Evaluation of Academic Stress on Intellectual Performance

through the Stroop Effect

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Abstract

The dilemma of academic failure has spiked in recent years, increasing the number of failing students in New York by thousands (Serrano, 2019). One of the primary reasons for failure itself is stress and its impact on an individual's psychological demeanor. The purpose of this study was to test whether or not academic stress directly impacts intellectual performance. High School students (n = 55) between the ages of 15-17 were randomly selected to voluntarily complete an academically modified version of Sheldon Cohen's Perceived Stress Scale survey followed by a Stroop Task during the month of December and again in January just before midterms. A correlation matrix was conducted between stress levels and stroop test results r = 0.041 and a p = 0.767 for December, and r = 0.135 and a p = 0.320 for January, showing no significant correlation. However, female students reported a statistically significant higher stress levels than males $t(54) = 3.924$ $p < .001$. Students with medium workloads and high stress levels performed best on the Stroop Task, suggesting that students with moderate levels of stress and workloads displayed optimal performance.

Introduction

Academic stress is known to cause various psychological problems such as depression and anxiety. (Bruno 2011) These stress-related disorders have a large impact on students' academic results and tend to negatively impact individual development. Students' have different ways of interpreting problems; while some students easily respond to difficult scenarios, others lack certain skills required to succeed. Russian psychologist Lev Semenovich Vygotsky theorized the zone of proximal development where he states that children have limited academic capabilities before they require assistance from their peers, that students' have limits preventing them from successfully completing a task. (Henderson, et. al. 2012) In this experiment, students were asked to complete a task that was determinant of their attention capacity and ability to focus. They were tested two different times; in what is assumed to be a non-stressful time, and stressful time. While it is theorized that students' have a certain limit to their knowledge, this experiment will allow the researcher to verify whether this limit is directly impacted by academic stress.

Stress itself is defined as a state of mental or emotional strain or tension resulting from adverse or very demanding circumstances. (Dictionary.com.) While this experiment focuses specifically on academically influenced stress, stress in general is caused by several different factors divided into three main categories: work stress, having a heavy workload or too much responsibility; life stress, having emotional problems or dealing with traumatic events; and internal stress, being afraid and uncertain. Academic stress falls under all three categories, whether it be caused by excess assignments, harsh administrators, or verbal presentations. (Goldberg, 2018) Although levels of stress are different for every individual, previous studies

show stress levels to have increased significantly between generations. The American Psychological Association conducted a survey in 2017 displaying trends of gradual increases in stress levels since 2006. (Stress in America: Coping with Change Part 1, 2017) It can be concluded that levels of stress are highest for students amid more recent generations compared to students from older generations.

Prior research emphasizes the relationship between stress and academic performance. The *Stress and Academic Achievement among Undergraduate Students* research paper from the University Putra Malaysia hypothesized that there would be no relationship between undergraduate students' stress level and academic achievement. Their conclusion supported that despite increased levels of stress, there was no significant correlation between stress and academic achievement. However, the researchers did recommend regular psychological evaluations for the undergraduate students. Data showed little improvement, but enough to conclude that reduced stress levels can enhance academic achievement. The *Effects of Stress Controllability and Subject Stress Response* paper on the National Center for Biotechnology website further proved that there is a negative relationship between students' stress level and their academic performance. Their research did not show enough distinct data to determine whether stress enhanced or impaired function, but were able to say that individuals under controllable stress showed greater improvement than the performance of those under uncontrollable stress.

The purpose of this study is to find reasoning behind academic examination failure and its correlation to stress. Based on the Common Core examinations that started in 2013, student scores gradually began to increase at a steady rate until recently from 2017-2018. The math

portion showed a drastic increase from a 25% failure rate to 30% failure rate which was more than 13,000 students. The english portion was worse increasing from 16% to 21%, almost 12,000 students. (Serrano, 2019) A study by M. Maajida Aafreen showed that stress was the ultimate reason for academic failure stating that "Stress is the body's reaction to a challenge." (Aafreen, 2018)

Materials and Methods

The supplies utilized to carry out the experiment consisted of an app, a survey, and consent forms. The app, Encephalapp, was a Stroop task simulation available to students on both android and iOS devices. Two hundred students were chosen at random to complete the activity; once in December, and a second time in January. They were selected from science classes at Valley Stream Central High School, representing almost equal amounts of juniors and seniors ranging from ages 15-17. Since these students are minors, they were required to get a parental signature on consent forms through a teacher before being given the survey and the research activity. Once the consent form was completed, students were shared a link containing a survey using Microsoft Forms and then individually completed the Stroop Task by class. The survey was an academically modified version of Sheldon Cohen's Perceived Stress scale, a model widely used to measure stress in psychological experiments. Students were instructed to download the Encephalapp app before taking the survey. The survey was expected to be completed in at least two minutes whereas the timings for the Stroop Effect was expected to have a larger range, on average three to five minutes. However, students took a mean time of about twenty-one minutes to complete both parts of the experiment, fourteen minutes longer than the

expected completion time. Results were submitted to an email address viewed by the administrator only; results were then sent to the researcher.

Sheldon Cohen's Perceived Stress Scale gives each answer choice a specific number from zero to four. These numbers are added to give individuals their final stress score. Participants ranging from zero to seven were considered of minimal concern, eight to eleven of low concern, twelve to fifteen of average concern, sixteen to twenty of high concern, and twenty one and above of very high concern. The Stroop Test consisted of two trials; one with Stroop off, where the colors matched the respective word, and one with Stroop on, where the colors did not match the respective word. The final stroop score was calculated by subtracting stroop on scores from stroop off scores. A negative value would indicate that the student had taken longer to complete the Stroop task compared to their normal time with stroop off whereas a positive value would indicate that the student had been quicker taking the Stroop task compared to their normal time with stroop off. A value of zero would indicate that the student took the same amount of time completing the task with stroop on and stroop off. Assuming that students would show higher stress levels in January due to Regents examinations and midterms compared to December right before winter break, stroop scores were expected to decrease from the first testing to the second testing.

Results

The survey and stroop task combined offered several variables to construe the data with including stress scores, stroop scores, sex, grade, and how much time each student spent on homework as well as their average daily workload. The initial hypothesis stated that individuals with a stress level of sixteen or higher would show negative stroop scores. However this

hypothesis was dependent on stress levels changing between the two testing periods, which after conducting a T-Test, was shown to have a p-value of 0.607, meaning there was no significant difference in stress levels between the months of December and January. Following the hypothesis, as stress levels did not change, stroop scores should remain the same as well, which was also proved correct with a p-value of 0.105. A correlation matrix was used to confirm whether there was any relationship between stress levels and stroop scores within each month resulting in an r-value of 0.041 and a p-value of 0.767 for December, and an r-value of 0.135 and a p-value of 0.320. Although the correlation matrix shows there to be no correlation between stroop scores and stress levels, the values show that there was a stronger relationship between the two variables in January than in December. The r-value is getting closer to one in January suggesting an increase in the strength of the correlation between stress levels and stroop scores and the p-value closer to 0.05 suggesting an increase towards the significance of the correlation itself.

Results were analyzed by gender and grade to find any discrepancies between stroop scores and stress levels in each month. T-Tests were conducted between all paired variables; male and female stroop scores, male and female stress levels, juniors and seniors stroop scores, and juniors and seniors stress levels, for each month. Male and female stroop scores for December and January showed insignificant p-values of 0.550 and 0.284 respectively. However stress levels between sex showed p-values of <0.001 and 0.016 meaning stress levels for females were significantly higher than stress levels in males. All values between grades remained above 5% deeming the results insignificant. Stroop scores between juniors and seniors in

December and January resulted in p-values of 0.332 and 0.732 respectively as well as stress levels with p-values of 0.501 and 0.452 respectively.

   To further analyze the data, participants were divided into groups based on responses to average daily workload and time spent on homework. The groups were created to see if there were any noticeable differences in stress levels and/or stroop scores for students with different workloads and homework times. Survey questions asked students "What is your average workload for school each day?" to which responses would be "Barely Any", "Small", "Medium", or "Heavy", and "How much time do you normally spend on homework?" to which responses would be "30 minutes", "1 hour", "2 hours", or "3+ hours". Each response allowed for sixteen separate groups; Barely Any and 30 minutes (BA + 0.5), Barely Any and 1 hour (BA + 1), Barely Any and 2 hours, (BA + 2), Barely Any and 3+ hours (BA + 3+), etc. An ANOVA test was conducted to find any significance between stress levels and workload and homework times in December and January. For stress levels in both months p-values came out to be 0.9696 and 0.2835 respectively and for workload and homework times came out to be 0.6544 and 0.6154. Although these values demonstrated insignificance, they were inaccurate seeing as values of n within each of the sixteen groups per month were different where a single participant would be in one group and thirty in another group. To eliminate this inaccuracy, data for these specific variables were turned into percentages where the researcher could say for example, "of the group of people sorted into group BA + 2, 4% showed average concern and contained stroop scores consisting of…". Responses to the questions above essentially acted as blocks to accurately analyze the data. "Blocks" referring to the removal of a variable of a given situation in order to obtain the best results; such as testing a vitamin for dogs and blocking on different dog breeds by

analyzing each group of breed individually. By listing out stroop scores and stress levels, there was a similar pattern visible for both months where a majority of the data centered around medium workload. Of this category students showed better stroop performance yet average and high levels of stress compared to students with barely any workload and few hours of homework who seemed to have higher stroop scores yet lower levels of stress. The same was said for the opposite end of the spectrum, offering the conclusion that students were most focused when having an intermediate level of stress.

Discussion and Conclusion

The original hypothesis of individuals with a stress level of sixteen or higher would show negative stroop scores was proved false as data showed no correlation between stroop scores and stress levels. Relationships between variables of stroop times, stress levels, grade, and gender showed insignificance except for stress levels between males and females where there was a significant increase in stress levels for females than males. Blocks on workload and homework time between stress levels and stroop scores suggested that students with a moderate level of stress would be most successful in completing a task.

Ideally, to confirm these results, the number of participants should be increased as well as clarification on instructions of the task at hand so there is no confusion on the participant's end. Consent forms should be labeled more clearly or clarified on how to submit student ID. Forms were labeled with three digit numbers such as 080. Some students made the mistake of putting in "080" when tested in December, and "80" when tested in January. A few students were unable to download the app, while this number of students was insignificant, of the students who were able to download the app, some had difficulty submitting results from the app due to problems on the

phone itself. When conducting the experiment again, solving these small problems would result

in a stronger data set.

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