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CAN NOSTALGIA DEFEND AGAINST STEREOTYPE THREAT?

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ABSTRACT

Stereotype threat causes individuals to perform worse on tasks when they are made aware of a task-relevant negative stereotype for a group to which they belong. Prior research has demonstrated that this effect has been alleviated by using a number of methods including changing test context or bolstering the stereotyped group. One method of bolstering the threatened group is through a self-affirmation of preferred character traits. Nostalgia is a sentimental longing for the past, which has been shown to provide many benefits to an individual, both personally and socially. Research has shown that when told to recall a nostalgic memory, participants are said to have greater access to self-affirming characteristics. The present study was performed in an attempt to utilize nostalgic recollection to directly ameliorate the negative effects of stereotype threat. The study provided participants with a selection of gender identification using gendered images, followed by an instruction which was used as the stereotype threat elicitation. Participants were then randomly assigned to one of three memory conditions — nostalgic, ordinary, and none — and were asked to recall and describe the appropriate memory. Participants then completed a hard math test using 26 sample GRE items. Multiple hypotheses were not supported. Some significant results are described. Probable null contributors, implications, and future directions are explored.

Keywords: Stereotype threat, nostalgia, gender, self-affirmation

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1. INTRODUCTION

Nostalgic Defense Against Stereotype Threat: Access to Self-Affirmation During Math Tests

The following experiment aimed to investigate a potential solution to stereotype threat through the use of nostalgia. Stereotype threat involves the knowledge of a negative stereotype about a group to which one belongs and the fear that any action could confirm that negative stereotype in the eyes of others or yourself (Spencer, Steele, & Quinn, 1999). Stereotype threat has been shown to lead to decreased performance on situationally relevant evaluations that the tested individual would otherwise have the capability to perform normally (Schmader, Johns, & Forbes, 2008). For example, consider a Caucasian[1] undergraduate woman in a math or computer science class. She is probably familiar with the idea that those academic areas are male dominated and that women are said to do worse than men in these areas. Because she knows of this stereotype and holds fears of confirming it, she ends up in a self-fulfilling prophecy and does worse than she otherwise would have if she were not affected by the stereotype threat. Although the student's negative performance in this instance does not accurately reflect her true ability, this could lead her to succumb to a snowball effect that leads to further failures. Suppose, for instance, that the woman in the example above receives a high B grade for a math course, but she does not achieve the A she was hoping for. This failure to meet her expectation may discourage her from choosing math as her major and continuing a professional career in the field. This

[1] There are many stereotypes revolving around intellectual performance generally, and math performance specifically. There is a stereotype that African-Americans perform worse than Caucasians on intellectual tasks as well as the stereotype that Asians outperform Caucasians when it comes to math. For this article, we focus specifically on Caucasian females in order to diminish potential stereotype confounds.

example illustrates how stereotype threat may contribute to the decreased number of women in science and math fields, despite early interest in these areas (Saucerman & Vasquez, 2014).

Research on stereotype threat has not been limited to Caucasian women and has included individuals who are considered a part of various minority groups such as African-Americans and older adults, and different performance areas including intelligence tests and memory measures (Steele & Aronson, 1995; Schmader, 2002; Hess, Auman, Colcombe, & Rahhal, 2003). In addition, a great deal of research has been conducted on successfully diminishing stereotype threat outcomes. Before describing the current experiment, the literature on reducing stereotype threat will be reviewed.

2. BACKGROUND

Reducing Stereotype Threat

In the general approach used when investigating ways to reduce stereotype threat, participants in the group of interest (e.g., women) are made aware of the stereotype of interest (women are not good at math) and then half of the participants are given an experimental manipulation meant to reduce the effects of stereotype threat. After the manipulation, all participants are given a relevant examination (e.g., math test) and scores on the examination are compared between conditions. Typically, these studies include a non-threatened group (e.g., men) to see if the manipulation for reducing stereotype threat effects affects the non-threatened group. An alternative approach is to elicit the stereotype threat covertly for half of the participants and compare this to a condition that should be less likely to elicit stereotype threat.

The latter approach was used by Steele and Aronson (1995) to compare verbal SAT performance for African- Americans and Caucasians. Half of the participants in each of these two groups were assigned to a personal relevance condition. In this condition, participants were informed that the test was representative of their personal ability. The other half was assigned to a not personally relevant condition in which participants were informed that the test was simply meant to better understand the psychology around verbal problem solving. The latter condition was given no information that their performance had personal relevance. In two experiments using this comparison, these researchers found that African-American participants in the personal ability condition scored significantly worse than the African-American participants in the condition that was not told that the test was personally relevant (Steele & Aronson, 1995). In

these experiments, the African-Americans performed worse on the examinations compared to the Caucasians. However, the difference in performance between African-Americans and Caucasians was reduced in the not personally relevant conditions compared the difference between these groups in the personally relevant conditions.

Another way the negative effects of stereotype threat have been lessened is by the detailing of group-specific achievement, even when the achievements are within a different domain. For example, Mcintyre, Paulson, and Lord (2003) compared men's and women's scores on sample GRE quantitative test items. In a series of two studies, participants first received information on data that suggests that women perform worse than men on math (i.e., all participants were exposed to information about the gender/math stereotype threat). This was followed by a manipulation that exposed one condition to positive information about women's success, while a control condition did not receive the same information. In the first experiment, the testing booklets informed participants in the successful women condition that women made better psychology participants than men, while the test booklets for the control condition did not provide this information. The analysis of the test scores showed that women in the successful condition scored better than women who did not get this achievement information, and women in the successful condition scored comparably to the men in both conditions. The experimenters then took this successful condition a step further in their next experiment by having the control condition receive information about successful corporations, while the successful women condition received information about successful women in a non-math fields such as law, architecture, medicine, and invention. As in their first experiment, the researchers found that women in the successful women condition scored significantly better than the successful

corporation control condition and the successful women condition also had scores similar to the men from both conditions (McIntyre, Pulson, & Lord, 2003).

Most importantly for the current study, the utilization of self-affirming character traits has been shown to alleviate the negative effects of stereotype threat. Martens, Johns, Greenberg, and Schimel (2006) conducted two studies that looked at the use of self-affirming characteristics and values on stereotype threat. In their first study, the researchers compared math performance for women and men when women were under stereotype threat. The manipulation of interest in this study was whether or not the participants self-affirmed. The participants in both conditions ranked a set of 11 characteristics such as humor, creativity, and physical attractiveness. Participants in the self-affirming condition were instructed to write about why their number one ranked characteristic was their most valued and describe a time from their past where it was particularly important. The participants in the non-self-affirming condition, however, were asked to describe why their ninth ranked characteristic was important for other people and detail a specific time when it was particularly important for those others. All participants then completed a set of adapted math questions from the Graduate Management Test (GMAT). Their results showed that women under threat who self-affirmed performed significantly better on the math examination than those under stereotype threat who did not self-affirm. Their second study was very similar to their first, except that the performance measure was a spatial rotation task instead of math test items. The results for this study were comparable to their first experiment in that women who self-affirmed scored better than those who did not (Martens et al., 2006). In both studies women in the self-affirmation conditions performed similarly to men and men did not differ as a function of self-affirmation conditions.

Building upon this prior work showing that self-affirmation can reduce the negative effects of stereotype threat, the current study was motivated by research showing that nostalgic recollection can elicit self-affirmation (Vess, Arndt, Routledge, Sedikides, & Wildschut, 2012). Before this connection is explored, the literature on nostalgia and its use will be described.

Nostalgia

Nostalgia is a sentimental longing for the past (Sedikides, Wildschut, Arndt, & Routledge, 2008). This commonly used definition showcases the interplay of affect and autobiographical memory within the experience of nostalgia. Much of the research on nostalgia has concluded that it is an emotion that is mostly positive, albeit with slight negative aspects, and is typically self-relevant (Wildschut, Sedikides, Arndt, & Routledge, 2006). Wildschut and colleagues found that nostalgia is an experience that most often concerns close others and is in the context of one's own personal past (Wildschut et al., 2006; Sedikides et al., 2008).

The typical paradigm used in nostalgia research involves having one group of participants recall a nostalgic memory (e.g. a grade school field trip to a water park) and having another group of participants recall an ordinary memory (e.g. getting groceries on Wednesday). After recalling the memories, participants complete various measures or tasks, such as recording their current affect, and the responses on these measures are analyzed for potential differences between the memory conditions.

Nostalgia has been shown to have several benefits in social contexts. For instance, Wildschut et al. (2006) found that after participants recalled nostalgic events, participants scored higher on measures of social connectedness, such as the Revised Experiences in Close Relationships Scale (Fraley, Waller & Brennan, 2000), when compared to participants who simply recalled ordinary past events. Additionally, the recollection of nostalgic events increased

feelings of social support and decreased feelings of loneliness when compared to recollection of ordinary past events (Zhou, Sedikides, Wildschut, & Gao, 2008).

Nostalgia has also been shown to provide access to personal benefits. Wildschut and colleagues (2006) found that reports of self-esteem measured by the Rosenberg Self-Esteem Scale (Rosenberg, 1965), and self-affect measured by the positive and negative affect scale (PANAS), were higher amongst individuals who had recalled a nostalgic event relative to individuals who recalled an ordinary past event. Using the same nostalgic versus ordinary past event manipulation, Sedikides, Wildschut, Routledge, and Arndt (2015) found that nostalgic recollection led to a greater sense of self-continuity between an individual's past and present self. This benefit can work to counteract potential negative consequences of self-discontinuity (i.e., the feeling that your present self is fundamentally different from your past self) such as anxiety and negative affect (Sedikides et al., 2015).

As mentioned earlier, the current experiment is motivated in part by prior research showing that nostalgia provides access to self-affirming characteristics. In one of their studies, Vess et al. (2012) used a slightly altered nostalgia paradigm. As a foil to the nostalgic condition, participants in the Vess et al. study imagined a positive future event as opposed to recalling an ordinary positive past event. In their first experiment, the researchers had participants categorize positive and neutral personality traits as self-descriptive or not self-descriptive in a Me/Not Me task. Although there were no differences between conditions regarding the number of positive and neutral characteristics that were associated with "Me", participants in the nostalgia condition were faster than participants in the future event condition at categorizing the positive characteristics as "Me". The way that Vess et al. (2012) analyzed this speed was by creating a positive self-attribute accessibility score, which controlled for individual differences in

categorization speed by using their neutral trait categorization speed as a baseline. This faster responding was believed to be indicative of greater accessibility to self-affirming characteristics, and acts as the basis for the current study.

Current Experiment

The current experiment bridges across the previously separate research domains of stereotype threat and nostalgia. As described above, prior studies in the area of stereotype threat have shown that by describing a time where their highest ranked characteristic was particularly important and detailing why that characteristic was the most valued to them, participants were less affected by stereotype threat than those who did no self-affirm in this way (Martens et al., 2006). In a similar vein, prior research in the area of nostalgia has shown that participants who engaged in nostalgic recollection had a faster activation of positive characteristics than those who did not (Vess et al., 2012). The current study investigates if engaging in nostalgic recollection will lead to a reduction the negative effects of stereotype threat.

In order to evaluate this idea, all participants in the study will be made aware of the stereotype regarding women and math scores. Participants in one condition will be asked to recall a nostalgic memory, participants in the second condition will be asked to recall an ordinary memory, and those in the last condition will be asked only to pause for a moment with no other instruction. Following this, all participants would take a difficult math test. We hypothesize that women under stereotype threat who recalled a nostalgic memory will perform better on the math test than women under threat who recalled an ordinary memory or recalled nothing at all. We also hypothesize that men will not differ in math scores between conditions.

3. METHODOLOGY

Participants

A power analysis was conducted using G*Power (Faul et al, 2007) to determine the sample size necessary to detect a medium (d = .05) effect of stereotype threat, with effect size based upon the results by McIntyre et al. (2003). With alpha set at .05, a sample with at least 50 participants in each of the six conditions was needed to have a power of .80 to detect a medium effect of stereotype threat. Due to slower recruitment, a smaller number of participants were tested than desired. One hundred forty-one University of Mississippi undergraduate students were recruited through the SONA experiment management system to participate in the experiment for partial course credit in an introductory psychology class.

Participation was restricted to individuals who identify as Caucasian. This was done to eliminate the effects of other, overlapping math stereotype threats, e.g. African Americans performing worse than Caucasian Americans and Asian Americans performing better than Caucasian Americans (Steele & Aronson, 1995; Aronson, Lustina, Good, Keough, Steele, & Brown, 1999). This restriction was mostly accomplished by using selective sampling based on the prospective participants' answers to demographic questions on the department's prescreening questionnaire, although errors were made during the first collection of participants. When transferring data from the prescreening output, more items were copied over than desired. This lead to emails being sent to those who did not meet this restriction.

Sixteen participants were excluded from the study due to not completing the survey. One participant was excluded from the study because they did not enter their identification code so

their prescreening information could not be gathered. Twelve participants were excluded based on race. Four participants were noted as having taken the survey more than once. Of those four participants only one was marked with this exclusion, as the other three were already marked with the incomplete exclusion. Final recruitment was 111, with twenty-one males and ninety females.

In order to combat floor effects on the math performance test, researchers have previously required that participants have a minimum score of 500 on the quantitative section of the SAT, or the score equivalent on the ACT, to participate in experiments on the math stereotype threat (Spencer et al, 1999). Although restricting participation was planned along these scores initially, due to difficulty in recruitment, test scores collected during prescreening did not affect a prospective participant's eligibility. In order to combat potential age confounds from older adults and cognitive decline stereotype threat, all participants were between 18-30 (Barber, 2017).

Design

This experiment involved a 2 X 3 factorial design. All factors were between subject variables. The factors were gender of the participant (male or female) and evoked memory type (nostalgic vs ordinary vs none). Prior research has shown this gendered math stereotype threat is reliably evoked (Martens et al, 2006; McIntyre, Paulson, & Lord, 2003), thus we did not use a non-threat control condition, and instead focused on the comparison of the effects evoked by memory type. Participants were assigned to the memory type conditions at random through the Qualtrics software.

Materials

Math Test. This measure consisted of 26 math test questions adapted from released

questions from the quantitative section of the GRE. These items have been successfully used by Taylor, Lord, McIntyre, and Paulson (2011) in a math related stereotype threat experiment. The test directions and items can be found in Appendix A.

Math Anxiety Scale. This study used the Abbreviated Math Anxiety Scale (AMAS) developed by Hopko, Mahadevan, Bare, and Hunt (2003). The AMAS uses a five point Likert scale, ranging from 1 *(low anxiety)* to 5 *(high anxiety)* to get a measure of anxiety from nine math-relevant scenarios that are summed together for a final aggregate score (Hopko et al., 2003). This measure was taken at two different points; once during the department's SONA prescreening and a second time following the administration of the math questions. We chose to give participants this assessment twice in order to check that our memory conditions in each gender group were roughly equal on trait math anxiety prior to the experiment (based upon prescreening), and to have a comparison to see if math anxiety was affected by the memory manipulation by looking at changes from the pre-screening to the post-test administration of the scale. This scale can be found in Appendix B.

Memory Instructions. These instructions were taken from previous research in the case of the nostalgic and ordinary memory conditions (Wildschut et al., 2006). For the none memory condition, a neutral request to wait for a moment was given in which participants could only continue after at least ten seconds had passed. The nostalgic instructions provide a commonly used definition of nostalgia and prompts participants to recall this memory and immerse themselves in it before writing about the experience. The ordinary memory instructions in contrast ask participants to think about something more mundane or typical and describe it in a removed perspective, providing only facts as if they were historians. Full instructions for these conditions can be found in Appendix C.

Single-Item Self-Esteem Scale. This measurement was used to gather information about a participant's global self-esteem and was developed as an alternative to the 10 item Rosenberg Self-Esteem Scale (Robins, Henden, & Trześniewski, 2001). The item uses a 5-point Likert scale, ranging from 1 *(not very true of me)* to 5 *(very true of me)* for the statement "I have high self-esteem." The measure was placed directly after the memory manipulation.

Positive and Negative Affect Scale. This measure consisted of 10 items, 5 for positive affect and 5 for negative affect, and was developed in order to be brief and easy to use (Watson, Clark, & Tellegen, 1988). The PANAS uses a 5-point Likert scale ranging from 1 *(never)* to 5 *(always)* to get a measure of how frequently the participant feels the given emotion. The positive emotions are taken and summed, and the same is done for the negative emotions to get one measure for positive affect and one for negative affect. Administration of this scale was done after the self-esteem measure and before the math test. The items in this scale can be found in Appendix D.

Gender Affirming Images. Pictures taken from the Chicago Face Database were used in the study in order to help ensure the participants' gender identity was salient as this was shown to contribute to the effects of stereotype threat (Ma, Correll, & Wittenbrink, 2015; Steele & Aronson, 1995). The images used can be found in Appendix E.

Procedure

The test procedure changed due to the global pandemic. A brief description of the planned procedure and the potential implications of the changes can be found in the discussion section.

After completing the department's prescreening questionnaire, qualified students were emailed asking if they would like to participate in a study. Students who answered in the

affirmative were given a link to the Qualtrics survey used for the experiment, and were provided with a code to enter to anonymize their data.

Once participants opened the survey, they were greeted with the informed consent and were asked to affirm that they were both 18 or older, and that they consented to participate in the study. If either were denied, the survey brought them to the end. Otherwise, participants were shown the face images and used them to select the gender with which they most identify. All participants were then presented with a stereotype threat elicitation slightly modified from the one used in McIntyre et. al (2003). They were presented with a page which said "Because this study involves an evaluation of math performance, it is important for you to be aware of the current literature. Some research shows men outperform women in mathematics, but the empirical evidence is mixed. Some studies have shown an advantage for men, but others have not." for a minimum of 30 seconds before they could move to the next survey page. Following threat elicitation, participants were randomly assigned to one of the three memory conditions by the Qualtrics software and were presented with the appropriate instructions, or a pause for the none condition. Full instructions for the memory conditions can be found in Appendix C. Participants were given time to write about their recalled memory before being presented with the self-esteem and PANAS measures. The math test was presented next, allowing participants 20 minutes to complete the 26 problems. The AMAS measure was presented following completion of the math test. Lastly, participants were given the debriefing and asked our test check questions to see if they used a calculator or skipped around on the math test.

4. ANALYSES AND RESULTS

Memory Conditions Check

In order to determine if participants followed instructions for their memory condition and were recalling the proper memory type, I read through all of the responses. I checked for subjective adherence to the instructions, but also examined them specifically for time frame and emotionality. While a couple of nostalgic memories were described as recent (within the past year), they still had a level of emotionality that indicated they were describing a nostalgic memory. For the ordinary memory condition, one participant did describe being sad at the end of the memory, however the rest of the memory was detached and descriptive and happened within the week as the instructions required.

Data Normality

Tests for normality were conducted for both of the primary variables; gender and memory condition. This was accomplished by using an explore test of math test score by these two variables. For gender, the Shapiro-Wilk tests showed no significant departure from normality for both males, $W(21) = .962$, $p = .549$, and females, $W(90) = .976$, $p = .087$. For memory condition, the Shapiro-Wilk tests for nostalgic, $W(41) = .989$, $p = .961$, and none, $W(37) = .959$, $p = .193$, showed no significant departure from normality. For the ordinary condition however, the test showed a significant deviation from normality, $W(33) = .932$, $p = .04$. Checking the box and leaf plots for these variables as well as the reports of skewness and kurtosis, no outliers were found and the shape reports were all within ± 1. Additionally, visual assessment of the histogram plot for the ordinary condition does not show full right skew or

platykurticity, though this condition appears more left aligned and flatter than the other two conditions. Before the description of the other variables of importance in the study, and because of decisions described in the following section, I decided to explore the memory conditions again while removing the male data from the test. Doing so did not yield different results in outliers, skewness, or kurtosis. It did, however, show that all three memory conditions, when including only female participant data, did not significantly deviate from normality. Nostalgic, $W(30) = .986$, $p = .954$, none, $W(33) = .968$, $p = .426$, and now ordinary, $W(27) = .934$, $p = .086$, all show normality across score. Descriptive statistics for the main variables of importance can be found in Table 1. These statistics include female data only and display data for all memory conditions together.

During the study design phase, it was decided that student AMAS scores would be checked for outliers and data for those individuals would be removed if their scores were beyond three standard deviations away from the mean. Both pre- and post-AMAS scores were tested by transforming the data into z-scores and checking if any of the scores were ± 3. None of the scores met this boundary.

Table 1

Additional Descriptive Statistics for Variables of Interest Using Only Female Data

	M	*SD*	*N*
Positive Affect	17.82	3.15	90
Negative Affect	11.87	2.78	90
Self-esteem	3.4	.98	90
Prescreening AMAS	24.64	7.94	78
Posttest AMAS	24.37	7.29	90
SAT Math scores	591.83	95.17	71
Math test scores	9.23	4.02	90

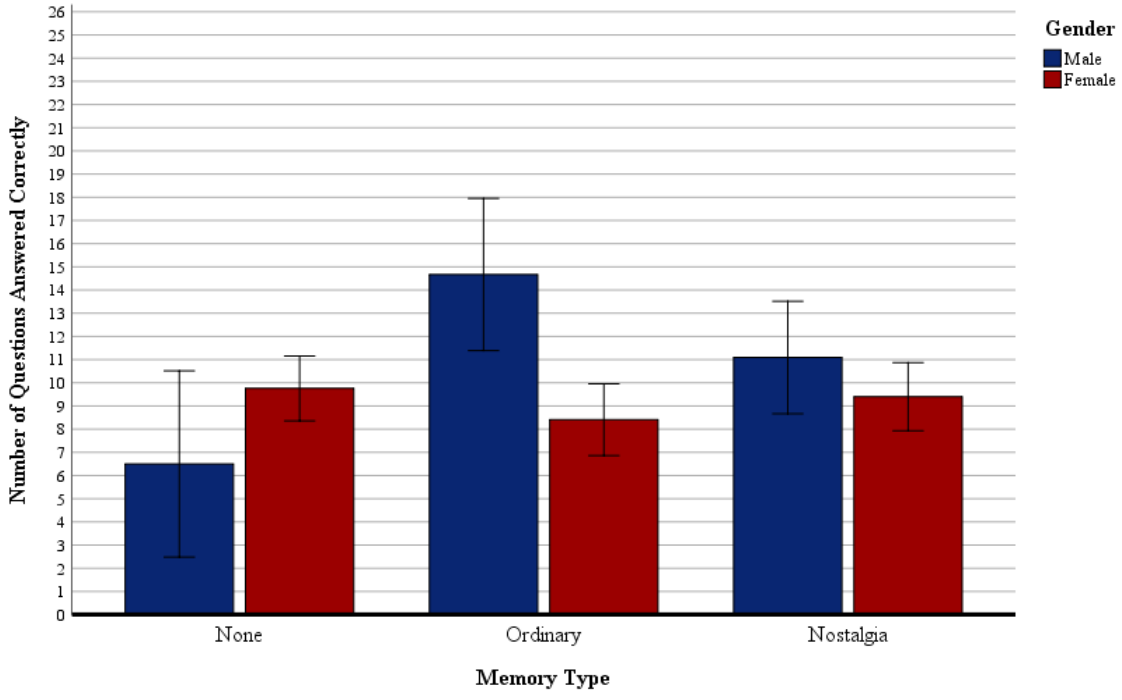
Note. All values rounded to the nearest hundredth.

Primary Analyses: Math Test Scores

In order to determine the effect of nostalgic recollection on math test scores for people under stereotype threat, I conducted a 2 X 3 Factorial ANOVA. Both factors were between-subject factors, with one being gender (male or female), and the other being memory condition (nostalgic, ordinary, or none). The dependent variable in this analysis was the number of questions answered correctly on the math test. A significant interaction between gender and memory condition was found with larger then medium effect size, $F(2, 105) = 5.735$, $p = .004$, $\eta_p^2 = .098$, though neither the main effect of gender nor the main of memory condition reached statistical significance, $F(1, 105) = 2.204$, $p = .141$, and $F(2, 105) = 2.932$, $p = .058$ respectively. The significant interaction was investigated with separate analyses of the effects of condition for each gender group.

Figure 1

Math Test Scores Between Males and Females Across Memory Types



Note. Sample size was 21 for Males and 90 for Females.

With 11 participants in the nostalgic condition, 6 in the ordinary, and 4 in the none conditions, I ran a one-way ANOVA in order to test the hypothesis that men will not score differently between memory conditions based on previous studies on stereotype threat, with the understanding that these sizes are far below the desired 50 participants per condition (McIntyre, Paulson, & Lord, 2003; Martens et al., 2006). Surprisingly, there was a significant difference found between memory conditions, $F(2, 18) = 4.584$, $p = .025$, with post hoc comparisons using the Tukey HSD test revealing that those in the ordinary memory condition ($M = 14.67$, $SD = 5.046$) scored significantly higher than those in the none condition ($M = 6.50$, $SD = 3.109$), while those in the nostalgia condition ($M = 11.09$, $SD = 3.986$) did not differ from the other two conditions.

In order to test if there was a difference in math test scores between memory type for women, I ran a one-way ANOVA. No significant differences were found among the memory conditions, $F(2, 87) = .874$, $p = .421$.

The two comparison memory groups — ordinary memory and none — were collapsed together into a true control level of memory type and tested against nostalgic memory. This was done because the method more closely resembles the manner in which most of the nostalgic recollection studies are designed. Doing this, however, yielded no significant differences between gender, $F(1, 107) = 3.607$, $p = .060$, the adjusted memory condition, $F(1, 107) = .001$, $p = .977$, or the interaction, $F(1, 107) = .073$, $p = .788$. Males scored an average of 10.563 ($SD = 1.032$) and females scored similarly at 9.832 ($SD = .482$) on average. Participants in the nostalgic condition ($M = 9.969$, $SD = .915$) scored no different than those in the collapsed control condition ($M = 10.427$, $SD = .811$).

Covariate analyses were run for both the original memory conditions and the adjusted conditions to investigate the results of accounting for certain related variables in the model. These variables were added to the methodology from the beginning in order to both; determine if the effects of nostalgia on the personal variables would replicate, and to test them as covariates in the overall model. The variables — positive affect, negative affect, and self-esteem — were included as covariates because of their reported relationship with nostalgic recollection. SAT Math scores and AMAS scores were included into the model because of their subject connection with the dependent variable. Adding these variables to the model provided no significant differences for gender, $F(1, 65) = .093$, $p = .761$, memory condition, $F(2, 65) = .816$, $p = .447$, or the interaction, $F(2, 65) = 1.75$, $p = .182$. Covariate analysis using the adjusted memory conditions also rendered no significant differences for the main effects of gender, $F(1, 67) = .4$, $p = .529$, memory condition, $F(1, 67) = .475$, $p = .493$, or the interaction, $F(1, 67) = .589$, $p = .446$.

Additional Analyses

Because only 21 males participated in the study, and female outcomes were the focus of the study, the remainder of analyses were done with only the female participant data. Table 2 shows descriptive statistics for positive and negative affect, self-esteem, Pre- and Posttest AMAS, SAT Math test scores, and study math score by memory condition.

Condition Differences & Correlations. Multiple one-way ANOVAs and Pearson correlations were run in order to determine if there were any group differences between the memory conditions on the other measures, and to detect any significant relationship between some of these measures and the math scores. The full correlation matrix run for these analyses can be found in Appendix F. No significant differences were found among the memory

conditions on total survey duration, $F(2, 87) = 1.852$, $p = .163$, stereotype threat elicitation duration, $F(2, 87) = .575$, $p = .565$, or math test duration, $F(2, 87) = .048$, $p = .953$. There was a significant positive correlation between math test duration and math test score, $r(88) = .39$, $p < .001$.

Table 2

Descriptive Statistics for Variables of Interest By Memory Condition

	Memory Condition								
	None			Ordinary			Nostalgic		
Variable	*M*	*SE*	*N*	*M*	*SE*	*N*	*M*	*SE*	*N*
Positive Affect	17.97	.63	33	17.37	.61	27	18.07	.47	30
Negative Affect	11.67	.48	33	12.11	.56	27	11.87	.5	30
Self-esteem	3.45	.19	33	3.56	.16	27	3.2	.18	30
Pretest AMAS	23.97	1.31	33	26.09	1.74	22	24.19	1.71	26
Posttest AMAS	23.67	1.22	30	25.33	1.32	27	24.27	1.47	30
SAT Math scores	581.92	17.39	26	587.73	17.3	22	606.96	24.08	23
Math test scores	9.76	.69	33	8.41	.76	27	9.4	.76	30

Note. All values rounded to the nearest hundredth.

Based on previous research, we expected to find significant differences between memory conditions for the self-esteem and PANAS measures (Wildschut et al., 2006). However, there were no significant differences found for self-esteem, $F(2, 87) = 1.015$, $p = .367$, nor for either positive affect, $F(2, 87) = .40$, $p = .672$, or negative affect, $F(2, 87) = .186$, $p = .830$. Unsurprisingly, we did find a significant negative correlation between the self-esteem measure and the calculator test check, $r(88) = -.22$, $p = .040$. As reported self-esteem increased, the use of a calculator decreased. Additionally, the two test checks were significantly positively correlated, $r(88) = .26$, $p = .013$, showing that as calculator use increased, the decision to skip around on math questions increased.

Both SAT and ACT scores were collected during the prescreening. Due to sample size limitations, SAT Math scores were not used as participation criteria as planned. Instead, SAT equivalence scores were calculated using the student's provided SAT response or a converted ACT response. This conversion was done by referencing a table provided by the ACT organizations website (ACT, Inc., 2018). No significant memory condition differences were found, $F(2, 68) = .445$, $p = .643$. There was a significant positive correlation between SAT Math scores and the math test score, $r(69) = .46$, $p < .001$.[2] In addition, there was a significant positive correlation between SAT Math scores and math test duration, $r(69) = .32$, $p = .006$, showing that individuals who scored higher on the standardized subtest spent longer working on this study's math questions.

AMAS Scores. The AMAS scores which were taken from the prescreening were analyzed using a one-way ANOVA to determine if our memory conditions were different on this variable despite the random assignment. No significant difference was found among the conditions on this prescreening measure, $F(2, 75) = .51$, $p = .602$. Scores on the AMAS were also collected following the math test, with no significant differences between the memory conditions, $F(2, 87) = .387$, $p = .68$, which suggests that nostalgic recollection did not ease math anxiety compared to ordinary or no recollection.

The posttest AMAS scores were significantly positively correlated with negative affect, $r(88) = .28$, $p = .008$. A significant negative correlation between posttest AMAS scores and math

[2] Because there is a range in the conversion table, this analysis was done with the SAT Math equivalence scores that were the higher number in the range. Analyses were also run using the lower SAT Math equivalence scores as well as both the higher and lower overall SAT scores. No significant differences were found for these tests as well, with results of $F(2, 68) = .073$, $p = .93$; $F(2, 81) = .119$, $p = .888$; and $F(2, 81) = .105$, $p = .9$, respectively. Similar results are seen with the correlations being significantly positively correlated with math test score. The lower SAT Math scores had a correlation of $r(69) = .5$. The lower and the higher overall SAT score both had a correlation of $r(82) = .39$. All three correlations were significant at the .001 level.

test duration was also found, $r(88) = -.3$, $p = .005$. As math test duration decreased, the posttest math anxiety increased. A significant negative correlation between the posttest AMAS scores and the math test score was found, $r(88) = -.35$, $p < .001$, though a significant correlation was not found between the pretest AMAS scores and the math test scores, $r(88) = -.217$, $p = .057$. This finding remained even after controlling for SAT scores, though the test's p-value did trend towards significance, $r(58) = -.248$, $p = .052$.

In order to determine how AMAS scores may have changed over the course of the study, a difference score was calculated. The difference scores were calculated by subtracting the prescreening AMAS scores from the posttest AMAS scores. Difference scores of positive numbers indicated an increase in math anxiety, while negative difference scores indicated a decrease in math anxiety. There was a lack of significant differences found in the AMAS difference scores between the memory conditions, $F(2, 75) = .002$, $p = .988$. A significant finding was found for the AMAS difference scores and how they correlate with positive affect. This relationship is significant and positive, $r(76) = .27$, $p = .017$, such that the more positive a participant was feeling going into the study, the more their difference score increases.

In order to check that the participants did differ in the type of memory recalled, the memories provided were scored for memory perspective, adapted from Wildschut's work on the content of nostalgia (Wildschut et. al, 2006). Although previous researchers only looked at the proportions of perspective within nostalgia, I compared the patterns of difference between the proportions of ordinary memory and nostalgic memory to find potential differences. Memory perspective was coded into one of four categories: sole actor, in which the participant was the only person mentioned; major role, in which the participant mentions others but is still the primary focus; minor role, in which the participant is mostly an observer and/or reactor to others;

and outside observer, in which the participant either describes themselves in the third person, or recounts witnessing others without mention of the self. Proportions of the memory perspective between ordinary and nostalgic recollection can be found in Table 3. Nostalgic memories were recorded as either sole actor or major role, with the latter perspective being taken the vast majority of the time. This pattern is similar to previous findings except that the minor role and outside observer perspective were also recorded with the same miniscule frequency as the sole actor perspective (Wildschut et. al, 2006). While the ordinary memory recollections still did primarily use the major role perspective, the proportion of the other perspectives used were greatly different from both the previous literature and the nostalgic memory recollections.

Table 3

Memory Perspective Proportions in Ordinary and Nostalgic Memory Recollection

	Proportion	
Perspective	Ordinary Memory	Nostalgic Memory
Sole Actor	.26	.07
Major Role	.41	.93
Minor Role	.07	0
Outside Observer	.26	0

5. DISCUSSION

In order to test the hypothesis that women who engage in nostalgic recollection benefit from a decrease in the negative outcomes of stereotype threat, this study informed participants of the stereotype that women perform worse than men on math examinations and had participants recall either an ordinary memory, a nostalgic memory, or no memory before a difficult math test. This study did not result in the findings of significant differences that would support the hypothesis, although other results of interest were found.

Our results did not replicate previous findings that males and females would differ significantly on math testing when they are provided with a context relevant stereotype threat (Martens et al., 2006). But interpretation of our findings is limited due to the small number of men in our sample. Because we were unable to meet our overall targets for sample size, we were unable to draw as many strong conclusions as we had hoped. We found that men did have a significant difference in score between the groups despite previous research showing that this would be very unusual. The finding was likely due only to the fact that the total number of men participating in the study was 21. Despite this limitation, we did have a sample of women large enough to investigate the effects of memory type and math anxiety on women's math performance, although it was only 60% of the sample per condition based on the a priori power analysis.

Math Performance

A few conclusions could be drawn from our null findings between memory condition and math score for women. If the strength of previous research is to be accounted for, it is possible

that the smaller than planned sample size obtained did not allow for sufficient variability across groups to detect the typically found effect. It is also quite conceivable that, despite nostalgia possibly providing greater direct access to self-affirmation, and self-affirmation reducing stereotype threat effects, the manner of use of nostalgia in this study may not have been conducive to finding the hypothesized effect. Specifically, the environment in which individuals are experiencing the memory is not as controlled as the typical nostalgia recollection studies, and the measures between the memory recollection and the test may have interfered with the benefits from nostalgia.

Although it was expected that memory condition would differ on posttest AMAS scores because of nostalgia's improvement of general anxiety (Wildschut et al., 2006), no significant difference was found. It is possible that general nostalgic recollection does not typically affect specific anxieties. The other limitations discussed, such as sample size and level of experimental control, may have also contributed to this lack of anxiety difference between conditions.

Something that was found which makes intuitive sense was the negative correlation between the posttest AMAS scores and the math test scores. Because pretest AMAS scores didn't share a similar correlation, a possible explanation for this finding is that because students performed worse, they reported higher math anxiety. However, since we could have measured math anxiety directly prior to the math test during the study, it is also possible that participants' state anxiety led to lower performance, or that an uncollected variable played a role which cannot be currently described.

Potential Limitations to the Online Format

Initially this study was meant to take place in person, in a classroom setting, with a more controlled environment and representation of gender. Due to COVID19, the study procedure was

moved to an online format. Based on previous literature, having the stereotyped group mixed in with the comparison group aided in gender identification, which also aids in the recognition of the stereotype threat (Martins et al., 2006; Murphy et al. 2007). Although the online version employed pictures in the gender identification question in order to emphasize the gender comparison, it is possible that the pictures may have not aided the women in the study in experiencing the stereotype threat as much as they otherwise would in a mixed-gender classroom setting.

Another potential limitation of transitioning into an online study is that the pace of the study could not be ensured. Both the stereotype threat elicitation and the memory instructions were meant to be presented for a certain amount of time and the math test was meant to be taken at a certain pace. Unfortunately, participants did not engage with the study nearly as long as they would have in person; the planned duration was set at 45 minutes while only 20 minutes were spent on the entire test on average. It is possible that having participants take the entire required time could lead to a greater variability in scores. The fact that math test scores were significantly positively correlated with the participant's SAT Math scores does help to show validity of the test measure, illustrating that the math test in the study is consistent with participant performance in real world settings. Additionally, average scores were similar to those in previous work (McIntyre et al., 2003). Their averages for experiment 1 were 10.08 for men and 8.63 for women, with respective standard deviations of 4.94 and 4.16 (McIntyre et al., 2003). The averages in this study were 11.24 for men and 9.23 for women, with respective standard deviations of 4.88 and 4.02. Although they used a slightly larger math test size, 34 items compared to 26 items, they also adjusted for guesses which they urged participants not to do (McIntyre et al., 2003). No such instruction was given to the participants in the current study, nor

were their scores adjusted by 20% of wrong answers. This decision was made due to the fact that 8 questions could not be found by McIntyre and colleagues when sharing their materials for this study, and the goal with this line of research is to aid in course testing where students tend not to be punished by guessing.

Issues of Identity

There are a few potential problems that could arise for the replication experiments proposed here revolving around identity. When individuals are high in group identification, they are more likely to experience the negative effects of stereotype threat (Schmader, 2002; Schmader, Johns, & Forbes, 2008). Because nostalgia is known to increase social connectedness, one could assume that nostalgia could also increase group identification relevant to the stereotype threat. However, Smeekes (2015) shows that while eliciting national nostalgia does increase group identification, eliciting nostalgia for a personal past does not. This means that students who recall personal nostalgic events should not increase group identification and students who did recall a nostalgic memory that is nationalistic could be removed from the data analysis.

Along with this group identification, there are individual differences in the extent to which one identifies with their gender group. Further, there are more reported genders than just male and female. Although variation in gender identity are not considered in this experiment, future work could look at nostalgia's effects on stereotype threat across a wider spectrum of gender identification. The method used for gender identification in this study would likely not be as conducive to gender selection unless overt physical stereotypes were used. An alternative method that is specific enough to adhere to someone's identification, while being general enough not to fall into tropes would need to be used in such a study.

A final difficulty around identity revolves around the idea of intersectionality. Because people belong to more than one group, they can be differentially affected by stereotypes regarding those different groups. For example, Caucasian males do not perform worse on math examinations when women are the comparison. However, when Asians are the comparison group, Caucasian males do succumb to math stereotype threat (Murphy, Steele, & Gross, 2007). This intersectionality effect on stereotype threat is the reason this study only drew from a white participant pool. Future analyses could look at the differential effect of nostalgic recollection across a more diverse participant pool to discover more nuanced results.

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List of Appendices

Appendix A

Math Instructions and Items.

These instructions and items functionally match those used in Taylor et al. (2011).

Directions for the test.

You will be taking a math test with 26 items and will be given 20 minutes to complete the test.

The use of calculators is prohibited. You may use scratch paper which the test administrator will provide you if needed. Try to do your best on each item without guessing. Please complete the items in order and DO NOT skip around. If you cannot confidently identify the correct answer then you may guess if needed. Also do your best to complete at least 10 of the items.

You will have 20 minutes. Good luck!

Test Items

Please click the answer you feel is most correct.

1. If $3^n<500$, which of the following is the greatest possible value of n?
    a. 2
    b. 4
    c. 5
    d. 7
    e. 7

2. $\frac{m+m}{m} - n =$

a. $\frac{mn}{m-n}$

b. $\frac{m}{m(m-n)}$

c. $\frac{m-n}{m}$

d. 1

e. -1

3. In deciding the asking price for a piece of property, a real estate broker determines that the market value of the lot is 1/7 the market value of the building on it. If the total value of the property is set at $140,000, then what is the total value of the lot?

    a. $10,000

    b. $17,500

    c. $20,000

    d. $120,000

    e. $122,500

4. In deciding the asking price for a piece of property, a real estate broker determines that the market value of the lot is 1/7 the market value of the building on it. If the total value of the property is set at $140,000, then what is the total value of the lot?

    a. $\frac{100}{K+L}$

    b. $\frac{1}{K+L}$

    c. $\frac{K+L}{100}$

    d. 100(K+L)

e. 1000(K+L)

5. John has 4 ties, 12 shirts, and 3 belts. If each day he wears exactly one tie, one shirt and one belt, what is the maximum number of days he can go without repeating a particular combination?

   a. 12

   b. 21

   c. 84

   d. 108

   e. 144

6. If y= 2x-1, what is the value of x in terms of y?

   a. $\frac{Y}{2}$-1

   b. $\frac{Y}{2} - \frac{1}{2}$

   c. $\frac{Y}{2} + \frac{1}{2}$

   d. $\frac{Y}{2} + 1$

   e. Y+$\frac{1}{2}$

7. If a = 2, b = 4, and c = 5, then $\frac{a+b}{c} - \frac{c}{a-b} =$

   a. 1

   b. 11/30

   c. 37/10

d. -11/30

e. -1

8. If (p-q)/p = 2/7, then q/p =

   a. ⅖

   b. 5/7

   c. 1

   d. 7/5

   e. 7/2

9. If integer x were divided by 7, the quotient would be 12 with a remainder or 1. Therefore, x equals

   a. 91

   b. 90

   c. 88

   d. 85

   e. 83

10. If $y \neq 0$ and $2x + y = 12$, then which of the following is NOT a possible value of x?

   a. 12

   b. 10

   c. 8

   d. 6

e. 4

11. If $4x + 3y = 8$ and $x/2 = 1/4$, what is the value of y?

    a. 4/3

    b. 2

    c. 7/3

    d. 3

    e. 10/3

12. Two people were hired to mow a lawn for a total of $45. They completed the job with one person working for 1 hour and 20 minutes and the other working 40 minutes. If they split the $45 in proportion to the amount of time each spent working on the job, how much did the person who worked longer receive?

    a. $33.75

    b. $30.00

    c. $27.50

    d. $25.00

    e. $22.50

13. A rectangular window with dimensions 2 meters by 3 meters is to be enlarged by cutting out a semicircular region in the wall as shown below. What is the area, in square meters, of this semicircular region?

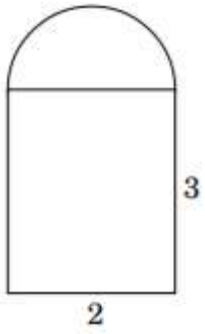
a. $\pi/4$

b. $\pi/2$

c. π

d. 2π

e. 4π



14. $\frac{10^2(10^8+10^8)}{10^4} =$

a. $2(10^4)$

b. $2(10^6)$

c. 10^8

d. $2(10^8)$

e. 10^{10}

15. If $n = 15 \times 28 \times 26$, which of the following is NOT an integer?

a. n/15

b. n/21

c. n/32

d. n/35

e. n/39

16. In square PQRS below, T is the midpoint of side RS. If PT = $8\sqrt{5}$, what is the length of a side of the square?

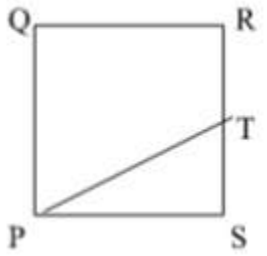
a. 16

b. $6\sqrt{5}$

c. $4\sqrt{5}$

d. 8

e. $2\sqrt{6}$



17. If $q \neq 0$ and $k = qr/2 - s$, then what is r in terms of k, q, and s?

a. $\frac{2k+s}{q}$

b. $\frac{2sk}{q}$

c. $\frac{2(k-s)}{q}$

d. $\frac{2k+sq}{q}$

e. $\frac{2(k+s)}{q}$

18. |3| + |-4| + |3-4|

a. 14

b. 8

c. 7

d. 2

e. 0

19. A computer can perform 30 identical tasks in 6 hours. At that rate, what is the minimum number of computers that should be assigned to complete 80 of the tasks within 3 hours?

a. 6

b. 7

c. 8

d. 12

e. 16

20. Which of the following is 850 percent greater than 8 ×103?

a. 8.5×10^3

b. 6.4×10^4

c. 6.8×10^4

d. 7.6×10^4

e. 1.6×10^5

21. $\frac{9^2-6^2}{3} =$

a. 1

b. 15/9

c. 5

d. 8

e. 15

22. What is 0.423658 rounded to the nearest thousandth?

a. 0.42

b. 0.423

c. 0.424

d. 0.4236

e. 0.4237

23. If 3(x +2) = x-4, then x =

a. -5

b. -3

c. 1

d. 3

e. 5

24. If $x^2 + 2xy + y^2 = 9$, then $(x = y)^4 =$

a. 3

b. 18

c. 27

d. 36

e. 81

25. If the sum of two numbers is 14 and their difference is 2, what is the product of the two numbers?

a. 24

b. 28

c. 40

d. 45

e. 48

26. A secretary typed 6 letters, each of which had either 1 or 2 pages. If the secretary typed 10 pages in all, how many of the letters had 2 pages?

a. 1

b. 2

c. 3

d. 4

e. 5

STOP TEST IS COMPLETE!

Appendix B

AMAS Instructions and Items.

These instructions and items were taken from Hopko et al. (2003).

The following statements describe different situations. For each statement, please rate how anxious you would be in each situation on a scale ranging from 1 (low anxiety) to 5 (high anxiety).

1. Having to use the tables in the back of the math book.
2. Thinking about an upcoming math test 1 day before.
3. Watching a teacher work an algebraic equation on the blackboard.
4. Taking an examination in a math course.
5. Being given a homework assignment of many difficult problems that is due the next class meeting.
6. Listening to a lecture in math class.
7. Listening to another student explain a math formula.
8. Being given a “pop” quiz in math class.
9. Starting a new chapter in a math book.

Appendix C

Memory Instructions.

These instructions were taken from Wildschut et al. (2006).

Nostalgic Condition

According to the Oxford Dictionary, ‘nostalgia’ is defined as a ‘sentimental longing for the past.’ Please think of a nostalgic event in your life—a nostalgic event that has personal meaning for you. Specifically, try to think of a past event that makes you feel most nostalgic. Bring this experience to mind. Immerse yourself in the nostalgic experience. How does it make you feel? Then, write about this experience in the space below. Describe the experience and how it makes you feel nostalgic.

Ordinary Condition

Please think of an ordinary event in your life that took place in the last week. Try to bring this event to mind and think it through as though you were an observer of the event, rather than directly involved. Imagine the event as though you were a historian recording factual details (e.g., I got on the number 37 bus). Then, please write about this everyday event in the space below. Write a purely factual and detailed account (e.g., like in a court of law, avoiding emotionally expressive words).

None Condition

One moment…

Appendix D

PANAS Items

These items were taken from Watson, Clark, & Tellegren (1988)

Thinking about yourself and how you normally feel, to what extent, from 1 (never) to 5 (always), do you generally feel: Upset

Thinking about yourself and how you normally feel, to what extent, from 1 (never) to 5 (always), do you generally feel: Hostile

Thinking about yourself and how you normally feel, to what extent, from 1 (never) to 5 (always), do you generally feel: Alert

Thinking about yourself and how you normally feel, to what extent, from 1 (never) to 5 (always), do you generally feel: Ashamed

Thinking about yourself and how you normally feel, to what extent, from 1 (never) to 5 (always), do you generally feel: Inspired

Thinking about yourself and how you normally feel, to what extent, from 1 (never) to 5 (always), do you generally feel: Nervous

Thinking about yourself and how you normally feel, to what extent, from 1 (never) to 5 (always), do you generally feel: Determined

Thinking about yourself and how you normally feel, to what extent, from 1 (never) to 5 (always), do you generally feel: Attentive

Thinking about yourself and how you normally feel, to what extent, from 1 (never) to 5 (always), do you generally feel: Afraid

Thinking about yourself and how you normally feel, to what extent, from 1 (never) to 5 (always), do you generally feel: Active

Appendix E

CFD Images

Male

Female

Appendix F

Full SPSS Correlation Table Output

Variable	*n*	*M*	*SD*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Test Duration	90	1177.67	448.52	--														
2. Memory Type	90	1.97	.841	.169	--													
3. Positive Affect	90	17.82	3.15	-.142	.010	--												
4. Negative Affect	90	11.87	2.78	.022	.032	-.109	--											
5. Post-Test AMAS	90	24.37	7.29	-.160	.037	-.106	.280**	--										
6. Calculator Use	90	1.76	.432	.052	.008	-.041	-.046	-.118	--									
7. Answer Out Of Order	90	1.59	.495	.107	.129	-.091	.099	-.026	.260*	--								
8. Math Test Score	90	9.23	4.02	.186	-.041	.193	.090	-.350**	.098	-.053	--							
9. SAT Total	84	1245.58	145.15	.091	-.037	-.059	-.040	-.358**	.347**	.116	.390**	--						
10. SAT Math	71	591.83	95.17	.271*	.109	-.187	.027	-.427**	.269*	.152	.456**	.779**	--					
11. Math Test Duration	90	773.67	332.01	.817**	.018	-.083	.056	-.296**	.100	.065	.393**	.294**	.322**	--				

12.AMAS Difference Scores	78	.15	6.40	.189	.006	-.270*	.102	-.364**	-.008	.090	.162	.113	.324**	.278	-		
13. Self-Esteem	90	3.40	.981	.054	-.106	.307**	-.273**	-.099	-.217*	-.190	.073	-.131	-.048	.013	-.038	-	
14.Pre-Test AMAS	78	24.64	7.94	-.004	.016	-.369**	.348**	.660**	-.086	.029	-.217	-.213	-.109	-.067	.459**	-.108	-

*$p < .05$. **$p < .01$.

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