and no other students were present besides the test proctor.

Each control group was tested at a different time of day. The control group was tested in the morning from approximately 10:00 am to 12:00 P.M. The No Pitch Variation group was tested in the early afternoon from approximately 2:00 P.M to 4:00 P.M. Finally, the Pitch Variation group was tested during the late afternoon and evening from approximately 5:00 P.M. to 8:00 P.M. Within each group, participants were tested in twenty-minute time blocks with a five-minute window between each new participant.

Participants were instructed to sit at a desk and were given a laptop, two blank index cards, and a pen. They were instructed to memorize two neuroanatomy diagrams (Figure 1) which were shown on the laptop screen side-by-side. They were given exactly 2.5 minutes to memorize the diagrams, during which the white noise soundtrack would play from a speaker beside the laptop. After the period for memorization was complete, study materials were removed, soundtracks were stopped, and participants were asked to draw a picture of their favorite animal on one of the index cards for five minutes. During this time, no soundtracks were played, but participants were invited to talk to the proctor if desired. This drawing period was

intended to simulate a normal school environment in which students immediately move from one task to another.

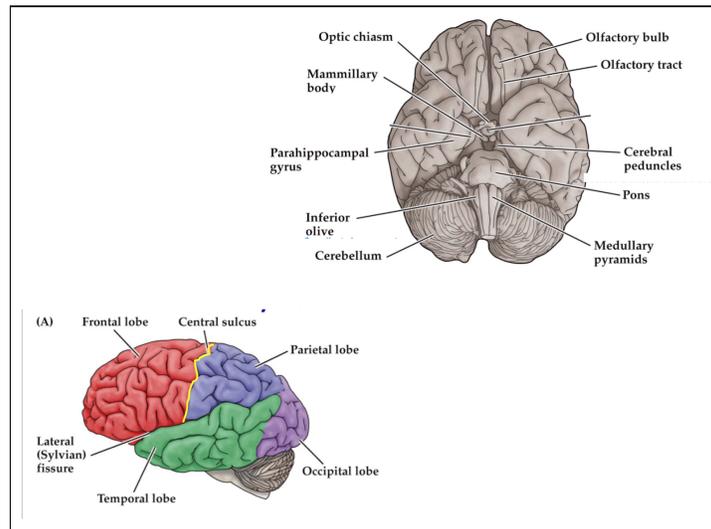


Figure 1. Neuroanatomy charts were given for Phase 1 Memorization.

Top: Ventral view of the human brain. Bottom: Sagittal view of human brain lobes.

After approximately five minutes, drawing materials were removed and participants were given 2.5 minutes to fill out blank neuroanatomy diagrams (Figure 2) to the best of their ability. They were told that each blank label would count as one point; spelling errors would not result in the loss of a point. During this time, the background white noise would resume from the same speaker.

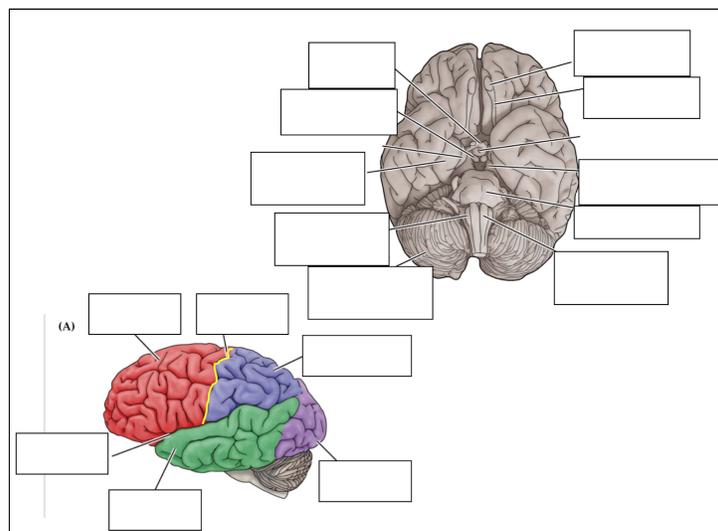


Figure 2. Blank neuroanatomy charts were given for Phase 1 Memory Recall.

Top: Ventral view of the human brain. Bottom: Sagittal view of human brain lobes.

After 2.5 minutes, the soundtracks were stopped and participants were told to stop typing. They were allowed to get up, stretch, or drink water if needed while the study materials were switched. Once ready to resume, the above procedures were repeated with a list of names and birthdates (Figure 3) as the new study materials. The same soundtracks were used.

Ernst Herbert	08/23/2004
William Hull	12/05/1981
Lewis Richard	12/11/1987
Karl Rudolf	10/22/1942
Maria Elias	11/14/1980
Alfred John	12/03/1962
Sara Elizabeth	05/02/1997
Thomas Henry	06/14/1946
Edith Corse	11/13/1960
George James	04/22/1980
Manuel Gonzales	10/11/1990
Robina Maggie	06/04/1956
Anthony Wood	11/07/1950
Annie Clemmer	04/25/2003
Hans Kristensen	02/03/1967
Sydney Leslie	07/20/2009
Robert Olston	12/27/1972
Alice Phoebe	04/16/2006
Bridge Delia	06/10/2001
Ellen Truelove	03/12/2008

Figure 3. List of names and birthdates for Phase 2 Memorization.

For the Phase 2 drawing period, participants were asked to draw a picture of their friends on the second index card. After the drawing period, participants were provided a blank two-column chart to fill in. Participants were told that spelling errors would not deduct points, but each point consisted of the first and last name in addition to the corresponding birthdate in month/date/year format. If only a name or birthdate was filled in, the point would not count. Participants were also informed that the order of names and dates would not be counted; as long as the name and corresponding date were listed correctly in the same line, the point would be given. After the allotted 2.5 minutes, materials were removed and participants were dismissed.

RESULTS

The effect of background white noise on participants' short-term memory recall was measured by grading each individual's completed anatomy diagrams and list. As described above, each phase was graded with a point system. For the neuroanatomy diagrams, each box counted as a single point, with a total of sixteen points possible. For the list of names and

birthdates, there was a total of twenty points possible, where each point contained the name and the date. Minor spelling errors would not result in the loss of a point.

On average, the control group scored 53.125% on the anatomy diagrams and 11.25% on the names and birthdates list. In other words, each control participant correctly remembered around eight anatomy labels and two sets of names and dates. The No Pitch Variation group scored an average of 65.625% (10 labels) on the anatomy diagrams and 11.25% (2 sets) on the names and dates. Finally, the Pitch Variation group scored an average of 64.0625% (10 labels) on the anatomy diagrams and 13.75% (3 sets) on the names and dates. The data is summarized in Figure 4 and represented graphically in Figure 5, where it can be seen that there is no discernible difference in memory recall between the three groups.

	Anatomy Chart	Names and Dates
Control Group	68.75%	20.00%
	43.75%	10.00%
	37.50%	10.00%
	62.50%	5.00%
No Pitch Variation	75.00%	20.00%
	68.75%	10.00%
	81.25%	10.00%
	37.50%	5.00%
Pitch Variation	37.50%	0.00%
	37.50%	15.00%
	100.00%	25.00%
	81.25%	15.00%

Figure 4. Summarization of participant scores.

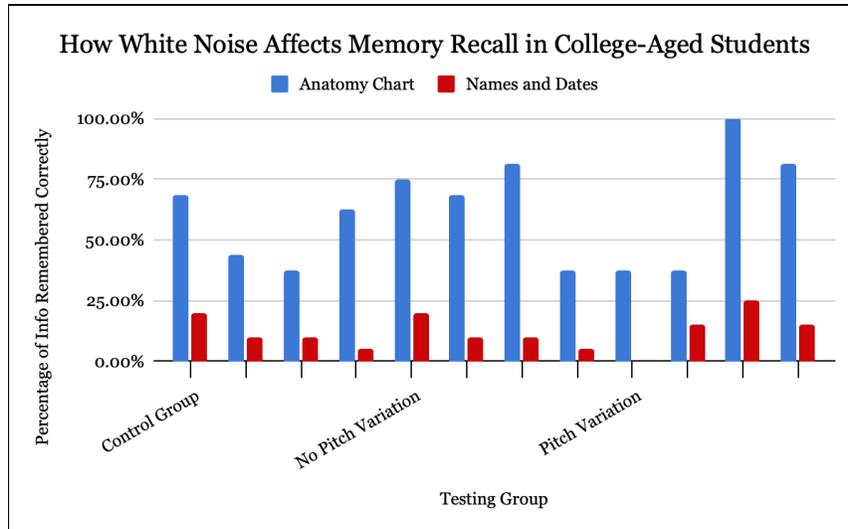


Figure 5. Graphical representation of participant scores.

The lack of significance of these results was further seen in statistical analysis (Figure 6). An ANOVA test showed a P-value of 0.88 when all results were grouped, meaning that there is no statistical significance to the data. Although it seems that the experimental groups scored better than the control group when looking at the raw data, the improvements are not large enough to conclude that white noise has a positive effect on short-term memory recall.

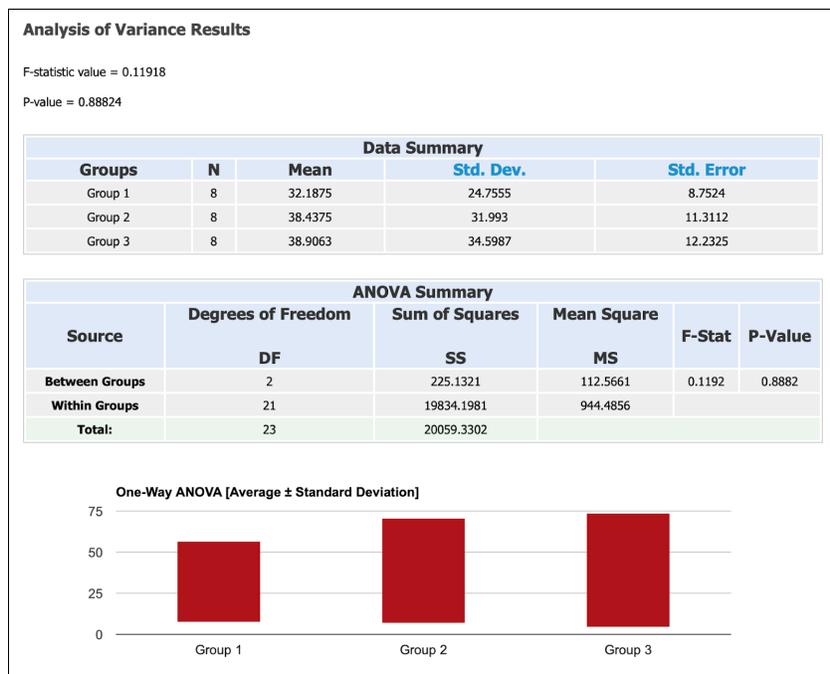


Figure 6. ANOVA test of participant scores from each group. P-Value = 0.8882.

DISCUSSION AND CONCLUSION

This experiment was intended to evaluate the effect of white noise on memory recall in college-aged students. It was hypothesized that white noise with pitch variations would have the greatest positive effect on memory recall due to studies showing that classical music has positive effects on memory recall. However, after statistical analysis, the data shows that there was no statistically significant difference in memory recall among the three test groups. An ANOVA test showed a P-value of 0.88, which is far from a statistically significant value. Furthermore, after results were graphed in a bar graph, it became clear that there was no discernable difference among the three testing groups' memory recall.

There were many limitations to this experiment that could account for the lack of statistically significant results. To begin with, due to the ongoing COVID-19 pandemic, it was extremely difficult to find volunteers for the memory tests. Because the nature of the tests requires that they be conducted in person, it was only possible to test one person at a time. The social distancing restrictions and lack of volunteers at the university where this experiment took place almost certainly affected the results. A larger sample size would make statistical analysis easier and likely reveal any trends that could not be seen in this data set. Furthermore, it is possible that the volunteers' behavior during the memory tests affected their results. Many of the volunteers did not talk at all during their tests, or at the very most only spoke during the drawing task that was used to let the information process in their brains. However, a small portion of the volunteers talked for the entirety of their test, either to the proctor or to themselves as they memorized the material. It is possible that this extra noise interfered with the effects of the white noise and thus affected the results of the memory tests. Finally, it may be possible that the time of day at which the tests were taken affected the results. It is well-known among teachers and scientists that people have a preferred time of day for studying; many students do not study well early in the morning, for example. The memory tests in this experiment were conducted over a single day, meaning that the control group took their tests in the morning while the pitch variation group took their tests in the late afternoon. It is unknown whether timing may have affected results, but it is worth noting.

Future experiments on this topic should control for all of the aforementioned limitations and experiment on a much greater number of volunteers to have more data for statistical analysis.

Also, future experiments should consider investigating whether the type of material being studied affects memory recall. It was clear in this experiment that students did much better overall on the anatomy memorization and generally did not remember more than 4 names and dates. This avenue is worth exploring. Does white noise only affect certain kinds of memory recall? Did the visual component of the anatomy chart make memorizing the information easier? Overall, this experiment's idea is intriguing and should be explored further to make any viable conclusions.

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Traumatic Brain Injuries and Increased Dementia Risk

Sophia Panos

ABSTRACT

This experiment was designed to determine if a causal link exists between TBI's sustained and the development of dementia--a degenerative brain disease--later in life. For this experiment, data collected from "Traumatic Brain Injury and Risk of Dementia Diagnosis" by PLOS medicine was reanalyzed to provide updated figures. Two medical professionals, DO Nedd a Neurologist, and Dr. Ganesh, another Neurologist, were also interviewed to receive commentary on the link between dementia and sustained TBI's. The resulting data found that, the younger you have sustained a TBI, the more your chances of developing dementia later in life increase. The percentage of TBI's triples in the 60 and older population when sustaining a head injury 30 years ago, compared to having a TBI within the last year; this is most likely because these brain injuries occurred closer to the person's developmental years. Thus, this data analysis concludes that persons with TBI's are much more likely to develop dementia, up to 1.8% of persons with TBI's develop dementia while only .18% of the typical population does.

INTRODUCTION

Traumatic Brain Injuries have become increasingly frequent throughout the years, especially in younger populations. This is why it has also become increasingly important to track the long-term effects of sustaining a TBI, especially in a person's younger years. This can not only enable doctors to properly inform their patients, of not only the immediate effects of TBI but also severe long-term effects like the increased risk of degenerative brain disease development. By having this information readily available, to both patients and doctors, TBI sufferers can work on improving brain health, and taking other preventative measures to help combat their increased dementia risk.

Yet, research on the causal link between TBIs and dementia is relatively new. These studies have only been replicated a few times, and thus doctors have only begun trusting this news and spreading it to patients fairly recently. This experiment was designed to determine if

there is a connection between sustaining a TBI and developing dementia later in life. It was also designed to get neurologists' opinions on this subject, to see if they are beginning to share this information with their patients. Ultimately, the problem explored in this experiment was if repeated brain injuries (TBI) can increase the risk that a person will develop degenerative brain diseases, like dementia, later in life? If so, is this information being provided to TBI patients? The predicted answer to this question within the confines of this experiment was that if a person suffers from a Traumatic Brain Injury, then they will be at an increased risk for degenerative brain diseases because TBI's can decrease microtubule function in the brain, allowing pathologies that cause neurodegeneration to develop. These pathologies prove extremely harmful and can cause conditions like dementia (examined in this report), Alzheimer's, etc. If doctors promote this information to patients, not only as a preventative measure to take TBI's seriously especially for adolescent athletes but also to sufferers of TBI's who can prevent this disease development they are at risk by adopting practices vital to brain health.

METHODS

In this experiment, data from PLOS Medicine's journal article "Traumatic Brain Injury and the Risk of Dementia Diagnosis: A Nationwide Cohort Study"¹ was examined and analyzed, generalizing to the population of the United States. This generalization was designed to aid in the application of TBI and Dementia research, making it easy for anybody to understand. Generalized graphs were created on excel, and percentages of the TBI population who developed dementia were compared to percentages of the non-affected population who also developed dementia. This data was converted into bar graphs that represent the total populations sampled vs the affected population, and also a table which lists the percentages of TBI's developed in the nonaffected population and persons who have developed these brain injuries X amount of years from the time they were studied. These categories were divided into 1-365 days ago, 1-4.9 years ago, 5-9.9 years ago, 10-19.9 years ago, 20-29.9 years ago, 30 years ago, or more. So for example, if a person studied sustained a TBI 25 years ago they would be placed into the 20-29.9 years age group. If this person did develop dementia, this result was counted towards the total that did develop dementia. Then, the total that developed dementia was plotted against the total who suffered a TBI 20-29.9 years ago. For the chart, the total that developed dementia from a

sample at a given time was divided by the total amount of persons who were sampled (or N). N varies slightly from population to population, based on how many subjects were able to be sampled. This variance in the N value is also demonstrated on the bar graph included. This concludes the methods for designing and creating the first part of the experiment, where data was collected and synthesized.

For the second part of the experiment, interviews were conducted with multiple healthcare professionals. The first professional was a Doctor of Osteopathic Medicine who is certified in Neurology, DO Nedd. The second was a Medical Doctor of Neurology, Dr. Ganesh. They were asked multiple series of questions regarding the link between Traumatic Brain Injuries and the development of dementia. These questions not only evaluated the extent to which they warn their patients about the adverse effects but also if they believe enough research in the field has been conducted to determine a causal link between dementia development and TBI.

In this experiment, there were two groups, a group that had sustained a TBI, and a group that had never sustained a TBI. The sustained group was then broken down into further subcategories (mentioned above) stating how many years since their last TBI had occurred. From these two independent groups, a dependent variable--of dementia was developed--was measured. To keep the groups as controlled as possible, persons who suffered serious accidents but were not officially diagnosed with TBI were ruled out from being in the control (never sustained a TBI) group. Similarly, only persons with officially diagnosed TBI were included in the sustained group. This group also only evaluated the year in which the person's most recent TBI was sustained, to further classify them.

RESULTS

The results of this study, on pages 5 & 6, illustrated that receiving a TBI at any point of life increases the risk of a person developing dementia. These persons had developed dementia by age 60 which is extremely uncharacteristic of the disease itself. In populations unaffected by TBI's and any other suspicious head traumas, the percentage of persons who developed dementia was .18%. This is a relatively low percentage and is especially low when comparing it to the percent of persons suffering from dementia who had sustained a TBI. In persons who suffered a TBI up to 364 days ago, creating the lowest incidence rates of dementia in the TBI-affected

population, still, .6% of these persons developed dementia. Again, while this is a small percentage, the number of affected persons increased by a factor greater than 3, which is extremely significant when you consider the horrific side effects of dementia. The rest of the groups who suffered a TBI consistently had an incidence rate between 1.2% and 1.7%, making the standard deviation of this sample .25. However, two outliers were one positive standard deviation away from the mean, carrying a prevalence rate of 1.8%. These were persons in the 20-29.9 years age group, and the 30 or more years age group. This deviation may be because since the persons sampled were all 60 years old, these persons may have still been undergoing critical brain development. Or, yet another reason this could occur, is that TBI's occur more frequently after the first incidence, and these persons simply had more years of life to continue damaging their brain further. This concludes the analysis of raw data.

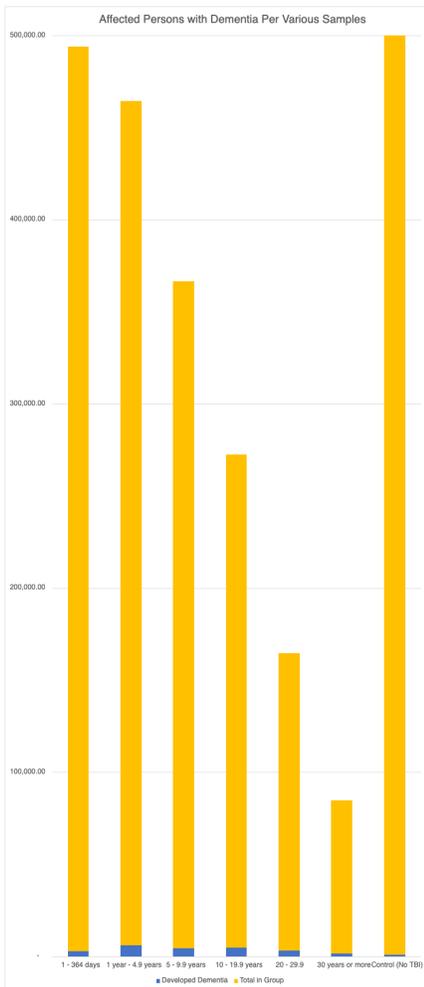
Now, to detail the most important aspects of the interviews (Full Interview snippets on pages 7 & 8) with healthcare professionals, it is important to highlight their concern for TBIs and suffers from other head injuries. As Neurologists, these particular physicians are extremely well informed in the ways of brain damage and thus care about this issue greatly. Dr. Ganesh has personally noticed sudden brain changes, especially in elderly folks, and thus does not doubt any research linking brain injury to dementia. Both doctors reported commonly seeing patients who had sustained a TBI, and then, later on, come back with some form of dementia--either mild or severe--or another result of CTE. These doctors advise their patients to take TBIs seriously, not only to prevent increased risk of dementia but also to prevent other health problems that may occur later on in life.

DISCUSSION/CONCLUSION

This study was designed to determine if there was a causal link between sustaining a TBI and developing dementia later in life. It was hypothesized that sustaining a TBI can increase your risk for developing dementia since TBIs can cause dangerous changes in your overall brain chemistry. This hypothesis was supported by evidence, since the normal prevalence rate in persons without TBI at the age of 60 (the control group) is .18%, while rates can increase 10 fold to 1.8% of a population developing dementia if they sustained a TBI more than 20 years before their 60th birthday. Thus, since this claim was supported, it begs the question that persons should

pay much more attention to scientific discourse on TBI. TBI's while pretty common, especially in elderly populations and athletes, are still a very serious issue that can have major health complications down the line. So although it is not a "well known" fact that TBI's can cause dementia and other degenerative brain diseases, this is information worth sharing, and information that will most likely be widely popularized--with the help of doctors' advice--for years to come.

CHARTS



Group	Percent Effected by Dementia
1 Day - 365 Days	0.60%
1 year - 4.9 years	1.30%
5 - 9.9 years	1.20%
10 - 19.9 years	1.70%
20 - 29.9	1.80%
30 years or more	1.80%
Control (No TBI)	0.18%

INTERVIEW QUESTIONS AND ANSWERS:

In your experience, do you believe there is a link between TBI and Degenerative Brain Diseases?

- “Yes, I’ve been seeing patients come in with TBI’s and years down the line have memory problems, and eventually develop some awful degenerative brain diseases. The cause of this link is still being investigated to find full understanding, but there is a link between TBI and CTE or other DBD’s.” - DO. Nedd
- “Yes, since we now understand that TBI’s can cause CTI and we understand these changes at a more microscopic level. We tend to see people suffer a TBI, and then develop dementia or some sort of other coexistence with CTI.” - Dr. Ganesh

Do you believe the likelihood of developing a DBD increase if people suffer a TBI later in life?

- “I’m not sure on this one, but the rate of having a TBI is higher for older people. They tend to fall more often, and just be generally more fragile because of conditions like osteoporosis, so they do suffer more TBI’s but may not have more DBD” -DO. Nedd
- “So when the elderly suffer a head injury, normally due to falling, I’ve seen that it can normally cause more sudden cognitive changes, much different from the cognitive changes we see in children. Since old people are also on blood thinners it creates a greater risk for falls and sustained head injuries like subdural hematomas. However, I’m not 100% sure if the likelihood is higher since that would be found in a more laboratory or data analysis typesetting” - Dr. Ganesh

What happens to the brain when a TBI occurs?

- “When someone has a TBI, their brain starts to move around in their skull in the direction of impact, this could cause a brain bleed or just other damage to occur inside the head” -DO. Nedd
- “The brain will begin to keep moving in the skull, since it is suspended in the fluid, and begins to get knocked around a little bit. It sends shocks to the brain causing major injuries if the brain begins to scrape the skull or hit the skull” - Dr. Ganesh

Can a person suffer multiple TBI’s at once?

- “Well, brain injury is the most complex disease of one of the most complex organs, so yes many people suffer multiple injuries at once, or have many incidents right after each other in situations like sports games.” - DO. Nedd

- “Yes, in most instances the brain will hit the skull on impact in one spot, but it will also hit the skull as it bounces back in multiple other places” - Dr. Ganesh

Is there anything else you'd like to say on the subject of TBI's and developing DBD?

- “Not really, we talked about as much as I know” - DO. Nedd
- “You know, we've known about this connection for a very long time, about since the 1920s. I'm not sure if you've looked into Harrison Martland, but he was the first person to observe the phenomena of “punch drunk” that when people get hit in the head they tend to be a little bit slower. So, we've known about this, it's just taken a long time for it to affect so many people it's come to the forefront of medicine” - Dr. Ganesh

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The Effect of BMI on Self-Perception

Sarah Gallardo

ABSTRACT

The purpose of this study is to investigate individuals' self-perception after calculating their own body mass index (BMI). A survey was created with questions regarding general demographic information as well as those related to the calculation of BMI and changes in self-perception via a rating system from 1-10, with 1 being "much worst" and 10 being "much better." Once completed, 36 people had submitted their results. In conducting ANOVA tests, $p = 0.01$, $\alpha = 0.05$ when observing the general relationship between a person's BMI and their self-rating, $p = 0.02$, $\alpha = 0.05$ when observing the relation between a person's BMI, biological sex, and self-rating; $p = 0.24$, $\alpha = 0.05$ when observing the relationship between a person's BMI, race, and self-rating; and $p = 0.15$, $\alpha = 0.05$ when observing the relationship between a person's BMI, age, and self-rating. From these results, it can be concluded that BMI affects individuals' self-perception, more so about biological sex than age or race.

INTRODUCTION

This research study explores the effects of discovering one's BMI on their self-perception. BMI is a subject that has caused controversy among the modern-day medical community due to its racial bias. Experimenting on how BMI affects self-perception and how it varies among the biological sexes, various races, and different ages reveal how and if knowledge of an individual's BMI also negatively impacts how the person views.

Body mass index, or BMI, has been used as an indicator of an individual's weight, susceptibility to certain health risks, and developing public health policies since its conception in the mid-nineteenth century (Nuttall, 2015). To calculate a person's BMI, their weight in kilograms must be divided by their height in meters squared. The BMI categories are as follows: a BMI value of 18.5 or less is underweight, a value between 18.5 to 24.9 is normal, 25.0 to 29.9 is overweight, and 30.0 and above are obese (CDC, n.d.). Despite being used primarily for medical purposes, its usage for weight indication has influenced how some individuals come to

view themselves. For example, people are relieved upon learning of their healthy BMI categorization. On the other hand, those who classify as underweight, overweight, or obese may come to view themselves as being less healthy or physically unfit in comparison to those considered healthy.

Underweight and obese individuals are more prone to demonstrate symptoms of eating disorders, such as anorexia, binge-eating disorder, and bulimia. According to a 2012 study, women between the ages of 16-20 had the highest rate of binge-eating and vomiting episodes. Furthermore, underweight women experienced the highest rates of vomiting, and those who were obese experienced the highest rate of regular binge eating. Those who were underweight had the second-highest rate of regular binge eating and those obese had the second-highest rate of regular vomiting (Ro et. al., 2012). Although it is not clear whether or not these individuals were aware of their BMI at any point during this study, one can observe that these people were dissatisfied with their physical appearances, specifically their weights, thus developing eating disorders to reach their desired look. These individuals place more of their worth on a numerical value rather than on anything else, whether it be what another person thinks or what they think.

In consideration of the background information, this study investigates the effect of knowing one's BMI on how they perceive their physical appearance, and thus the question "How does BMI affect how an individual perceives their physical appearance, regardless of how healthy they may be?" If an individual's BMI is categorized as "normal," then their self-perception will be positively impacted because the individual is considered to have a healthy height-to-weight ratio.

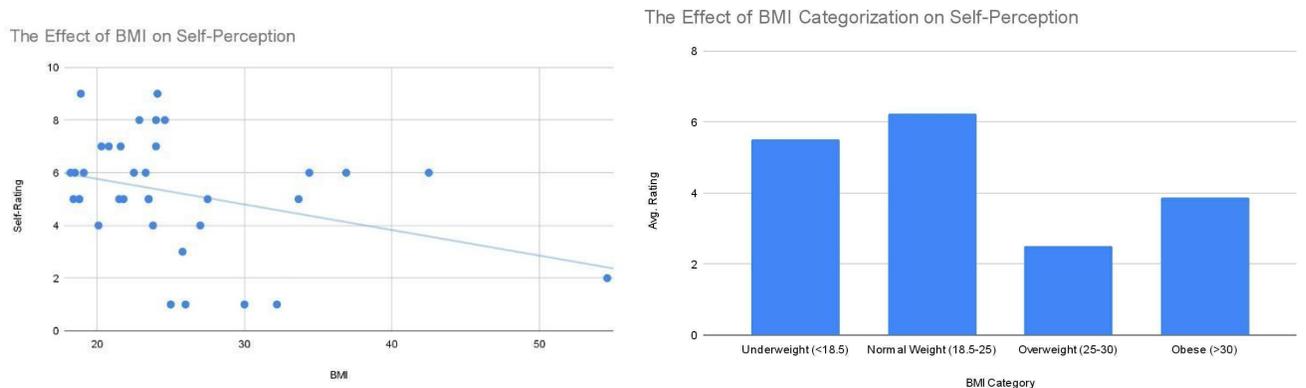
METHODS

A survey was created with the sections "Introduction," "Demographics," "BMI," "Self-Perception," and "Agreement & Debriefing" to assess their alteration of self-perception. In "Introduction," a disclaimer was provided regarding the subject matter of the research project as well as a question asking the individual to describe their physical appearance in 10 words or less. In "Demographics," the individual was asked to provide their biological sex, race(s), and age. In "BMI," the individual was asked to provide their height in inches, weight in pounds, and, using the two, calculate their BMI using the BMI calculator provided by the CDC electronically. In

“Self-Perception,” the individual was asked to describe their physical appearance in 10 words or less once again as well as to rate their feelings upon knowing their BMI. This assessed whether BMI affects one’s self-perception. In “Agreement & Debriefing,” the individual was informed about the purpose of the research project, made aware that all of their responses were anonymous, and that they truthfully answered each question.

In planning the survey, those with a normal BMI collectively formed the control group, whereas those with BMIs classified as “underweight,” “overweight,” or “obese,” were divided into three experimental groups. The independent variable was the individual’s BMI; the dependent variable was their self-reported self-perception measured on a scale from 1 to 10. The control variables were the demographics of age, race, and biological sex. Although this study focused on the effects that BMI has on one’s self-perception, it was important to be mindful of how these factors could impact how individuals felt about their physical appearances as a result of these elements.

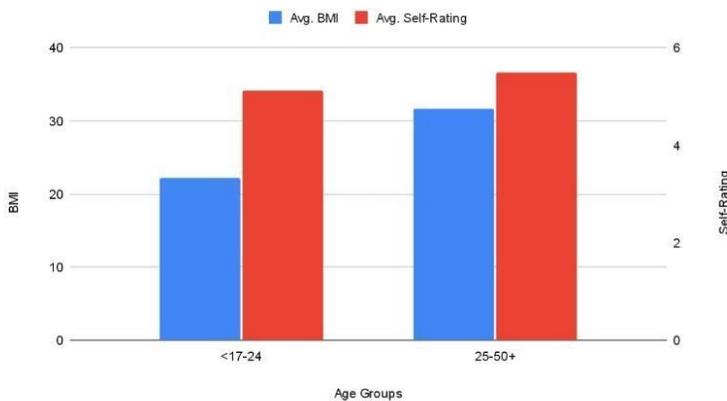
RESULTS



The scatterplot (above left) and the bar graph (above right) both display the survey results, with the scatterplot showing the negative trend between BMI and one’s self-rating and the bar graph showing the average rating for each of the four BMI categories. A single-factor ANOVA test (below) was performed to test for statistical significance between BMI and self-perception. When 95% CI for BMI [23.57, 27.12] and 95% for self-perception [0.12, 10.38], there was statistical significance as $p = 0.01$, $\alpha = 0.05$.

ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	24.4	3	8.133333333	4.490797546	0.008898493323	2.866265557
Within Groups	65.2	36	1.811111111			
Total	89.6	39				

The Effect of BMI on Average Self-Rating Across Age Groups

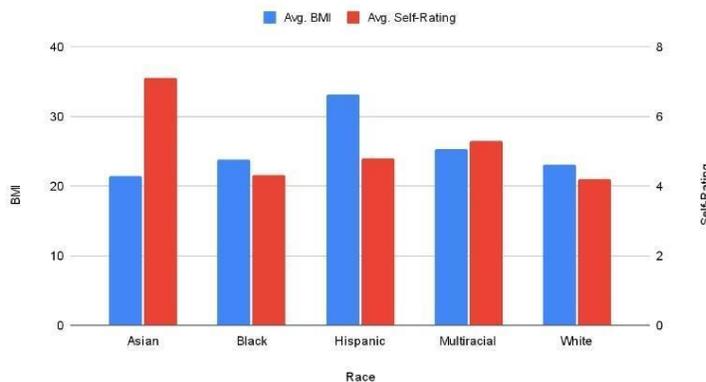


ANOVA						
Source of Variatio	SS	df	MS	F	P-value	F crit
Rows	45.2	9	5.022222222	1.686567164	0.2240890763	3.178893104
Columns	7.2	1	7.2	2.417910448	0.1543767587	5.117355008
Error	26.8	9	2.977777778			
Total	79.2	19				

significance as $p = 0.15$, $\alpha = 0.05$.

The histogram (above left) displays the average BMI as well as the average self-rating between the age groups <17-24 and 25-50+. A two-factor without replication ANOVA test (bottom left) was conducted to test the statistical significance between average BMI, age, and average self-rating. When 95% CI for average self-rating from ages <17-24 [1.27, 8.98] and 95% for average self-rating from ages 25-50+ [3.62, 7.38], there was no statistical

The Effect of BMI on Average Self-Rating Across Races



The histogram (above left) displays the average BMI as well as the average self-rating between races. A two-factor without replication ANOVA test (bottom left) was conducted to test the statistical significance between average BMI,

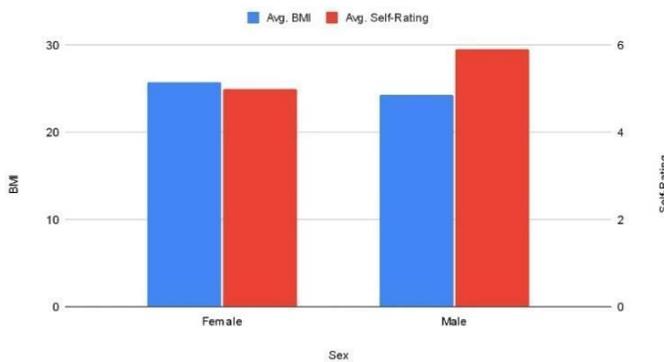
race, and average self-rating. When 95% CI for average self-rating of Asians [6.18, 8.02], 95%

CI for average self-rating of black people [3.56, 5.10], 95% CI for average self-rating of Hispanics [3.37, 6.19], 95% CI for average self-rating of people identifying with two or more races [3.99, 6.68], and 95% CI for

ANOVA						
Source of Variatio	SS	df	MS	F	P-value	F crit
Rows	18.08	9	2.008888889	1.907172996	0.08241209372	2.152607472
Columns	6.08	4	1.52	1.443037975	0.2398654254	2.633532094
Error	37.92	36	1.053333333			
Total	62.08	49				

average self-rating of white people [1.47, 6.90], there was no statistical significance as $p = 0.24$, $\alpha = 0.05$.

The Effect of BMI on Average Self-Rating Between Sexes



The histogram (above left) displays the average BMI as well as the average self-rating between males and females.

A two-factor without replication ANOVA test (bottom left) was conducted to test the statistical significance between average BMI, age, and average self-rating. When 95% CI

for average self-rating for males [4.85, 6.93] and 95% for average self-rating for females [0.81,

ANOVA						
Source of Variatio	SS	df	MS	F	P-value	F crit
Rows	45.2	9	5.022222222	2.539325843	0.09063663371	3.178893104
Columns	16.2	1	16.2	8.191011236	0.01871942326	5.117355008
Error	17.8	9	1.977777778			
Total	79.2	19				

9.62], there was statistical significance as $p = 0.02$, $\alpha = 0.05$.

DISCUSSIONS/CONCLUSIONS

This research study was conducted to test the effect of an individual's knowledge of their BMI on their self-perception. It was predicted that if an individual has a normal BMI, then their self-perception will be positively impacted. Through conducting a survey, the hypothesis was proven as $p = 0.01$, $\alpha = 0.05$. Those with a normal BMI demonstrated the most positive change in self-perception, whereas those who are overweight had the most negative. Additionally, there was

statistical significance between biological sex and knowledge of one's BMI in respect to self-perception, where $p = 0.02$, $\alpha = 0.05$, but none was observed when considering race and knowledge of one's BMI as $p = 0.24$, $\alpha = 0.05$ in addition to age and knowledge of one's BMI as $p = 0.15$, $\alpha = 0.05$.

In the 2012 study performed by Ro et. al., women who were underweight or obese struggled with eating disorders more often than those whose BMIs were deemed normal or obese. The results from the aforementioned study may be explained by the data analysis conducted in this study; the average BMI and self-rating for females were 25.7 and 5, respectively, and the average BMI and self-rating for males were 24.3 and 5.9, respectively. Due to the higher average BMI and lower self-rating observed in females, they may feel as if they must do anything they can do to have a normal weight according to the BMI scale to be accepted by those around them. Upon knowledge of these results, the general public should place less importance on numerical values, such as the BMI, in defining one's physical health and appearance due to their potentially detrimental effects on individuals' mental health and self-perception. Although individuals must be mindful of their overall health, they should not base their self-worth on a number. Furthermore, the scientific and medical communities should be more transparent regarding the origin and usage of BMI when discussing patients' health with them. Not all people are familiar with how BMI came to be and why BMI continues to be used today. So providing them with the necessary historical context may aid in alleviating their worries and thoughts of self-depreciation regarding their physical health.

Despite the real-life applications of these results, this study was limited by the number of research participants ($n = 36$) and geographical location. Therefore, further research can be conducted with a larger number of participants and a broader geographical location. Moreover, self-perception regarding BMI can also be studied by monitoring individuals' calorie intake, diet, and exercise activities and having them fill out this questionnaire or a similar one before and after the observation period instead of simply filling out this survey. Overall, this study was meant to provide insight into how individuals' self-perceptions shift based on discovering one's own BMI. BMI should not be used as an indicator of self-worth, but many will continue to do so because there is a need to be normal to feel a sense of acceptance from others.

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Erasing and Altering or Implanting Human Memories

Aarya Deshmukh

ABSTRACT

Memory modification involves selective artificial erasure, alteration, or implantation of memories and associations in the mind. Most psychological treatments rely on the modification of maladaptive cognitive, behavioral and emotional patterns. The nature of memory adaptation and accommodation is relevant to clinical treatment strategies and interventions (Kredlow, M.A, Eichenbaum, H, Otto, W.M, 2018). According to Veterans Affairs, 11-20% of war veterans suffer from PTSD. Other potential PTSD patients include victims of violent crimes and witnesses of traumatic events. As a result, the treatment should appear as more of a medical necessity than simply a philosophical inquiry.

This paper investigates the process of memory modification along with the role of the amygdala in emotion and memory-related functioning. The research further examines the implication of the amygdala in crime and the influence of past experiences on criminal behavior. It presents the use of memory modification in the criminal justice system and ends with a discussion on the ethical implications of the same.

INTRODUCTION

Memory refers to the storage, encoding, and retrieval of information in the brain. There exist methods that can modify, suppress or enhance memory. Engrams are groups of neurons that physically reside together, thus maintaining a specific locale for each memory. Targeted engrams can be manipulated in such a way that people forget specific memories either temporarily or permanently. Identification of the nature of an engram requires information about the changes that occur at the site of memory formation and the memory-specific pattern of neural activity. Memory modification consists of three primary ways; false memories, molecular memory modification and directly targeting memory storing neurons. False memory modification employs

a psychological method to implant false childhood memories while molecular memory modification follows a similar course on a molecular level.

Criminal offenders serve jail time but that doesn't assure reformation or rehabilitation. Recidivism refers to the relapse of criminal behavior after incarceration. According to a 2021 report by World Population Review, criminal recidivism reports around the world are as high as 50%. The concept of incarceration regarding deterrence at the cost of large tax burdens does not seem utilitarian enough. The aim is to reform criminals through a more reliable solution. Erasing or altering memory in cases of PTSD victims is quite conventional. In the case of criminals, any prior traumatizing or crime-influencing memories can be modified. So how can the memories of criminal offenders be modified for rehabilitation?

This research paper reviews literature in order to question whether any prior memories that may have influenced the crime can be altered. In case such memory is altered, can it possibly change the way a criminal regards similar situations in the future? It is known that the amygdala plays a role in both emotional memory and the fight or flight response. Consequently, can the fight or flight response run differently, and will the altered emotional memory induce a contrasting reaction?

The discussion of memory interventions in the criminal justice system is yet to gain impetus. Neuroethics being relatively new hasn't ventured deep enough into the ethical implications of memory modification. Assessing the same strictly about the case of criminals is, therefore, within limits.

If memories of criminal offenders are modified, then they will be rehabilitated because the amygdala, which is responsible for emotional memory also plays a pivotal role in driving flight or fight responses and is implicated in crime.

ANALYZATION OF RESEARCH SOURCES

The paper titled 'Memory Modification and Ethical Implications' by Ross Michael Reul, Jr reviews memory modification and its types and also introduces an ethical debate on memory research and modification. It begins with a description of memory formation and recall or reconsolidation and talks about sensory, short-term, and long-term memories including procedural, semantic, and episodic memories. The author reviews studies and experiments such

as bilateral resection of the hippocampus of patient H.M. and E.P. by William Scoville, Hebb's postulate about synaptic plasticity of neurons and the uses of anisomycin and propranolol for reactivation of memories. The reactivation of memories opens a time-sensitive window for alteration, strengthening, or weakening of memories to test this, researchers tested 36 university students. The paper then discusses false memories which are not exactly performed as neuroscientific research but rather as a psychological one. The author points out that the methodology involves activation of memory engrams from a distant past presented with new information which would be the same as the reactivation-reconsolidation process in false memory studies. To aid the false memory research, studies such as that of Ira Hyman and colleagues and Bugs Bunny at a Disney resort by researchers in Elizabeth Loftus lab. A study by Allen Scorpia and colleagues identified the five components of false memory formation, another which tested the role of sleep deprivation and food and alcohol preferences in false memory implantation. The paper goes on to a discussion of memory modification at the molecular level and includes a study of the dampening effect of propranolol on the emotional fear memories by the amygdala. It also studies the role of the molecule protein kinase M-zeta on long-term memories by long-term potentiation. Memory and neuromodulation techniques such as electroconvulsive therapy, transcranial direct current stimulation, transcranial magnetic stimulation, and optogenetics are elaborated on.

The second part of the paper is on Neuroethics which addresses the primary concern of safety for therapeutic memory treatments. It provides an ethical framework and debates over the consideration of altered memory and personal identity.

Traumatic memories are not easily forgotten but easily brought up due to over-consolidation. (Ross Michael Reul, Jr.) The more frequently a memory is brought up, the stronger it becomes thus influencing everyday behavior and responses. Ergo, the best time for modification is as soon as possible after its formation.

A paper by Dere, E, Pause, M.B, Pietrowski, R on 'Emotion and Episodic Memory in Neuropsychiatric Disorders' begins with a description of episodic memory and then reviews the role of long term memory establishment in the mammalian brain through evidence from clinical, neuropsychological, neuroimaging and animal research. The interaction between the amygdala (which generates emotions) and the hippocampus (which associates multidimensional stimuli

into episodic memory) is then discussed. It further goes on to talk about memory impairments observed in emotional and affective disorders. With a special focus on episodic memory, its effects on post-traumatic stress disorders, schizophrenia, and major depression are reviewed. It also includes the relationship between deficits in Alzheimer's and neurodegeneration with mediating emotions.

Emotions enhance memory performance and become an integral part of episodic memories.

Neuroanatomical and neuroimaging evidence suggests that the amygdala is a crucial part of the central fear system and it processes and evaluates sensory stimuli in terms of potential danger. (Dere,E, Pause,M.B, Pietrowski,R) This further suggests that the amygdala plays a dual role regarding memory and emotions and in the case of memory modification might alter its functioning too. Since the amygdala is also responsible for the activation of the fight or flight response, that may be affected as well.

Another paper by Ling, S, Umbach, R, Raine, A focused on 'Biological Explanations of Criminal Behaviour' reviews three factors, psychophysiology, brain mechanism, and genetics. The psychophysiological review focuses on heart rate and skin conductance measures. It suggests a low resting heart rate is associated with a risk of criminality, whereas a blunted autonomic functioning may lead to increased criminal behavior and disruptive psychological activity. The review on the brain includes a study on the prefrontal cortex, the amygdala, and the striatum. The PFC is considered responsible for decision-making, attention, emotion regulation, impulse control, and moral reasoning. In cases of criminal behavior, structural defects and functional impairment of the PFC have been observed. An example is Phineas Gage, who displayed a changed personality after a brain lesion has been provided. There is evidence of variation within criminal subgroups, such as that between successful and unsuccessful psychopaths. A reduced volume of the amygdala has been associated with increased aggressive and psychopathic characteristics. This also displays differences between criminal subtypes psychopaths tend to be cold and calculating whereas non-psychopaths are impulsively and emotionally aggressive. The striatum is involved in reward and emotional processing and dysfunction underlying criminal behavior. The paper then discusses the neuromoral theory of antisocial behavior suggesting the importance of a fully developed emotional moral capacity for

lawful behavior, moral responsibility would appear to require intactness of the neuromoral circuit. The paper then moves on to genetics and summarizes the interaction between biological factors which studies that the systems work together to produce behavior. The paper concludes with implications and suggestions to address issues of psychological differences.

The amygdala is responsible for recognizing threat cues that deter individuals from risky behavior by associating harmful actions towards others and aversive reinforcement of the victim's distress. (Ling,S, Umbach,R, Raine,A) An individual's biology, psychology, and social environment all influence criminal behavior. Antisocial individuals do not deter from criminal behavior because they do not experience appropriate physiological responses to risky and stressful situations nor potential aversive consequences. If this can be corrected, rehabilitation of criminals is certain.

A paper by Kredlow, M.A, Eichenbaum, H, Otto, W.M reviews basic research about the formation of memory, consolidation and describes the two ways of integration of learning within memory structures, assimilation, and accommodation. This paper then discusses augmentation strategies for memory modification. The use of novel cognitive and pharmacological interventions to modify memory consolidation and reconsolidation in service of clinical outcomes has been analyzed including;

(1) Preventive efforts directed at inhibiting maladaptive memory formation,
This approach targets the consolidation and/or assimilation process immediately upon memory formation. One way is through pharmacological interventions using propranolol and cortisol as well as oxytocin, ketamine, rapamycin, garcinia indica, morphine, and albuterol which are still being explored. The pharmacological strategies have limited success which leads to the exploration of cognitive interventions. They employ extinction trials during consolidation to prevent the development of PTSD and sleep disruption for inhibiting consolidation. These strategies successfully have targeted fear memories relevant to underlying stress disorders, however, there may as well be an impact on declarative memories.

(2) Strategies to interfere with the reconsolidation of maladaptive learning,
This approach targets the reconsolidation process aiming to weaken traumatic memories. Pharmacological strategies employ the use of propranolol, mifepristone, and cortisol, with ketamine, xenon, and cannabidiol still being explored. Behavioral strategies include

post-retrieval extinction to prevent memory from being updated, episodic memory strategies, sleep, and brain stimulation, and neuromodulation.

(3) Strategies to enhance the consolidation of new therapeutic learning.

Instead of influencing the memories that underlie psychological disorders, other strategies have focused on enhancing the consolidation of memories of therapeutic learning in the treatment of psychological disorders. Pharmacological strategies use cortisol, methylene blue, D-cycloserine, Yohimbine, and Modafinil, whereas cognitive strategies study the effects of inhibitory learning, sleep, physical activity.

This paper encourages research on potential new avenues for memory enhancement in service of the treatment of mental health disorders.

Imagery rescripting is an intervention that involves the reactivation of a preexisting unpleasant memory followed by a retelling of that memory with the use of benign or positive images.

Family experiences during infancy determine the way individuals relate to people and situations and predict (or mispredict) the actions of others in their adult lives. Such negative experiences can pave the way for criminal behavior. Along with successful therapy, it is possible to free individuals of these dominating memories and develop adaptive responses to current situations. The core belief process involves a recall of early life events which support the core negative beliefs about the self. (Kredlow, M.A, Eichenbaum, H, Otto, W.M, 2018)

This suggests that these kinds of negative experiences influence criminal behavior and with the right treatment, it is possible to alter responses to similar perilous situations in the future.

CONCLUSION

The topic is ‘Erasing, Altering and Implanting Human Memories’ and the research question explores the effects of memory modification specifically in cases of criminals. How is memory modified and which centers of the brain are affected by it? The hypothesis states that “if memories of criminal offenders are modified then they will be rehabilitated because the amygdala which is responsible for emotional memory also plays a pivotal role in driving the fight-or-flight response and is implicated in crime.”

Since prior trauma ignites the fight-or-flight response, (Stevens, 2018) it is safe to assume that a modified memory of the trauma may alter the response to a certain extent in the future, thus proving the hypothesis.

Almost every decision and every step a person takes in his life is based upon a series of past experiences. Family experiences during infancy determine the way individuals relate to people and situations and predict (or mispredict) the actions of others in their adult lives (Kredlow, M.A, Eichenbaum, H, Otto, W.M, 2018). This implies that an individual's biology, psychology, and social environment all influence criminal behavior. This paper looks at the correlation between traumatic memories and criminal behavior.

The working of the amygdala with emotional memory and the fight-or-flight response is also studied. Emotions enhance memory performance which is done in coalition with the amygdala and hypothalamus. The paper reviews neuroscientific and psychological techniques to alter memory. Neuroanatomical and neuroimaging evidence suggests that the amygdala is a crucial part of the central fear system and it processes and evaluates sensory stimuli in terms of potential danger. (Dere,E, Pause,M.B, Pietrowski,R). The core belief process involves a recall of early life events which support the core negative beliefs about the self. (Kredlow, M.A, Eichenbaum, H, Otto, W.M, 2018).

The idea is to modify prior traumatic memories such that it helps in retribution. Antisocial individuals are prone to criminal behavior because they do not understand appropriate physiological responses to risky and stressful situations nor the consequences. Along with successful therapy, it is possible to free individuals of these dominating memories and develop adaptive responses to current situations. (Kredlow, M.A, Eichenbaum, H, Otto, W.M, 2018). Criminal recidivism rates are as high as 50% which proves that the retribution process needs to be more effective. Incarceration is at the cost of large tax burdens and yet the result is not desirable. Retribution based on altered memory will surely be a more permanent and reliable solution with a spectacular impact on society.

Cabrera and Elgar proposed a technique that could aid the criminal justice system and serve by making incarceration and the therapy of criminals more economically viable and efficient. This can be done either by dampening memories associated with the pleasure criminals receive or by enhancing the emotional content of criminal memories.

Neuroethical restrictions and criminal treatment rights cause limitations in the research. If memory interventions are in the hands of the state, they would then have the ability to shape peoples' minds to an extent to which we do not currently know (Ross Michael Reul, Jr.). With future developments, it would be interesting to find out how every crime influencing experience can be traced and to which extent can criminals be treated in the future for such an idea to be implemented.

Although memory modification on criminals could show promising results, its application is highly improbable as of now. Yet, the belief stays that in the right scenarios, memory alteration could do wonders in the neuroscientific and psychological community.

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The Impacts of Mentorship to High School Students

Justine Paragas

ABSTRACT

Mentorship plays a significant role in high school students' overall character and academic career. The purpose of this research is to dive deeper into the impacts of mentorship on high school students to raise awareness about the vitality of having a mentor as early as possible in their academic journey. In this research, google form surveys were assigned to 60 high school students (9th-12th grades) who are predominantly first-generation and second-generation students and with diverse backgrounds. They were asked a variety of questions ranging from whether they have a mentor or not and rating college and character development statements from a one to five (one being strongly disagree and five being strongly agree) scale. 78.3% of the students who answered the survey wanted to have a mentor; 53.3% of the students strongly agree that mentorship is beneficial to high school students. The data demonstrates that every high school student in different grade levels needs support in their academic and college process journey regardless of their background. As our world continues to evolve, our students' support should be evolving as well-- they must have the guidance they need as they choose the careers they want to go to. Supporting the youth as early as possible equates to preparing future generations to make our society succeed.

INTRODUCTION

Mentorship has continuously become more of a necessity as different mentorship programs are introduced to students particularly to 11th and 12th-grade students. The focus of these mentorship programs is often aimed to prepare for college and students' future careers. In this lab, the impacts of mentorship on high school students are further explored. Although the focus is not particularly on the existing mentorship programs, this lab covers the broad concept of the presence of mentors (formal or informal) and its effects on high school students (9th-12th). Formal mentorship counts as getting guidance from a college prep program and/or a community-based mentorship organization (ie. Matriculate, CollegeBound, Questbridge College

Prep Scholars, etc) whereas informal mentorship means getting guidance and advice from a peer, parent, neighbor, and older sibling. This experiment serves as a calling to provide mentorship to all high school students, especially those who live in underrepresented regions.

One in three young people wouldn't have a mentor growing up, especially youth who live in underserved areas. It is estimated that a staggering 16 million young people, including nine million who are considered "at-risk", will reach their adulthood without the presence of a mentor. However, 4.1 million "at-risk" students will have an informal mentoring relationship with teachers, coaches, parents, neighbors, and relatives growing up. Students view their mentor as their role model and support system. These numbers elucidate that there is only a small portion of students who can get an informal mentor and this proves that there should be an increase of mentors present in all students' lives regardless of the situation.

In this lab, the question "what are the impacts of mentorship to adolescents/high school students?" will be explored more in-depth. It is already known that mentorship catalyzes positive impacts on high school students, but this lab will explore the specifics of these effects.

If every high school student has a mentor, then there is a higher likelihood that they will develop a positive attitude and improved performance both in and out of academia because through the guidance provided by their mentor, they are conscious of their decisions and have the support needed to succeed in their chosen careers. Mentorship catalyzes the "mentoring effect" where students academically and socially thrive in a multicultural setting. Mentors will be able to guide their mentees (high school students in this case) and prepare them for their future academic endeavors ranging from the college process to career-wise decisions. The mentors can provide wisdom based on their experiences that would be beneficial to high school students. The advice that mentors provide will enable high school students to become more aware of their decisions as they navigate their academic journey and future with the mentors' academic support and real-world advice.

METHODS

A Google form survey was sent to high school students. 60 responses in total were accumulated. The survey consisted of four mentorship experience statements where each must rate the statements from a scale of one to five (one being strongly disagree and five being

strongly agree) based on their experiences with their mentor. And if they didn't have a mentor, they were asked if they wanted to have one and elaborated on why they wanted to have a mentor.

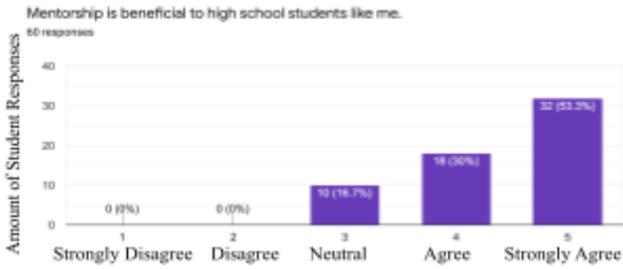
To determine the impacts of mentorship, the control group in this experiment were the students who did not have a mentor. This was the control because the main goal of this lab is to explore the benefits of having a mentor. Students who fall in the control group are the ones who did not have a mentor from a community organization such as college prep programs etc. The experimental group in this experiment were the students who had a mentor in a professional setting (whether it'd be from college prep programs, guidance counselor, and peer mentor from a community-based organization such as college students). Both control and experimental groups have students who are considered at-risk.

The independent variable in this experiment is the presence of a mentor in the high school students' life. The mentors present vary per student. In this case, a mentor counts as a peer mentor (someone older than the high school student such as college students), guidance counselor, and anyone from a college prep program they applied for. The dependent variables are the effects of mentorship on the student ranging from physical to social impacts.

Different factors were controlled throughout this experiment. The grade levels of the students (9th-12th) were consistent throughout to maintain the focus of the research: high school students. Additionally, the students' backgrounds as first and second-generation students were maintained and the diversity. Most of the students who participated in this survey studies in a public high school-- this is another factor that was controlled throughout because this will further elucidate the necessity of having mentor support since public high schools only have one counselor covering almost 500+ students. The backgrounds of the students being diverse and at-risk were maintained throughout the experiment to illustrate how mentorship has different impacts on students facing different circumstances.

RESULTS

Mentorship is Beneficial to High School Students



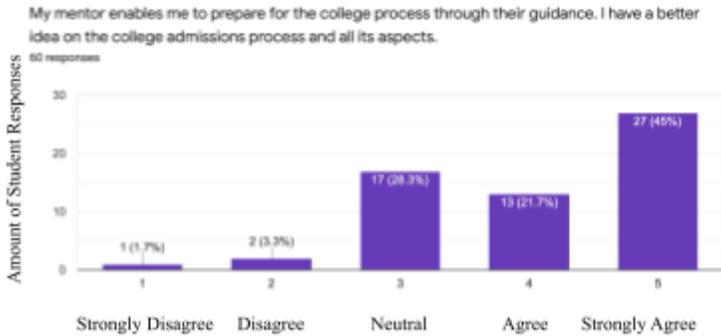
This bar graph demonstrates that 53.3% strongly agrees that mentorship is beneficial to them. Students who participated in this survey know that their mentor (whether in a formal or informal setting) provided a significant impact in their lives.

Mentorship helps improve high school students' decision making skills.



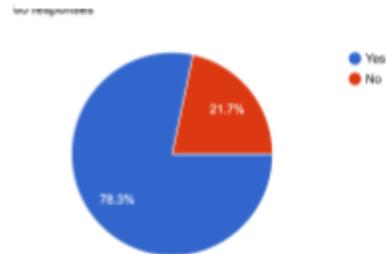
Most students answered between three and five. These answers are based on students' (both control and experimental) experiences on having either a formal or informal mentorship.

The Essence of Mentorship in the College Process



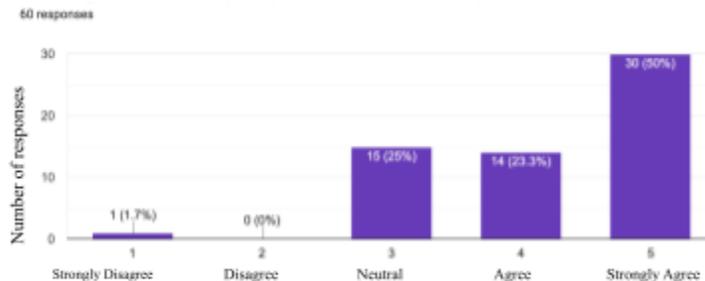
Most students selected three (neutral) and five (strongly agree) which illustrates the range of familiarity students have particularly ninth and tenth graders in the college process. Because the responses involve underclassmen such as ninth and tenth graders, they do not have that full exposure to the college process yet; therefore, the fives mostly reflect the responses of eleventh and twelfth graders.

The Amount of Students Who Wants Mentorship



In this chart, students were asked previously if they had formal mentorship before, if not would they like to have one. 78.3% of the students agreed that they want formal mentorship/ they thought mentorship will beneficial to them.

Mentorship Promotes Personal Growth in Perspective



This question was worded differently on the survey: it was written as how mentorship allowed students to improve as a person and their perspective of the world. These results elucidate that 50% of the students who either have informal and formal mentoring provided them the opportunity to grow.

DISCUSSION/CONCLUSION

This research covers the specific impacts of mentorship on high school students. If every high school student has a mentor, then there is a higher likelihood that they will develop a positive attitude and improved performance both in and out of academia because through the guidance provided by their mentor, they are conscious of their decisions and have the support needed to succeed in their chosen careers. This hypothesis was supported in this experiment.

The role of a mentor is universal. They can either be formal or informal (To reiterate, formal mentorship involves being in a mentorship program from a community-based organization (i.e. Matriculate, QuestBridge College Prep Scholars, Thrive Scholars, etc.) while informal mentorship involves being mentored by a family member, neighbors, and peers.). A mentor can also provide both academic and personal support. 53.3% of the students strongly agree that mentorship is beneficial to high school students. Students wrote how their mentor (informal and/or formal) provided them with the opportunity of growth: to thrive inside and outside of a school setting. 43.3% of the students strongly agree that mentorship improves their decision-making skills and helps them prepare for their academic career and beyond. These results demonstrate how mentorship positively impacts high school students from college support to personal growth.

As mentorship leaves a significant mark on a student's life, the data gathered in this research demonstrates that 60% of the students don't have formal mentors (they either only had an informal mentor or none) and 40% of the students have formal mentors from college prep and mentorship programs they applied to. This data shows that despite the increasing amount of mentorship programs accessible to high school students, the gap in mentorship accessibility is still huge. 78.3% of these students wanted to have a formal mentor.

Students also shared that their mentor became their support system; they were comfortable sharing their personal experiences. They looked up to their mentors and were able to improve their social and communication skills. 50% of students strongly agree that mentorship helped shape their perspective as they tackled both academics and real-world situations. Additionally, 45% strongly agree that the presence of a mentor and having mentorship supported them (for twelfth graders) and is supporting them (underclassmen, 9th-11th graders) for their college admission processes. These results prove that the impact that the students' mentors leave

is remarkable on the students'/mentees' lives.

The information provided in this experiment is useful to academic institutions and community-based organizations that provide college support and mentorship. This can serve as support to increasing mentorship programs to high school students especially to those who live in underserved regions. The data in this experiment can also be applied to other fields of study such as education, sociology, and psychology where scholars can use this information to explore the positive impacts of mentorship on high school students and analyze the behavioral impacts that mentorship provides.

There are minimal problems in this experiment. Because most data gathered is qualitative, no t-tests and confidence intervals were used. This may not have a grave effect on the results, however, having quantitative data to use on t-tests and confidence intervals can further strengthen and support the data in this experiment.

To further improve this present experiment, there should be more high school students involved than what is provided here and there must be an equal amount of students per grade level. In this experiment, there should also be an equal number of students both in the control and experimental groups to have more consistent and thorough data. Finally, focusing on the number of students in one region or city is also ideal. In this experiment, there wasn't an emphasis on a specific location of the students and the schools they go to. The emphasis was only on their background and the type of school they go to. Focusing on the area and type of school together can further strengthen and impact the results.

Other factors could be tested in this experiment. The causes of lack of formal or informal mentorship to the high school students who answered the survey can be explored as well. The different causes of lack of mentorship and the results from that can also impact the results of this experiment and the importance of mentorship. There are different causes of lack of mentorship; it varies by the students' location, school, and background.

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Unfolding the Reality of the Pandemic:
A Comparative Study of Changes in Mental Health Before and During the Pandemic
Khushboo Shukla, Shourya Kashyap

ABSTRACT

The SARS-CoV-2 (COVID-19) pandemic has been unfolding since the past year and has revolutionized society. The implementation of mask mandates, quarantines, and social distancing measures have affected many dimensions of public health. Statistical studies analyzing the impact of the pandemic on mental health began when the World Health Organization (WHO) declared COVID-19 as a pandemic on March 11th, 2020 (1). Previous studies focused on adapting established tests such as a 4-item Patient Health Questionnaire-4 (PHQ-4), a 2-item depression scale (PHQ-2), and a 7-item anxiety scale (GAD-7) to understand how people have felt before the pandemic began and during its earlier stages. Between 24 February and 3 March 2021, a survey was conducted to develop a stronger understanding of self-reported stressors and changes in overall quality of life compared to pre-pandemic times, nearly one year since the pandemic began. The anonymous virtual survey adapted information from PHQ-4, PHQ-2, GAD-7, and PHQ-9, alongside demographic information and other self-report scales. Results indicated that 64.0% of US adult respondents (n = 483) reported having depression and/or anxiety symptoms, a 33.0% increase from reports in late June 2020 (2). Additionally, 53.6% of US respondents that reported being calm or very calm prior to the pandemic (n = 151) reported being stressed or very stressed now. As the results depicted, the impact of the COVID-19 pandemic on mental health is growing rapidly. Therefore, it is crucial to continue periodic assessments of COVID-19 on public health even after humanity moves past this pandemic.

INTRODUCTION

The Centers for Disease Control and Prevention (CDC) has conducted various studies to measure the effects of prolonged social isolation and loneliness on overall human health. The COVID-19 outbreak has been a pandemic for over a year now, and the extreme isolation it has brought with it is obvious. A CDC study has proven that prolonged loneliness is associated with

higher rates of depression, anxiety, suicide, with an overall four times more increased chance of death (3). Furthermore, the study also suggests that the LGBT, immigrant, and older population is at a greater risk of isolation of loneliness, due to variances in family dynamics, societal acceptance, and language barriers compared to their respective counterparts (3). Research done during prior epidemics and pandemics has shown economic downturns and job loss resulted in higher rates of substance abuse, depression, and suicide (4). As well, past public health crises have also illustrated the disproportionality in impact to different ethnic groups. Public health experts and researchers are likely to agree that people of color are the hardest hit, as they are known to have the least access to health care. In this research study, the impact of the COVID-19 pandemic on depression and anxiety-related symptoms is investigated throughout ethnicities in the United States and internationally by age range (4). The American Psychological Association (APA) through extensive research has depicted that natural body changes resulting from aging hold the capacity to increase one's risk of being diagnosed with depression (5). On the contrary, data obtained from CDC indicates that the percentage of adults experiencing depression or related symptoms is highest amongst the 18-29 age range at 21.0% (6). The same data suggests that the depression symptoms for those in the 45-64 and 65+ age range were tied at 18.4%, while people in the 30-44 age range were at 16.8%. (6). This study aims to collect independent data via the self-reporting survey to see whether the APA or CDC presents the more applicable statistics during the COVID-19 pandemic. Alongside the age and ethnic factors, demographics also can impact the data from this study, because there is variance in the impact COVID-19 has had on different countries, meaning that depression/anxiety-related symptoms are expected to vary likewise. The data was statistically analyzed to find whether or not disparities exist within these groups. If these trends have come true in past widespread diseases, then they can be expected to be strongly applicable during the COVID-19 pandemic.

METHODS

Participants: A survey was sent to individuals of all ages (n = 750) across the United States and internationally. Participants completed the survey without any requirements to answer every question and no personally identifiable information was collected. The survey was administered via google forms, and participants were recruited with the help of social media

platforms included but not limited to WhatsApp, Instagram, Snapchat, and Facebook. On average, the survey took approximately 2 minutes to complete and consisted of 14 questions that assessed different measures relating to anxiety and depression. Question style and format ranged from multiple choice, select all that apply, scale range, and also allowed participants to type in their answers if given answer choices did not match their response. The self-reporting survey was based upon established tests (PHQ-4, PHQ-2, PHQ-9, and GAD-7) which are used to diagnose depression and anxiety.

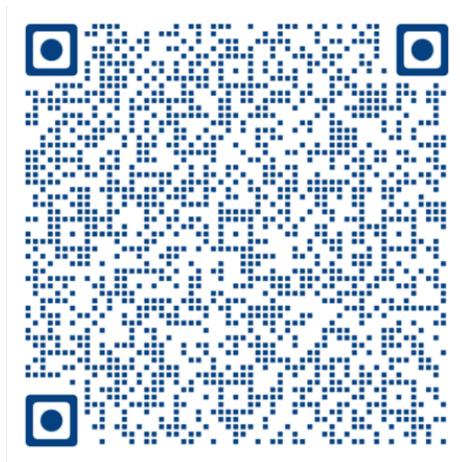


Figure 1: A QR code to the survey is provided for reference.

Measures of Interest: Many factors are associated with anxiety and depression. Having some or all factors can influence the likelihood of having either one (or both) of the mental health conditions, these are known as stressors. Based upon the established tests, the survey presented participants with questions regarding age, ethnicity, gender, household size, household income, city of residence, and employment status. These questions focused on the demographic aspects that can make one more or less likely to develop depression and/or anxiety. As well, the survey included questions inquiring about the diagnosis of previous mental health disorder, pre-pandemic hours outside of the house, current hours outside of the house, pre-pandemic stress levels, current stress levels, challenges experienced during pandemic (based on the questionnaires mentioned), and self-reported impact of COVID-19 on mental health. The purpose of these questions was to see if there has been a shift in symptoms during the pandemic compared to pre-pandemic times and what, if any, disparities exist in these symptoms between various ethnic groups. The pandemic has had different impacts on different parts of the world,

hence the study also statistically investigates significant disparities in anxiety/depression-related symptoms in the United States and internationally. As the study is a comparative study, there is no such control variable- only differences in responses are examined by age range, ethnicity, and geographical location.

Analysis: Relationships between variables were analyzed and adjusted for gender, ethnicity, age range, city of residence, suicidal thoughts, depression, anxiety, financial pressures, and stress levels. A p-test was conducted to test the validity of the null hypothesis, which was that if previous public health crises have caused an increase in the percentage of the population feeling anxiety and depression-related symptoms, then the same can be expected for the COVID-19 pandemic. An ANOVA test was also carried out to determine if the differences between the means of the selected groups were statistically significant. As this study is based on a self-reported anxiety/depression survey, there are no such independent, dependent, or control variables that can be addressed. It is merely a comparison of anxiety/depression symptoms in various ethnic groups and locations throughout the pandemic.

RESULTS

Data was collected in the same google form which was administered to participants. Later, it was transferred to Qualtrics, a powerful online survey software that has a data analysis feature. Separately, R-Studio was used to conduct a p-test and a single-factor ANOVA test to check for statistical significance. While a p-test indicates the validity of a set of data, an ANOVA test is done to test the significance of multiple factors on a single effect. A given data set is considered significant if the p-value is below 0.05.

In this study, two main data sets originating from two different questions on the survey were tested for statistical significance: “prior to the pandemic how did you feel” vs “since the pandemic has grown, how do you feel now?” The p-test produced a p-value of 1.86×10^{-47} which is less than α (0.05), meaning that the data is statistically significant. The single-factor ANOVA test showed that there are statistically significant differences between the two data groups being compared as the means range from 3.88-3.12. The data coming from individual international locations (i.e., outside the United States) was not significant on its own ($0.204 \leq p \leq 0.467$). Thus,

all international data was combined into one section, referred to as “other” and international in **Figures 2-5**.

Four key aspects were analyzed to develop a better understanding of how the pandemic has impacted mental health: anxiety/depression, suicidal thoughts, stress, and self-reported impact. Figure 2 below shows the percentage of people reporting anxiety and/or depression symptoms split by ethnic groups. The overall percentage of US respondents reporting depression and/or anxiety symptoms was 64.0%. When examined by ethnicities, it was found that Caucasians and Hispanics reported the highest percentage symptoms at 71.2% and 71.0% respectively. Asian respondents reported the lowest percentage of symptoms at 54.6%.

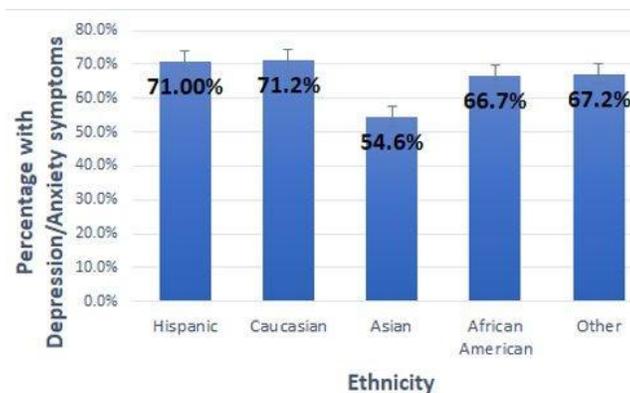


Figure 2: Depression data across ethnicities during the pandemic.

Figure 3 below highlights the percentage of respondents that reported having suicidal thoughts since the pandemic has begun. There was a stark contrast between the US, Canada, and International data with Canada having the highest percentage at 15.4%, US respondents falling in the middle at 10.1%, and International respondents having the lowest percentage at 7.7%.

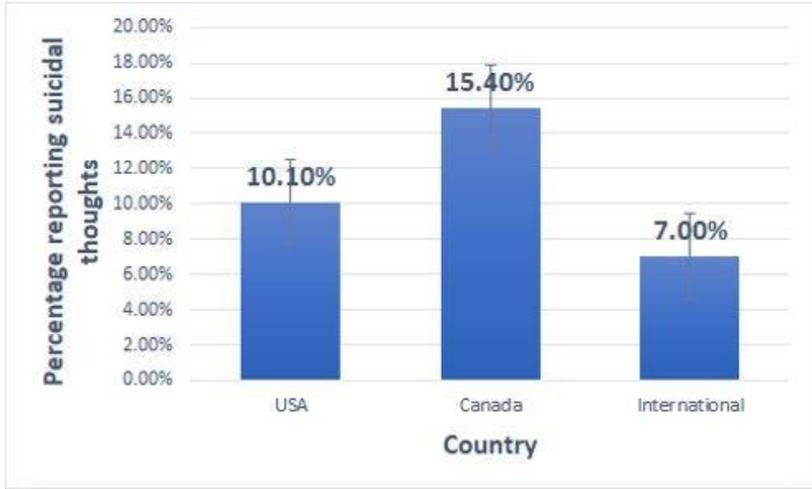


Figure 3: Percentage of people reporting suicidal reports in the United States compared to Canada and International locations.

The survey has two questions related to stress, one asking for pre-pandemic stress levels and one about current stress levels. The pre-pandemic stress levels serve to establish baseline data to determine how respondents felt before the pandemic. The current stress levels question shows how the respondents have changed in their perceived stress levels since the start of the pandemic. These results are shown below in Figure 4 in an alluvial diagram that shows the flow of how respondents' stress levels changed from prior to the pandemic to present times. The three highest categories of stress prior to the pandemic were neither stressed nor calm (neutral), stressed, and calm. The categories completely flipped for current stress levels with the three highest categories being stressed, very stressed, and neutral.

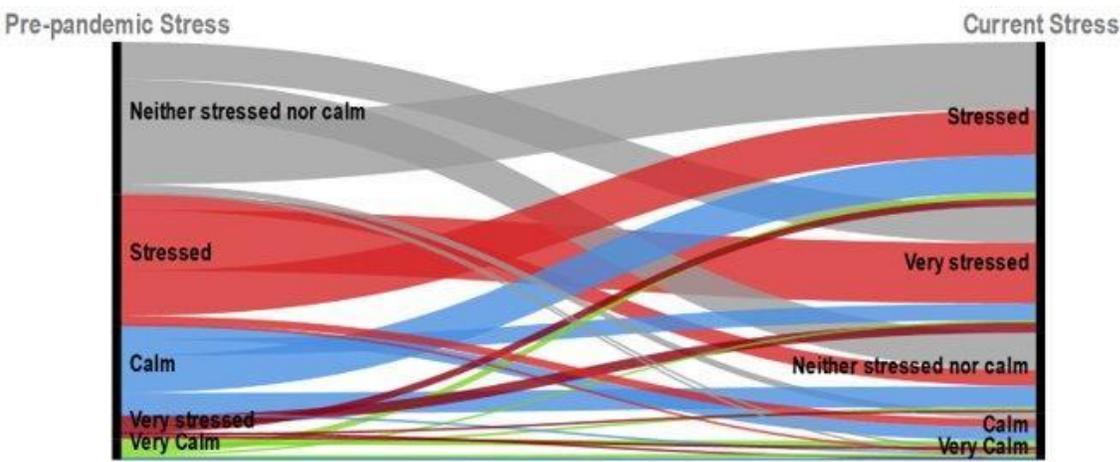


Figure 4: Alluvial diagram illustrating the shift in responses regarding stress levels pre-pandemic vs now.

The last question in the survey was to gather the respondents' self-reported perception of how the pandemic has impacted their mental health. The results for the United States and International respondents are shown below in Figure 5a and 5b, respectively. The vast majority of respondents reported having a negative impact both in the US and Internationally at 53.73% and 50% respectively. Surprisingly, roughly a third of US respondents reported COVID had a positive impact on their mental health and that number was even larger internationally at 38.1%. This could be a result of mental health becoming destigmatized and we think this could be a foundation for future research.

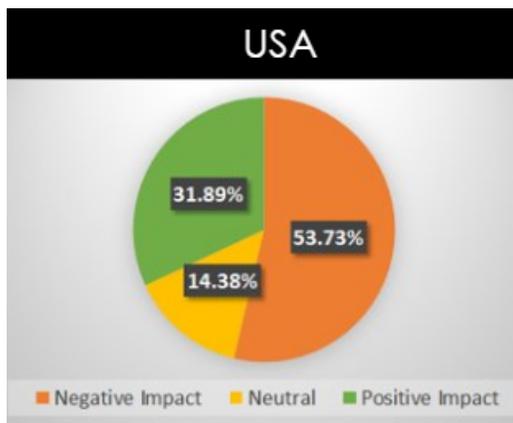


Figure 5a

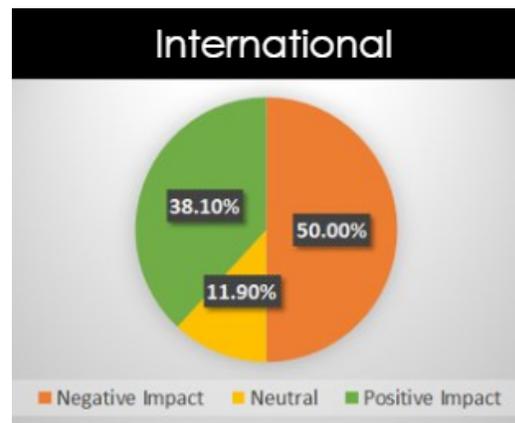


Figure 5b

Figures 5a and 5b: Pie-charts which show the percentage of respondents in the United States and Internationally reported the overall impact (positive, negative, and neutral) of the pandemic on them.

DISCUSSION/CONCLUSION

Previous studies during times of public health crises have shown that people of color are impacted the most by the outbreak. Furthermore, the APA and CDC have different statistics when it comes to which age range (5,6) is most prone to mental health disorders. This study intended to see how mental health symptoms have been shaped by the effect of the pandemic

since the past year in various age ranges, ethnicities, and geographical locations. Before the study, it was expected that if mental health had declined during past global outbreaks, then the same can be predicted for this pandemic. There are significant trends that the survey results show that highlight the extent of the negative impact the pandemic has had on mental health. With 64.0% of US respondents reporting having symptoms of depression and/or anxiety, there has been a 33% increase in such symptoms from as recent as June 24-30, 2020 (2). Additionally, the rate of suicidal thoughts for adults in the United States was found to be 10.1 %, a sharp rise from 2017-2019 results when that number was 4.5% (7). For Canadians, 15.4% of respondents reported having suicidal thoughts, a 3.6% increase from data reported in March 2020 (8). For stress levels, 53.6% of US respondents that reported being either calm or very calm prior to the pandemic (n = 151), reported being either stressed or very stressed now. When collecting the respondents' self-evaluation of the impact of COVID-19 on their mental health, half of the international respondents reported a negative impact and 53.73% of US respondents reported having a negative impact. Based on all these trends, this survey has shown that mental health has been significantly disturbed due to the pandemic. Anxiety, depression, suicidal thoughts, and stress levels are all rising not only from pre-pandemic levels, but also from data collected earlier in the pandemic. This information can be used by physicians, psychologists, teachers, counselors, etc. to better cater to their professional responsibilities to adapt to these changes. There are certain limitations to this study that may affect the strength of the conclusions made from the data. The first is the sample size being 750 respondents, a small scale when an international population is being evaluated. To avoid this playing a major role, the majority of the analysis is done with United States respondents since they make up 77.2% of all respondents. Another limitation is the potential for a snowball effect to limit the ability to broadcast these results to a large population. Since the survey was distributed through various mediums of social media and anyone could participate, there is the potential for respondents to have sent the survey to their friends and family members, localizing the results to particular areas. If this occurred, it would limit the representativeness of the results to a smaller sample than the entire United States.

The data points to the future where it can be expected that the negative effects of the COVID-19 pandemic on mental health will be visible throughout society for an extended period of time, even as life starts to return to the normalcy of pre-pandemic life. It is possible that as the

pandemic's span increases, isolation, financial pressure, and other such variables could be the root cause of such symptoms, but future studies are needed to confirm such claims. As well, future studies can analyze how the data will evolve after vaccinations are complete. An additional area of exploration for the future will be in the potential positive impact of the pandemic on mental health. The topic of mental health has had a stigma attached to it throughout society and it is possible that by becoming a key issue during this pandemic, it will become destigmatized. With the results showing how 31.89% of American respondents and 38.1% of International respondents believing the pandemic has had a positive effect on their mental health, this trend may continue with mental health becoming easier to discuss amongst peers.

COVID has had an impact on mental health even as the limitations on society have started to go down. That is why continued studies are necessary to evaluate just how much of an impact this pandemic has on society's mental health in the long run.

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