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ARE WOMEN BAD AT MATH OR IS IT JUST AN ILLUSION?

HOW FALSE MEMORIES AND GENDER STEREOTYPES CAN INFLUENCE WOMEN'S PERCEPTION OF STEM

A thesis submitted to

Regis College

The Honors Program

in partial fulfillment of the requirements

for Graduation with Honors

By

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May 2019

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TABLE OF CONTENTS

Acknowledgements.....v

Preface: A Fear of Flying Tomatoes.....1

Abstract.....10

Introduction.....11

Method.....14

Results.....17

Discussion.....20

Figures.....27

References.....31

Appendices……35

List of Figures

Figure 1. Change in Negative Experience in Math 27

Figure 2. Change in STEM Preferences.....28

Figure 3. Perceived Memory.....29

Figure 4. Perceived Belief.....30

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“Zealous conviction is a dangerous substitute for an open mind.”

— Dr. Elizabeth Loftus

Preface: A Fear of Flying Tomatoes

I first heard about false memories when I was a senior in high school. It feels very counterintuitive and ironic to be saying this when the memory I am about to recollect could, in of itself, be a false memory. I was in my AP Psychology class one morning discussing the implications of memory research when I first heard the name Elizabeth Loftus. For those who may not know, Elizabeth Loftus is a Cognitive Psychologist who pioneered the research in false memories and continues to study why our memory systems seem so reliable, but in all actuality are extremely fallible. She is easily one of the most decorated and controversial figures in the psychological community and in the history of the field.

In a now famous study conducted by Loftus and her former colleague at The University of Washington, participants were shown a video clip of a car crash. After watching the video, participants were asked questions pertaining to the accident they had just witnessed. For instance, some participants were asked "about how fast were the cars going when they *hit* into each other" while other participants were asked "about how fast were the cars going when they *smashed* into each other" (Loftus & Palmer, 1974). When participants were questioned a week later about the accident, those who were asked whether the cars *smashed* into each other believed that the cars were going faster than they actually were when they crashed. Likewise, those participants were also more likely to believe that there was broken glass at the scene when there actually was none.

This finding is better known as the *misinformation effect*, which asserts that people who are given misinformation, or incorrect or suggestible information, after-the-fact can be led to believe that the event was different than it actually was. This study was the first of its kind to seriously investigate the credibility of eyewitness testimony and whether memories can be

altered by the information being supplied to witnesses after the event. Furthermore, this study effectively showed that the way questions about events are worded, either through suggestibility or through leading wording, can significantly alter people's memories of the event itself.

Since the inception of this study, Loftus has continued to do research in the area of false memories. The implications of her research have been insurmountable, ranging from food preferences and "repressed" memories in therapy to the reliability of eyewitness testimony (Bekerian & Bowers, 1983; Bernstein, Pernat, & Loftus, 2011; Clifasefi, Bernstein, Mantonakis, & Loftus, 2013; Loftus & Ketcham, 1996). In fact, she has been active in the judicial system in testifying against the use of eyewitness testimony. To date, Loftus has testified in over 250 cases, some as infamous as the trials of serial killer Ted Bundy, O.J. Simpson, the Oklahoma City bombing, and even the litigation of Michael Jackson (Zagorski, 2005).

False memories are critical in the scope of the courtroom. Through methods like the misinformation effect, juries and eyewitnesses can be easily manipulated by lawyers and police officers, either intentionally or unintentionally, to alter their testimony. This quickly becomes an ethical dilemma when it comes to the integrity of our court system. The 7th Amendment of the United States Constitution effectively established a judicial system that introduced a "trial by jury" format in civil cases, meaning that a panel of peers ultimately decides your fate under the eyes of the law. This premise, though great in theory, is a prime example of how even our Founding Fathers were misguided by the assumption that memory is incorruptible and infallible. Many people, even in our contemporary world, falsely believe that memory operates like a videotape, recording in a perfectly linear fashion our every move and can be played back to you later in that exact same way. Rather, as people like Loftus have pointed out, memory is a highly constructive process that is susceptible to being altered at any stage of the memory process: from

the emotions present at the moment the memory is formed to who you are with while the memory is being stored, and, as the misinformation effect suggests, the framing of the words that are being presented to you when the memory is being retrieved.

Statistics show us that in the United States alone, around 200 people a day become criminal defendants based on eyewitness testimony (Gross, Jacoby, Matheson, & Montgomery, 2004). According to the Innocence Project, a nonprofit organization seeking to end the wrongful conviction and imprisonment of innocent people, as of 2012, DNA evidence has exonerated 341 people who were wrongly convicted and who served an average of 13 years in prison for crimes they did not commit. As much as 75% of these convictions involved eyewitness testimony (Goldstein, 2014). It is no coincidence that the shockingly high number of wrongful convictions are in some way tied to our over-reliance, and therefore over-confidence, in eyewitness testimony. Our blind trust and faith in our own memories, and the memories of others, are often a fatal flaw of human psychology, deeply rooted in the misconception that memory operates like a videotape. As cognitive psychologist Dr. Bruce Goldstein stated, “many of these miscarriages of justice and others, some of which will undoubtedly never be discovered, are based on the assumption, made by jurors and judges, that people see and report things accurately” (2014). In other words, while we think our memory is reliable, more often than not, it is entirely unreliable.

Some areas where the integrity of our judicial system has been especially challenged is with sexual assault allegations and with so-called “repressed memories.” As with any memory from your adult life, false memories from early childhood experiences can also be created by suggestion. This issue of repressed memories of childhood trauma and sexual abuse came to its peak during the 1990s, when numerous cases regarding this subject matter came forward that

challenged the psychological community and even the broader popular culture about our long-held beliefs about how memory truly functions.

I first became aware of this controversy when I watched the Netflix documentary series called “The Keepers,” which I would highly recommend you watch after reading this thesis. This seven-part docuseries centers around the cold case of Sister Catherine Cesnik, a nun and school teacher at Archbishop Keough High School in Baltimore, Maryland, who was brutally murdered in 1969 (Riddick, 2017). It is heavily implied, if not explicitly suggested, throughout the series that the Head Master of the school, Father Joseph Maskell, may have had something to do with Cesnik’s eerie disappearance. In the third episode of the series, entitled “The Revelation,” it is exposed that a couple of women who had formerly attended Archbishop Keough High School around the time of Cesnik’s murder were alleged victims of sexual abuse by none other than Father Joseph Maskell, who was also under suspicion for the murder of Catherine Cesnik. In 1996, decades after these women had attended Archbishop Keough, several of these “Jane Does” came forward and provided evidence to suggest that they were victims of sexual abuse by Father Maskell. This case, properly titled *Jane Doe et al. v. A. Joseph Maskell et al*., started an ongoing conversation about false memories and sexual trauma in the psychological community that continues to this day (*JANE DOE, ET AL. v. A. JOSEPH MASKELL, ET AL.*, n.d.).

In the litigation of the case, the main concern that the prosecution presented was why these women, who had apparently experienced such intense and traumatic abuse, had not come forward sooner. Was it that they had repressed the abuse from their memory, perhaps? In the state of Maryland, as well as many other states throughout the United States, there is a strict statute of limitations barring victims from coming forward and claiming sexual abuse after a certain amount of time has passed. In theory, this statute was implemented to try and prevent

false allegations from coming forward. In other words, the prosecution was trying to implicitly argue that these victims were either faking their claims or were subject to the forgetting clause of the statute of limitations; both of which would be due cause for the dismissal of their claims. The defense, in turn, argued that due to the severity of the incidences, most of these victims actually "repressed" the trauma, and with news of the Cesnik case again coming to the forefront, something caused these memories to resurface rather than simply be forgotten.

Repression is a psychoanalytical term originally popularized by Freud that is technically classified as a defense mechanism (Freud, 1957). People who supposedly repress memories are attempting to redirect unacceptable or unpleasant thoughts from the conscious mind to the unconscious; thereby, avoiding the potential stress or anxiety associated with that particular thought. The defense was trying to establish that these women did not just simply or passively forget their abuse; however, they had actively repressed these memories, which were later able to be triggered and retrieved. In their minds, there was a critical distinction to be made between the psychological concepts of forgetting and repression. However, the results of the case suggested differently:

> "After reviewing the arguments on both sides of the issue, [the court is] unconvinced that repression exists as a phenomenon separate and apart from the normal process of forgetting. Because we find these two processes to be indistinguishable scientifically, it follows that they should be treated the same legally. Therefore, we hold that the mental process of repression of memories of past sexual abuse does not activate the discovery rule. The plaintiffs' suits are thus barred by the statute of limitations" ("COURT DECISION ON RECOVERED MEMORY THEORY," n.d.).

In other words, this trial, though on the outside appeared to be merely a case involving sexual assault allegations and a blatant misconduct of power, was deeply rooted in psychological theory. The court essentially ruled that there was no difference in the cognitive processes of repression or forgetting; therefore, the defense's claim that these women's testimony should not subject to the statute of limitations was not granted. This ruling dramatically shifted the way cognitive psychologists, and the general public, thought about memory and memory errors.

After this trial, the American Psychological Association (APA) issued many statements in an attempt to clarify some of the cognitive and legal discrepancies between forgetting, repression, memory, and false memories. According to the APA,

> "It's important to state that there is a consensus among memory researchers and clinicians that most people who were sexually abused as children remember all or part of what happened to them although they may not fully understand or disclose it. Concerning the issue of a recovered versus a [false memory], like many questions in science, the final answer is yet to be known. But most leaders in the field agree that although it is a rare occurrence, a memory of early childhood abuse that has been forgotten can be remembered later. However, these leaders also agree that it is possible to construct convincing [false memories] for events that never occurred. The mechanism(s) by which both of these phenomena happen are not well understood and, at this point it is impossible, without other corroborative evidence, to distinguish a true memory from a false one" ("Questions and Answers about Memories of Childhood Abuse," n.d.).

This statement from the national organizing body of psychology is a critical clarification of how false memories may operate, especially in context of sexual abuse cases. While it should be noted that the vast majority of the claims of early sexual abuse are not fake, many do not come

forward initially because they may not have the vocabulary to describe what has happened to them or may be uncomfortable or even scared to disclose the abuse. This is especially true if the victim was a child at the time of the incident. The real issue here isn't whether or not the abuse has happened. Rather, if the details of the incident are indeed reliable, they, like most other memories, were subject to the normal forgetting process; thereby, making them vulnerable to becoming false memories. As of yet, there is still no clear-cut answer to this question that has continued to plague the psychological community.

Outside the psychological community, Loftus has received harsh criticism for the way she has testified against eyewitness testimony and acquitted many people for lack of credible evidence who otherwise would have been incarcerated. In fact, she has received hate mail, death threats, been accused of satanic rituals, conspiring against the government, and has even had to have protection by security guards while giving invited talks and presentations (TED). At one conference, Loftus herself even said something along the lines of not wanting to "wear my best jacket because of a fear of flying tomatoes" ("Elizabeth Loftus," 2019). As you can probably tell from this circumstantial case, Loftus, as well as several leading researchers of memories and false memories, have been extensively criticized for their research within the psychological community, the court system, and beyond. For one, the morality of many of Loftus' early studies in particular, like the car crash experiment mentioned earlier, have been deeply scrutinized by many psychologists who thought that manipulating people's memories was unethical.

Regardless of the criticism Loftus has received, she is truly one of the most influential figures in my life. She can be accredited to the deep fascination with memory, especially in everyday failures of memory, that has continued to haunt me since high school. The idea that core memories that you hold so near and close to your heart, such as the day you graduated

college, your wedding day, or the birth of your child, can actually be filled with discrepancies and inaccuracies is both terrifying and absolutely captivating to me. I also find the area of false memories so captivating for the significant implications they have in our court system. As an advocate for victims, especially with regards to sexual assault, I often struggle with negotiating my deeply held conviction and desire to support and believe others with my knowledge of the research in false memories. When I started planning what I wanted to do for my thesis when I first came to the Regis University's Honors Program, I knew from the first day of college that I wanted to incorporate false memories somehow into the picture. I just had no idea how I was going to do that. It wasn't until I took a class in the Psychology of Gender that I realized how I could shed a new light on one of my favorite areas of research.

Along with my love of false memories, I quickly realized my passion for gender research in the Psychology of Gender class. In this class, we learned about how gender stereotypes often affect our judgment of others and how this can eventually lead to problems at a systemic level. For instance, one of the most common gender stereotypes (and myths) is that "women are bad at math." Various theories in the field of psychology suggest that this idea, though completely implicit in nature, may be one of the root causes for why there are so few women represented in the fields of science, technology, math, and engineering (STEM). It is not a lack of ability; rather, it is a matter of stereotyping that may account for the disparity.

This got me thinking. If false memories can account for concepts as wide reaching as faulty eyewitness testimony and debatable abuse allegations, could this also mean that people could hypothetically be led to believe other things? For instance, could women be led to believe that they had a negative experience in a STEM subject, which in turn would make them less likely to enter a career in that field? My thesis strives to tackle questions such as these in a way

that brings my two passions of false memories and gender into conversation. I hope that by reading this thesis, you get a glimpse into two areas of psychology that are rich in research and have crucial implications in so many different areas of life. Hopefully, you will enjoy reading it as much as I loved researching, collecting data, and writing about it. If nothing else, perhaps you will have a false memory about enjoying it.

Abstract

False memories and gender stereotypes were used to investigate if inducing a false memory of having a negative experience in a STEM field would affect participant's preferences pertaining to the field. Women were recruited or volunteered to participate in the study. In the first session, participants completed a series of questionnaires to gauge their pre-existing experiences and attitudes towards STEM and non-STEM related subjects (n = 268). In the second session, participants whose responses from the first survey qualified, were randomly assigned to either the control (n = 74) or experimental condition (n = 71). Participants received a history profile that they were told was personalized to them, but it was actually a generic list of items. In the experimental condition, one of the critical items on the profile told the participant that they "had a negative experience in a math class". Participants then were asked to elaborate on and justify this false experience. Participants in the experimental condition ended the experiment with a task used to evaluate if the false memory was successful. They then completed all of the measures used in the first session again to compare how their experiences and attitudes towards STEM items may have changed since exposure to a false memory. Results indicated that the false memory was successfully implanted, as indicated by a memory and belief that the false event (i.e., having a negative experience in a math class) occurred, but this did not transfer to altered preferences regarding STEM.

False Memories, Stereotype Threat, and Gender Stereotypes

A vast amount of research exists pertaining to gender representation in certain academic subjects and career paths. For example, women have an especially high attrition rate in various science, technology, engineering, and mathematics (STEM) fields. This is especially true for college-aged students, where we see a two-fold increase in dropout rates for women math majors, for example, when compared to men who are majoring in math (Oswald & Harvey, 2000). Along those lines, women tend to harbor more negative feelings about mathematics and other related fields than men (Ashcraft, 2002). Likewise, regardless of gender, mathematics and other STEM-related subjects continue to be regarded as a more stereotypically "masculine" domain (Leader, 1986).

People who aspire to be involved in fields that do not adhere to their expected occupational roles face many barriers. These barriers are especially damaging to those in historically marginalized groups, like women for instance (Luzzo & McWhirter, 2001). People in gender-incongruent fields (e.g., a woman who is a surgeon) are often perceived as being less competent than people who are employed in a field considered to be consistent with their gender. Women who are successful in stereotypically masculine domains often face the predicament of being seen as unlikable or being viewed as incompetent; more often than not, they are seen as both (Brescoll, Dawson, & Uhlmann, 2010).

While there are many variables that account for why women are so underrepresented in the STEM fields, one possible explanation could be related to stereotype threat. Stereotype threat is the idea that if you are presented with a stereotype relevant to yourself, your concern about confirming that stereotype will actually make the behavior more likely to happen (Deemer, Thoman, Chase, & Smith, 2014). Even if you do not explicitly believe or uphold the stereotype,

implicit biases can still confirm the stereotype under conditions of stereotype threat. For instance, when a gender stereotype is presented, it can activate stereotype threat in a way that alters behavior to act more in accordance with the stereotype. Numerous studies have shown that inducing stereotype threat in women can have very diverse consequences such as scoring lower on math tests (Schmader, 2002), undermining their leadership aspirations (Davies, Steele, & Spencer, 2005) and lessening their interest in pursuing stereotypically masculine occupations (Rudman & Phelan, 2010).

False memories are memories of events that never actually occurred, but the participant was led to believe that they did (Loftus & Pickrell, 1995). This can be done through a variety of different paradigms, such as through suggestibility and misinformation. This finding demonstrates that false memories, though completely fabricated in nature, can still have a significant impact on a person's future behavior. To illustrate this, in one study, people who were led to believe they had been sick after drinking certain types of alcohol were found to have less preference for that type of alcohol after the false memory was implanted (Clifasefi et al., 2013). In general, people are more likely to have both true memories and false memories that are consistent with their own predisposed stereotypes (O'Connell & Greene, 2017). In other words, people are likely to unknowingly alter and assimilate their memories to be in accordance with their preexisting beliefs, regardless of whether those beliefs are accurate.

One study found that when participants saw a list of either stereotypically female or stereotypically male roles, like "quiet" for a female, it led to an increase in the false recognition of words not present on the list that were still consistent with that stereotype (Lenton, Blair, & Hastie, 2001). For example, participants with strong implicit stereotypes were more likely to falsely remember words such as "secretary" and "nurse" that seemingly fit in the feminine

stereotype. False recognition of gender stereotypic words was especially evident when the gender of the participant matched the gender role of the stereotyped words, suggesting that people can hold gender stereotypes about their own gender. In sum, even though the gender of the participant may increase the recall of gendered stereotyped words, it can also lead to false memories. In other words, even indirect associations can drastically influence the reliability of your own memory, which can in turn influence your attitudes towards gender stereotypes in various occupational settings (Tsukimoto, Hasimoto, Karasawa, & 2011).

Overview of the Present Study

Although there is an abundance of research on false memories and stereotypes, there is little research on the relationship between false memories and stereotype threat. In other words, there is little research examining the idea that false memories can be a potential source for why one's behavior can often conform to stereotypes relevant to themselves (e.g., how having a false memory pertinent to STEM may lead to more women opting out of STEM fields).

The purpose of this study is to investigate if inducing stereotype threat through a false memory paradigm can reinforce gender stereotypes and lead to a change in preference for those in certain college courses and career paths. In other words, this study will assess if creating a false memory about experiences within science fields can have an effect on females' behaviors and preferences pertaining to this field.

Through this study, I initially gauged the participant's previous experiences and opinions relevant to STEM-related subjects. Then, I attempted to implant a false memory in some of my participants that they had a negative experience in a math class when they were younger when they actually had not reported having a negative experience. I hypothesized that the false

memory would be successfully implanted and that this would result in a decreased preference towards STEM-related subjects.

Method

Participants

Prior to experimentation, participants were randomly assigned to the experimental or control condition. This was done via a random number generator. Participants who scored less than 4 on the first critical question (negative experience in a math class) and greater than 6 on the other critical question (positive experience in a math class) on the Life Events Inventory were excluded from the experimental condition. This was to avoid including people who already report having a memory of a negative experience in a math class from being placed in the experimental condition where they were asked to form a false memory about that same exact scenario.

A total of 268 participants took the first survey. All participants were women over the age of 18. Those that participated were either from Regis University or were invited to participate by the primary researcher. They were either recruited from the General Psychology and Neuroscience Subject Pool and received course credit for participation or were volunteers who received financial compensation in the form of $5.00 per survey.

Each participant that qualified to take the second survey was randomly assigned via random number generator to either the experimental or control condition. A total of 145 out of the initial 268 (54.1%) participants qualified for the second survey. A total of 71 participants were assigned to the experimental condition and the remaining 74 were assigned to the control condition. Of the 145 total participants that qualified for the second survey, only 122 (84.1%)

actually completed the full survey, including the critical questions, so the remaining 23 participants' data were excluded from final analyses.

Materials

Science Motivation Questionnaire. The Science Motivation Questionnaire (Appendix A) measures self-efficacy within the field of science by asking questions like "I am confident I will do well on the science tests" on a scale of 1 to 5, with 1 being "Never" and 5 being "Always" (Glynn, Taasoobshirazi, & Brickman, 2009).

Intended Research Involvement. The Intended Research Involvement scale (Appendix B) measures intrinsic research interest by asking questions about the likelihood of the participant pursuing research opportunities, with 1 being "Not likely at all" and 5 being "Very likely." I also added a free response question where participants are asked to state their intended major. This measure was also adapted from Glynn, Taasoobshirazi, and Brickman (2009).

Science Career Intent. The Science Career Intent (Appendix C) question is a dichotomous question used to assess participant's intentions to pursue a career in a science field. This measure was also adapted from Glynn, Taasoobshirazi, and Brickman (2009).

Life Events Inventory. Participants also took a 20-item Life Events Inventory (Appendix D), which asked the participant to respond to a range of questions pertaining to scholastic events that happened before the age of 18 with 1 being "Definitely did not happen" and 8 being "Definitely did happen." This was derived and developed from the research of Clifasefi et al. (2013).

Preferences Inventory. Finally, the Preferences Inventory (Appendix E) gauges their preferences regarding different types of subjects, including math. The Preference Inventory was also derived and developed from the research done by Clifasefi et al. (2013).

Individualized History Profile and Experimental Manipulation. For the second session, participants were given an Individualized History Profile (Appendix F). The profile will have 4 statements total regarding the participant's responses from session 1. The critical question for those in the experimental condition was #3, which reads "You had a bad experience in a math class." In the control group, #3 was a generic item that read, "You felt proud of your academic accomplishments." This is adapted from Clifasefi et al. (2013).

Elaboration Exercise and Memory or Belief Task. Participants in both conditions were given an Elaboration Exercise (Appendix G) where they were asked to elaborate on the third item on their profile. For those in the experimental condition, this was regarding the negative experience they had in a math class, while those in the control group were asked to elaborate on feeling proud of their academic accomplishments. An Additional Question (Appendix H) was asked to all participants about another negative incident that was not on the profile. This was used primarily as a manipulation check. Finally, a Memory or Belief Task (Appendix I) was given to indicate if the participants had a memory of different events, believed the event of having a negative experience in a math class actually occurred, or believed the event never occurred. This is adapted from Clifasefi et al. (2013).

Procedure

As part of the cover story for the experiment, participants were told that they were participating in a study to assess their preferences of different types of classes. Participants took both surveys 1 and 2 via an online survey administered through Survey Monkey. In the online session 1 questionnaire packet, participants first took the Science Motivation Questionnaire, to which they responded to each statement on a Likert scale ranging from 1 to 5, with 1 being "Never" and 5 being "Always." They then took the Intended Research Involvement Scale and

respond to each statement on a scale ranging from 1 to 5, with 1 being “Not likely at all” and 5 being “Very likely.” Next, they took the Science Career Intent Questionnaire. After this, participants were asked to take the Life Events Inventory and rank statements on a scale of 1 to 8, with 1 being “Definitely did not happen” and 8 being “Definitely did happen.” To conclude the first session, participants filled out the Preferences Inventory. This session took an average of 8 minutes to complete.

For the second session, participants were emailed the second survey a week after completing the first survey. The participant was first shown an Individualized History Profile. Through this, participants were told that the profile was created using a sophisticated computer program, but all profiles were actually identical to those in their same condition, being either the control or experimental condition. This methodology directly replicates that of Clifasefi, et al. (2013). Participants then elaborated on this profile via the Elaboration Exercise. These two measures attempted to implant a false memory regarding a negative experience in a math class. Next, the Additional Question was presented in an effort to conceal the hypothesis from the participant. Participants then answered the same questions from session 1. Then, the Memory or Belief Task was taken, and participants were asked what they thought the purpose of the study was. These sessions took an average of 13.5 minutes to complete, with an average of 12 minutes for the experimental group and an average of 15 minutes for the control group. As previously stated, this method is a replication of Clifasefi, et al. (2013).

Results

Analyses focused on the change in preferences for STEM-related items, as well as the memory or belief pertaining to having a negative experience in a math class. This allowed for the examination of how the participant’s preferences pertaining to STEM fields may have been

swayed after the false memory, as well as how successful the implantation of the false memory actually was; in other words, how strongly the participant remembered and believed that they had a negative experience in a math class, although this was fabricated.

After participants participated in the first survey, those who were eligible to participant in the second session were randomly assigned to either the experimental condition, which received the false memory, or the control condition, which did not receive a false memory. Therefore, each participant did 2 total rating scores of their preferences throughout the duration of the experiment. Since the main area interest was examining how the participant's preferences towards STEM were changed after a false memory, their preference scores across the 2-survey session were compared to quantify this phenomenon.

Question 1: Is it possible to plant a false memory about a negative experience in a math class?

Scores were examined with a 2 x 2 (Condition [experimental condition, control condition] x Time [session 1, session 2]) repeated measures analysis of variance (ANOVA). This ANOVA revealed that there was an interaction between the condition and time with regards to having a negative experience in a math class, $F(1, 116) = 66.58$ $p < .001$. Those in the experimental condition were more strongly convinced that they had actually had a negative experience in a math class after receiving the false memory than the control condition, who did not receive the false memory (Figure 1). Ultimately, this suggests that the false memory was successfully implanted.

Chi-square tests were also performed on the Memory and Belief tasks to determine whether the false memory was successfully implanted. Specifically, I tested whether participants

in the experimental condition were more likely than controls to report that they had "a memory" of a negative experience in a math class, or that they had "a belief" that this negative experience may have occurred. A significant effect was found for memory, X^2 (1, N = 122) = 8.94, p = .003; those in the experimental condition were more likely than controls to have a memory of having a negative experience in a math class than those in the control condition. Likewise, a significant effect was found for belief, X^2 (1, N = 117) = 9.92, p = .002. Those in the experimental condition were more likely than controls to have a belief that the event (the negative experience in a math class) actually occurred (Figures 3 and 4). As expected, there was no significant difference between the experimental group and controls on the third item, X^2 (1, N = 117) = .64, p = .43; the groups were equally likely to say that they believed the event never occurred.

Question 2: Will those exposed to the false memory change their STEM preferences?

As anticipated, there was no difference between the experimental or control conditions for non-STEM related preferences over time, $F(1, 120) = 1.11$, $p = .295$. Contrary to my hypothesis, there was also no difference between the experimental and control conditions for STEM-related preferences over time, $F(1, 120) = .23$, $p = .63$; however, there was a significant main effect of time, such that both groups demonstrated a decreased preference for STEM-related items over time $F(1, 120) = 17.11$, $p < .001$ (Figure 2).

Question 3: Is this effect moderated by participants' original career plans?

To determine the contributing factors of science motivation, research involvement, and science career intent, I ran a series of linear regressions. Overall, there was no significance in any of the moderator variables that were examined.

Controlling for all other factors, science motivation was not predictive of either the participant's view that they had a negative experience in a math class or their change in STEM preferences, $\beta = .404$, $t(114) = 1.20$, $p = .392$; $\beta = -.589$, $t(118) = 1.20$, $p = .557$. Furthermore, the participant's aspirations for research involvement were also not predictive of their reporting of a negative experience in a math class or their change in STEM preferences, $\beta = -.170$, $t(114) = -.490$, $p = .625$; $\beta = .034$, $t(118) = .117$, $p = .907$. Finally, the participant's science career intent was also not predictive of their reporting of a negative experience in a math class or their STEM preferences, $\beta = .429$, $t(114) = 1.08$, $p = .284$; $\beta = .-376$, $t(118) = -.849$, $p = .397$.

In other words, none of these variables significantly influenced the participant's view that they had a negative experience in a math class, which also didn't influence their STEM preferences.

Discussion

This study suggests that it is possible to implant a false memory about having a negative experience in a math class in female undergraduate students. In other words, false memories regarding negative experiences in STEM can indeed be implanted, which can influence someone's memory and beliefs pertaining to a particular field. However, interestingly enough, this did not translate to an altered preference for that same field.

Research Question 1

With regard to the first research question of if false memories can be successfully implanted regarding a negative experience in a math class, it was found that false memories can

successfully be implanted. This was evident in the results of the study, whereby those in the experimental condition were more likely to report a memory of a negative experience in a math class over the course of the study. Furthermore, participants in the experimental condition reported a stronger memory and belief for this negative experience than those in the control, meaning that they were more likely to genuinely believe that the false memory was actually true.

In the elaboration portion of the study, which was used in attempt to enhance the acquisition of the false memory, many participants in the experimental condition described various personal experiences that at first may not have seemed so bad, but in retrospect, could be considered negative. Some involved explicit mentions of bias from teachers or fellow students, while others were more covert in nature. One participant discussed a time when she had a teacher who was certainly qualified to be teaching math, but who wasn't very easy to follow. This participant said "my teacher was very, very smart but didn't know how to communicate what he knew. The class moved very quickly, so it was too easy to fall behind."

While many of these responses were focused on more direct situations like the ones previously mentioned, some participants claimed that they did not necessarily remember having a negative experience per say but would then go into extensive detail about an imagined or hypothetical event. For instance, one participant said,

> I don't necessarily remember what the experience was, but I can imagine the situation. I used to love math growing up but I remember going into [pre-calc] as a high schooler and feeling very unsupported in that class. My teacher just wasn't helpful and didn't attempt to change up his teaching style for anyone.

This demonstrates that even though this participant reported not having a negative experience in a math class initially, the act of elaborating on this event, though fabricated, can later influence

their memory and belief pertaining to the field. This finding is consistent with previous literature, which suggests that the act of elaborating on an experience, even if completely false in nature, can subtly convince someone that the experience they are describing is true simply by making it feel more vivid and personal (Drivdahl & Zaragoza, 2001; Drivdahl, Zaragoza, & Learned, 2009; Zaragoza, Mitchell, Payment, & Drivdahl, 2011).

Research Question 2

With regards to our second research question, my analyses next focused on if the exposure to the false memory would then translate to a change in preferences for a STEM field. Even with the false memory being effectively implanted, surprisingly, the results suggest that this did not influence participant's preferences regarding STEM (Figure 2). Interestingly, both groups displayed a similar decreased preference for STEM over time, but there was no significant difference between the experimental or control groups. This finding is inconsistent with much previous research, which suggests that false memories about negative items should decrease your preferences regarding related items (Bernstein & Loftus, 2009; Bernstein et al., 2011; Geraerts et al., 2008). However, there is some evidence to suggest that false memories can be successfully implanted without influencing later preferences in certain scenarios. For instance, in one study, it was determined that only false memories about plausible events, or events that participants could realistically imagine having happened to them, lead to a change in their attitude. Meanwhile, implausible events, though determined to be successfully implanted, did not influence the participant's attitudes (Pezdek, Blandon-Gitlin, & Gabbay, 2006).

When considering the context of this study, this could mean that although the false memory of having a negative experience in a math class was successfully implanted, if the participant viewed this false memory as implausible in some way, it may not have influenced

their attitudes regarding STEM. Alternatively, this study may build on previous literature and complicate the preconceived notion that false memories automatically translate to altered attitudes or behaviors about that particular memory.

Another possible explanation for why the false memory was successfully implanted but didn't translate to altered preferences for STEM could be that the way preferences were evaluated may not have been an entirely valid measure. For instance, by just assessing if the participant would be willing to take certain classes may not translate that well to long term preferences regarding STEM in a real-world setting. If this were the case, the validity of the results may be flawed, which could have drastically impacted the results of the present study. If the measure could be revised in future studies, for instance by assessing if the participant's actual later course registrations are impacted by the false memory acquisition, this may potentially result in a changed preference for STEM in another way.

Research Question 3

Additionally, with regards to the third research question, it was found that none of the variables examined, such as major, science motivation, science career intent, or research involvement, were found to be moderators to the results reported above. In other words, the results were equally as impactful to all participants in the study, regardless of their particular career path or standing within the field of STEM. Furthermore, this implies that all participants in the study were equally as susceptible to the implantation of the false memory that was being suggested, but in a way that didn't impact their later preferences.

These results seem to counter the commonly held notion that certain people are more likely to be deterred from a field or career path. For instance, a previous study by Crocker, Karpinski, Quinn, and Chase (2003) showed that people who place a high degree of their self-

worth to a particular field take failures in that field much harsher than those who don't. When these people get bad grades, especially for women who strongly identify with a gender-incongruent field (e.g., engineering), this can lead to a huge drop in self-esteem. Interestingly, however, this study also highlighted that while this can lead to a drop of self-esteem, this does not lead to less identification with that field (Crocker, Karpinski, Quinn, & Chase, 2003).

Though the authors of this study did not explicitly mention this, there is evidence to suggest that these women could have experiened the phenomenon of *stereotype lift*. Opposite of stereotype threat, stereotype lift is the idea that when peeople are exposed to stereotypes about themselves, their behavior may actually work in a way that diametrically opposes that stereotype rather than conforms to it (Crisp, Bache, & Maitner, 2009; Martens, Johns, Greenberg, & Schimel, 2006; Shih, Pittinsky, & Ho, 2012). For instance, if a woman was reminded of the stereotype that "men are better at math," in a stereotype lift scenario, the women might actually perform better in a math test after exposed to the stereotype. This could be one of the reasons why the women in this study exhibited signs of a false memory but without a significant change in their STEM-related preferences. In other words, even though they were falsely convinced that they had a negative experience in a math class, stereotype lift could have been inacted in these participants such that rather than significantly diminishing their future STEM-related preferences, they didn't actually disidentify with the field.

Limitations

As with any empirical project, this study was limited in a couple of ways. Although there is ample research on how presentation modality influences memories and false memories (Pezdek & Lam, 2007; Smith, Hunt, & Gallagher, 2008), there has been little research about how the use of computers, more specifically, influences the production of false memories. Being that

I used a computer as the means of both evaluating the participant's previous experiences and attitudes regarding STEM, and later attempt to implant a false memory about this field, my study was reliant on my methodology being sound. Since there is limited research on how effective false memories can be implanted when not done in a more personal, face-to-face setting, this could have potentially limited the results of this study.

Furthermore, another possible limitation of my study was the sample I used. Being that the participants in my study were all college-aged females, this limits the external validity of my results slightly. While this study aimed to show that having a false memory about a negative experience in a math class can impact a women's involvement in STEM fields, it is difficult to extrapolate the results of this study to a non-college aged demographic. For instance, to say that these results could apply to women already in the workforce, more specifically a STEM-related career, would be inconclusive.

Conclusion and Future Directions

Overall, even with the limitations considered, this study builds off the previous literature and has many important implications. Effectively, this study suggests that false memories regarding negative experiences in STEM can be implanted, which can influence one's memory and belief about a particular field. However, this does not translate to an altered preference for that field. As a whole, false memories may be a contributing factor to the leaky pipeline (Huyer, 2002) issue of women in STEM. Even though no change in STEM preferences was found, women were more convinced after exposure to the false memory that they had a negative experience in a math class, which could potentially alter their engagement in STEM in other ways that were not examined in the present study. This could have major consequences for the educational system and the workforce. Future studies should evaluate if this false memory study

can be replicated, and if a change in preferences for STEM could be demonstrated using a revised or new paradigm.

Figures

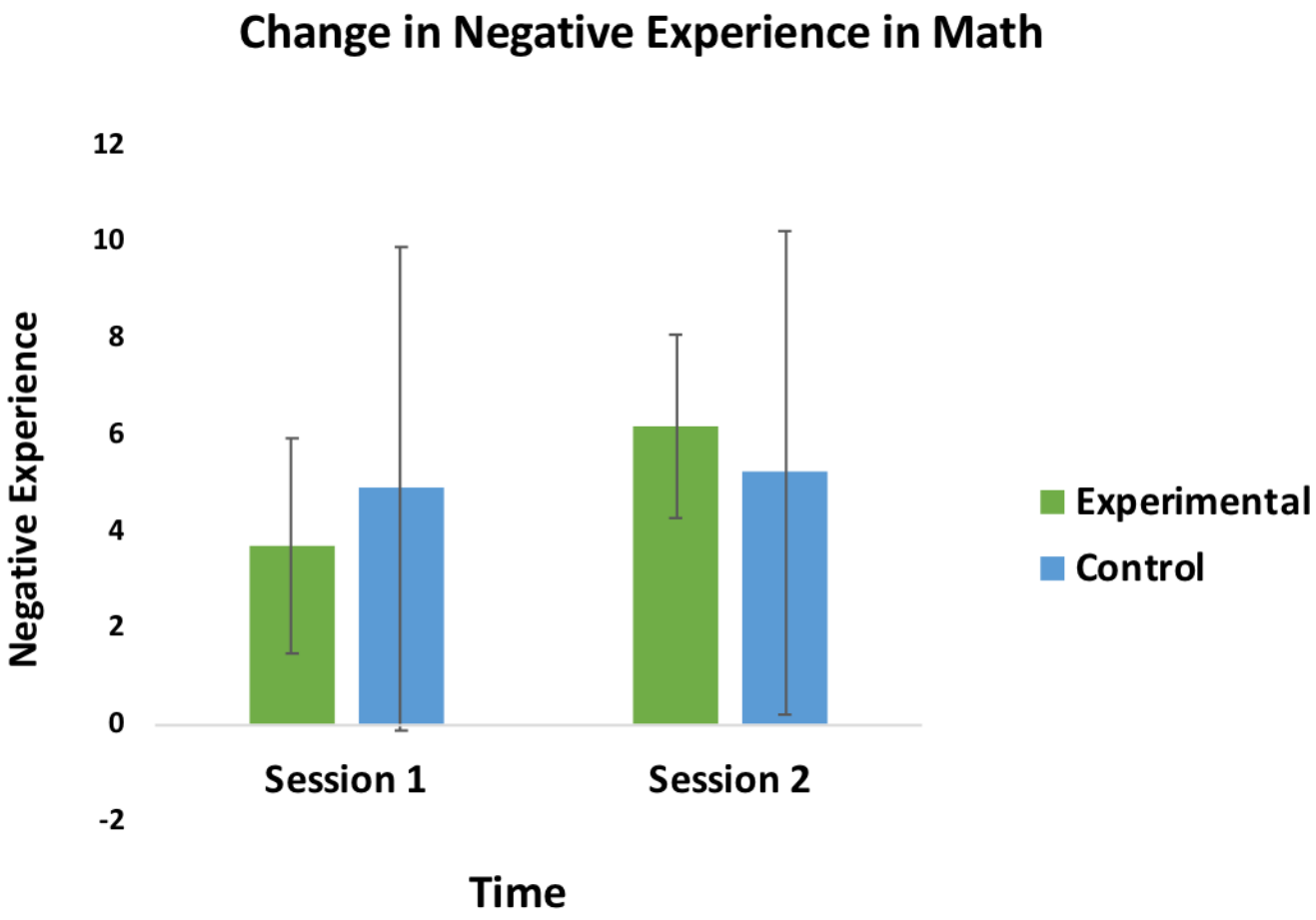

Figure 1: The change in participant's reporting of having a negative experience in a math class over time. Green bars represent the experimental condition, which received the false memory, while blue bars represent controls. Lines represent Standard Error.

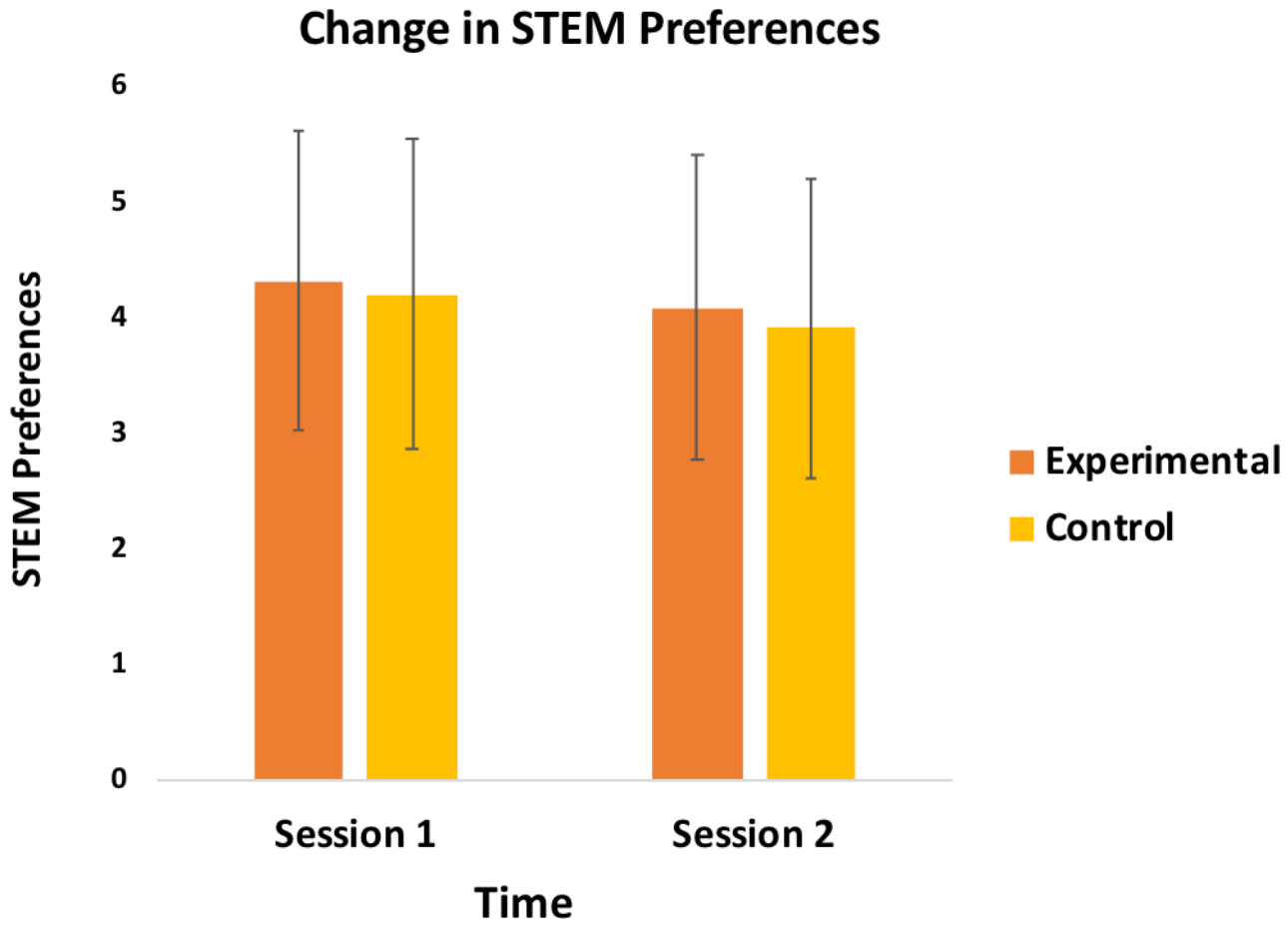

Figure 2: The change in STEM preferences over time between the experimental (orange) and control (yellow) groups. No significance is reported.

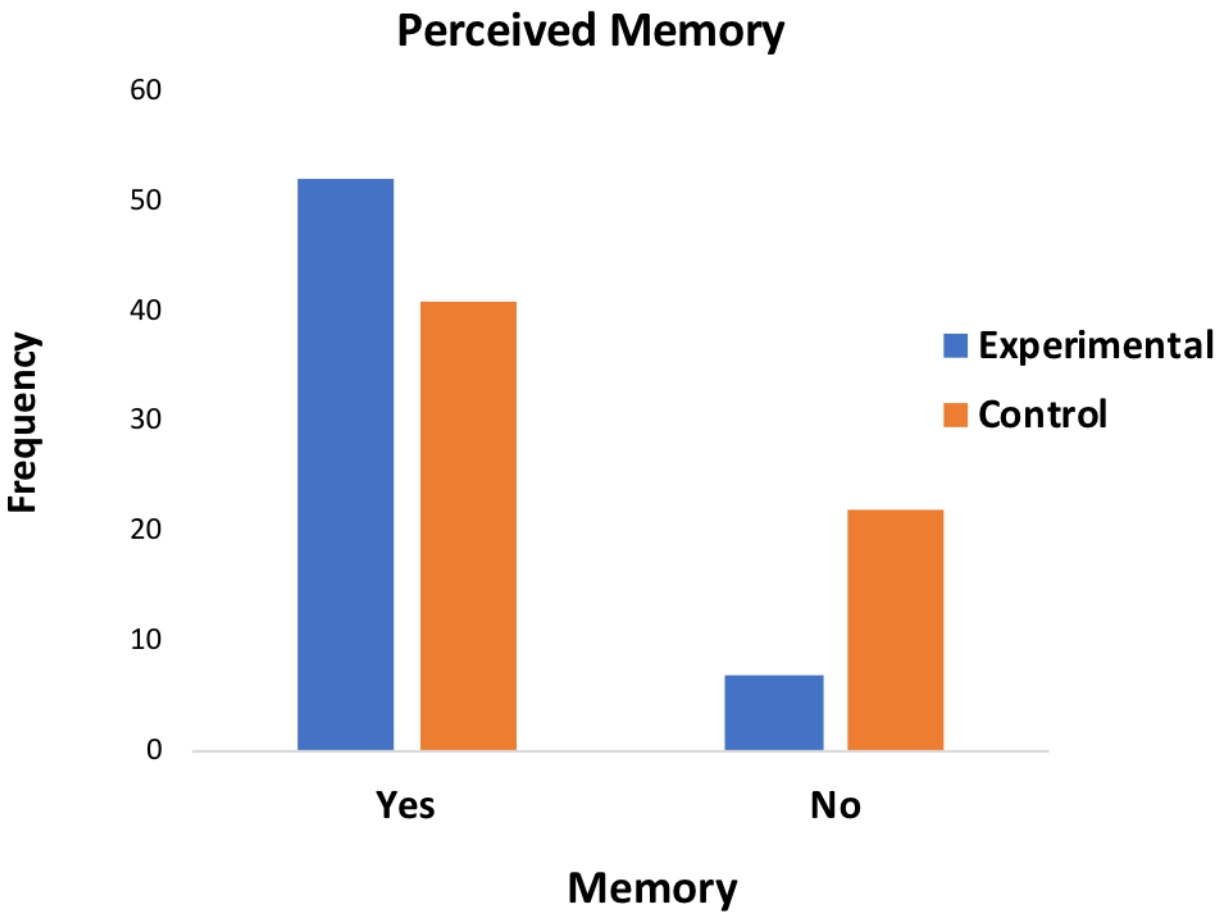

Figure 3: Chi-square analyses representing the participant's reporting if they have a memory of having a negative experience in a math class. Blue bars represent the experimental group, while orange bars represent the control.

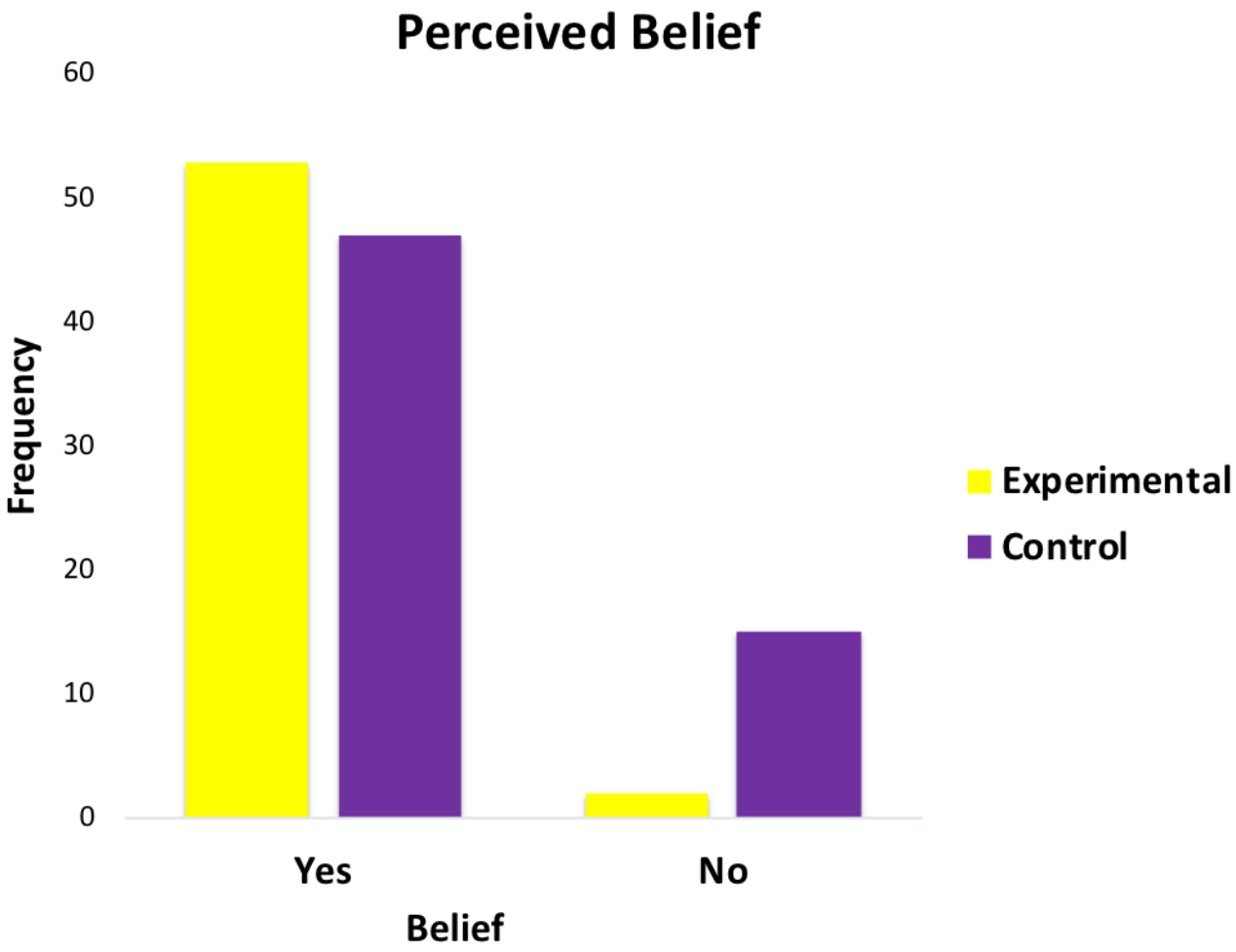

Figure 4: Chi-square analyses representing the participant's reporting if they have a belief of having a negative experience in a math class. Yellow bars represent the experimental group, while purple bars represent the control.

References

Ashcraft, M. H. (2002). Math anxiety: Personal, educational, and cognitive consequences. *Current Directions in Psychological Science, 11*(5), 181–185.

Bekerian, D. A., & Bowers, J. M. (1983). Eyewitness testimony: Were we misled? *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *9*(1), 139.

Bernstein, D. M., & Loftus, E. F. (2009). The Consequences of False Memories for Food Preferences and Choices. *Perspectives on Psychological Science, 4*(2), 135–139. https://doi.org/10.1111/j.1745-6924.2009.01113.x

Bernstein, D. M., Pernat, N. L. M., & Loftus, E. F. (2011). The False Memory Diet: False Memories Alter Food Preferences. In V. R. Preedy, R. R. Watson, & C. R. Martin (Eds.), *Handbook of Behavior, Food and Nutrition* (pp. 1645–1663). https://doi.org/10.1007/978-0-387-92271-3_107

Clifasefi, S. L., Bernstein, D. M., Mantonakis, A., & Loftus, E. F. (2013). "Queasy does it": False alcohol beliefs and memories may lead to diminished alcohol preferences. *Acta Psychologica*, *143*(1), 14–19. https://doi.org/10.1016/j.actpsy.2013.01.017

COURT DECISION ON RECOVERED MEMORY THEORY. (n.d.). Retrieved April 26, 2019, from http://www.religioustolerance.org/rmt_crt1.htm

Crisp, R. J., Bache, L. M., & Maitner, A. T. (2009). Dynamics of social comparison in counter-stereotypic domains: Stereotype boost, not stereotype threat, for women engineering majors. *Social Influence, 4*(3), 171–184. https://doi.org/10.1080/15534510802607953

Crocker, J., Karpinski, A., Quinn, D. M., & Chase, S. K. (2003). When Grades Determine Self-Worth: Consequences of Contingent Self-Worth for Male and Female Engineering and

Psychology Majors. *Journal of Personality and Social Psychology*, *85*(3), 507–516. https://doi.org/10.1037/0022-3514.85.3.507

Drivdahl, S. B., & Zaragoza, M. S. (2001). The role of perceptual elaboration and individual differences in the creation of false memories for suggested events. *Applied Cognitive Psychology*, *15*(3), 265–281. https://doi.org/10.1002/acp.701

Drivdahl, S. B., Zaragoza, M. S., & Learned, D. M. (2009). The role of emotional elaboration in the creation of false memories. *Applied Cognitive Psychology*, *23*(1), 13–35. https://doi.org/10.1002/acp.1446

Elizabeth Loftus. (2019). In *Wikipedia*. Retrieved from https://en.wikipedia.org/w/index.php?title=Elizabeth_Loftus&oldid=886490677

Freud, S. (1957). Repression. In *The Standard Edition of the Complete Psychological Works of Sigmund Freud, Volume XIV (1914-1916): On the History of the Psycho-Analytic Movement, Papers on Metapsychology and Other Works* (pp. 141–158).

Geraerts, E., Bernstein, D. M., Merckelbach, H., Linders, C., Raymaekers, L., & Loftus, E. F. (2008). Lasting False Beliefs and Their Behavioral Consequences. *Psychological Science*, *19*(8), 749–753. https://doi.org/10.1111/j.1467-9280.2008.02151.x

Goldstein, E. B. (2014). *Cognitive psychology: Connecting mind, research and everyday experience*. Nelson Education.

Gross, S. R., Jacoby, K., Matheson, D. J., & Montgomery, N. (2004). Exonerations in the United States 1989 through 2003. *J. Crim. l. & CrimiNology*, *95*, 523.

Huyer, S. (2002). The Leaky Pipeline: Gender Barriers in Science. *Engineering and Technology', Presentation at the World Bank Group, Gender and Digital Divide Seminars*, *15*.

JANE DOE, ET AL. v. A. JOSEPH MASKELL, ET AL. (n.d.). 19.

Loftus, E., & Ketcham, K. (1996). *The myth of repressed memory: False memories and allegations of sexual abuse*. Macmillan.

Martens, A., Johns, M., Greenberg, J., & Schimel, J. (2006). Combating stereotype threat: The effect of self-affirmation on women's intellectual performance. *Journal of Experimental Social Psychology*, *42*(2), 236–243. https://doi.org/10.1016/j.jesp.2005.04.010

Pezdek, K., Blandon-Gitlin, I., & Gabbay, P. (2006). Imagination and memory: Does imagining implausible events lead to false autobiographical memories? *Psychonomic Bulletin & Review*, *13*(5), 764–769. https://doi.org/10.3758/BF03193994

Pezdek, K., & Lam, S. (2007). What research paradigms have cognitive psychologists used to study "False memory," and what are the implications of these choices? *Consciousness and Cognition*, *16*(1), 2–17. https://doi.org/10.1016/j.concog.2005.06.006

Questions and Answers about Memories of Childhood Abuse. (n.d.). Retrieved April 26, 2019, from https://www.apa.org/topics/trauma/memories

Riddick, R. (2017). Keeping the Faith. *Conscience*, *38*(3), 1–5.

Shih, M. J., Pittinsky, T. L., & Ho, G. C. (2012). Stereotype boost: Positive outcomes from the activation of positive stereotypes. In *Stereotype threat: Theory, process, and application* (pp. 141–156). New York, NY, US: Oxford University Press.

Smith, R. E., Hunt, R. R., & Gallagher, M. P. (2008). The effect of study modality on false recognition. *Memory & Cognition*, *36*(8), 1439–1449. https://doi.org/10.3758/MC.36.8.1439

TED. (n.d.). *How reliable is your memory? | Elizabeth Loftus*. Retrieved from https://www.youtube.com/watch?v=PB2OegI6wvI

Zaragoza, M. S., Mitchell, K. J., Payment, K., & Drivdahl, S. (2011). False memories for suggestions: The impact of conceptual elaboration. *Journal of Memory and Language*, *64*(1), 18–31. https://doi.org/10.1016/j.jml.2010.09.004

Appendix A: Science Motivation Questionnaire

1. I expect to do well or better than other students in a science course

Never Rarely Sometimes Usually Always

2. I am confident I will do well on science labs and projects.

Never Rarely Sometimes Usually Always

3. I believe I can master the knowledge and skills in a science course.

Never Rarely Sometimes Usually Always

4. I believe I can master the knowledge and skills in a science course.

Never Rarely Sometimes Usually Always

5. I believe I can master the knowledge and skills in a science course.

Never Rarely Sometimes Usually Always

6. I am confident I will do well on science tests.

Never Rarely Sometimes Usually Always

7. I believe I can earn a grade of “A” in a science course.

Never Rarely Sometimes Usually Always

Appendix B: Intended Research Involvement Questionnaire

How likely would you be to do the following:

Pursue undergraduate research opportunities?

Not likely at all Unlikely Maybe Likely Very likely

Volunteer to work in a faculty research lab?

Not likely at all Unlikely Maybe Likely Very likely

Volunteer to work on a faculty member's research team?

Not likely at all Unlikely Maybe Likely Very likely

What is your intended major? (Please write answer below. If not sure, write "Undeclared.")

_____

Appendix C: Science Career Intent Questionnaire

I plan to pursue a career in science.

Yes No

Appendix D: Life Events Inventory

Please rate how certain you are that each event listed below has or has not happened to you before the age of 18:

1. Did well in a history class

2. Took at least one art class

3. Avoided taking physical education classes

4. Wrote essays

5. Took more than one foreign language class

6. Was involved in a music class (e.g. orchestra, band, choir, etc.)

7. Took at least one math class

1 2 3 4 5 6 7 8

Definitely did not happen Definitely did happen

8. Had a negative experience in a math class

1 2 3 4 5 6 7 8

Definitely did not happen Definitely did happen

9. Felt proud of your academic accomplishments

1 2 3 4 5 6 7 8

Definitely did not happen Definitely did happen

10. Were required to take a health class

1 2 3 4 5 6 7 8

Definitely did not happen Definitely did happen

11. Wanted to do well in school

1 2 3 4 5 6 7 8

Definitely did not happen Definitely did happen

12. Had a positive experience playing a sport

1 2 3 4 5 6 7 8

Definitely did not happen Definitely did happen

13. Felt accepted by other students

1 2 3 4 5 6 7 8

Definitely did not happen Definitely did happen

14. Had a negative experience in a science class

1 2 3 4 5 6 7 8

Definitely did not happen Definitely did happen

15. Wanted to take more English classes

1 2 3 4 5 6 7 8

Definitely did not happen Definitely did happen

16. Felt forced to take art classes

1 2 3 4 5 6 7 8

Definitely did not happen Definitely did happen

17. Was inspired by a teacher

1 2 3 4 5 6 7 8

Definitely did not happen Definitely did happen

18. Wanted to take fewer music classes

1 2 3 4 5 6 7 8

Definitely did not happen Definitely did happen

19. Felt forced to take foreign language classes

1 2 3 4 5 6 7 8

Definitely did not happen Definitely did happen

20. Enjoyed school overall

1 2 3 4 5 6 7 8

Definitely did not happen Definitely did happen

Appendix E: Preferences Inventory

Please rate the following types of classes based on how much you liked them:

1. Art

	1	2	3	4	5	6	7	8	
Definitely don't like	●	●	●	●	●	●	●	●	Definitely like

2. Biology

	1	2	3	4	5	6	7	8	
Definitely don't like	●	●	●	●	●	●	●	●	Definitely like

3. English

	1	2	3	4	5	6	7	8	
Definitely don't like	●	●	●	●	●	●	●	●	Definitely like

4. History

	1	2	3	4	5	6	7	8	
Definitely don't like	●	●	●	●	●	●	●	●	Definitely like

5. Chemistry

	1	2	3	4	5	6	7	8	
Definitely don't like	●	●	●	●	●	●	●	●	Definitely like

6. Algebra

	1	2	3	4	5	6	7	8	
Definitely don't like	●	●	●	●	●	●	●	●	Definitely like

Please rate the following classes on how much you would like to take them based only on their course titles:

1. "Art, Pop, and Culture"

	1	2	3	4	5	6	7	8	
Definitely don't like	●	●	●	●	●	●	●	●	Definitely like

2. "The Science of Fear"

	1	2	3	4	5	6	7	8	
Definitely don't like	●	●	●	●	●	●	●	●	Definitely like

3. "Conservation Biology"

1	2	3	4	5	6	7	8

Definitely don't like ○ ○ ○ ○ ○ ○ ○ ○ Definitely like

4. "Exploring Identity Through Literature"

1 2 3 4 5 6 7 8

Definitely don't like ○ ○ ○ ○ ○ ○ ○ ○ Definitely like

5. "Nuclear Technology and Climate"

1 2 3 4 5 6 7 8

Definitely don't like ○ ○ ○ ○ ○ ○ ○ ○ Definitely like

6. "Creative Writing"

1 2 3 4 5 6 7 8

Definitely don't like ○ ○ ○ ○ ○ ○ ○ ○ Definitely like

7. "Contemporary Mathematics"

1 2 3 4 5 6 7 8

Definitely don't like ○ ○ ○ ○ ○ ○ ○ ○ Definitely like

8. "Introduction to Printmaking"

1 2 3 4 5 6 7 8

Definitely don't like ○ ○ ○ ○ ○ ○ ○ ○ Definitely like

Please rate the following places on how much you would like to visit them:

1. An art gallery

1 2 3 4 5 6 7 8

Definitely don't like ○ ○ ○ ○ ○ ○ ○ ○ Definitely like

2. A science laboratory

1 2 3 4 5 6 7 8

Definitely don't like ○ ○ ○ ○ ○ ○ ○ ○ Definitely like

3. A library

1 2 3 4 5 6 7 8

Definitely don't like ○ ○ ○ ○ ○ ○ ○ ○ Definitely like

4. A music concert

1 2 3 4 5 6 7 8

Definitely don't like ○ ○ ○ ○ ○ ○ ○ ○ Definitely like

5. A math competition

	1	2	3	4	5	6	7	8	
Definitely don't like	●	●	●	●	●	●	●	●	Definitely like

6. A library

	1	2	3	4	5	6	7	8	
Definitely don't like	●	●	●	●	●	●	●	●	Definitely like

Please rate the following movies based on how much you would like to watch them based only on their titles:

1. "The Electricity War"

	1	2	3	4	5	6	7	8	
Definitely don't like	●	●	●	●	●	●	●	●	Definitely like

2. "The Use of English"

	1	2	3	4	5	6	7	8	
Definitely don't like	●	●	●	●	●	●	●	●	Definitely like

3. "The Story of Musicals"

	1	2	3	4	5	6	7	8	
Definitely don't like	●	●	●	●	●	●	●	●	Definitely like

4. "Bad Science"

	1	2	3	4	5	6	7	8	
Definitely don't like	●	●	●	●	●	●	●	●	Definitely like

5. "Beautiful Equations"

	1	2	3	4	5	6	7	8	
Definitely don't like	●	●	●	●	●	●	●	●	Definitely like

6. "A Mathematical Mystery Tour"

	1	2	3	4	5	6	7	8	
Definitely don't like	●	●	●	●	●	●	●	●	Definitely like

7. "How Art Made the World"

	1	2	3	4	5	6	7	8	
Definitely don't like	●	●	●	●	●	●	●	●	Definitely like

8. “How Math Explains Humanity’s Greatest Inventions”

	1	2	3	4	5	6	7	8	
Definitely don’t like	●	●	●	●	●	●	●	●	Definitely like

Please rate the following books based on how much you would like to read them based only on their titles:

1. “The Four Pillars of Geometry”

	1	2	3	4	5	6	7	8	
Definitely don’t like	●	●	●	●	●	●	●	●	Definitely like

2. “The Story of Art”

	1	2	3	4	5	6	7	8	
Definitely don’t like	●	●	●	●	●	●	●	●	Definitely like

3. “Music and Language”

	1	2	3	4	5	6	7	8	
Definitely don’t like	●	●	●	●	●	●	●	●	Definitely like

4. “Once Upon an Algorithm: How Stories Explain Computing”

	1	2	3	4	5	6	7	8	
Definitely don’t like	●	●	●	●	●	●	●	●	Definitely like

5. “History of Beauty”

	1	2	3	4	5	6	7	8	
Definitely don’t like	●	●	●	●	●	●	●	●	Definitely like

6. “Language Myths”

	1	2	3	4	5	6	7	8	
Definitely don’t like	●	●	●	●	●	●	●	●	Definitely like

7. “The Calculus Story: A Mathematical Adventure”

	1	2	3	4	5	6	7	8	
Definitely don’t like	●	●	●	●	●	●	●	●	Definitely like

Appendix F: Individualized History Profile

Part A: Experimental Condition

Based on your responses to the previous survey, an individualized profile was created regarding your answers. Your answers were collected and analyzed using a sophisticated computer program. Your main results are as follows:

1. Were inspired by a teacher
2. Had a bad experience in a math class
3. Wrote essays
4. Wanted to do well in school

Part B: Control Condition

Based on your responses to the previous survey, an individualized profile was created regarding your answers. Your answers were collected and analyzed using a sophisticated computer program. Your main results are as follows:

1. Were inspired by a teacher
2. Felt proud of your academic accomplishments
3. Wrote essays
4. Wanted to do well in school

Appendix G: Elaboration Exercise

Part A: Experimental Condition

Please elaborate on your experience of having a negative experience in a math class. Where were you? What were you doing? Who were you with? How did it make you feel? (If you do not remember this event, imagine what might have occurred.)

_____

_____

_____

_____

_____

_____

_____

Part B: Control Condition

Please elaborate on your experience of feeling proud of your academic accomplishments. Where were you? What were you doing? Who were you with? How did it make you feel? (If you do not remember this event, imagine what might have occurred.)

_____

_____

_____

_____

_____

_____

_____

_____

Appendix H: Additional Question

What is the most important class-related incident that was not listed on the profile? Please explain.

_____

_____

_____

_____

_____

_____

_____

_____

_____

Appendix I: Memory or Belief Task

Please indicate whether you:

1. Were required to take a health class

   A memory of the specific listed event above __ Yes __ No
   Believed it may have occurred __ Yes __ No
   Were positive the event never occurred __ Yes __ No

2. Had a negative experience in a math class

   A memory of the specific listed event above __ Yes __ No
   Believed it may have occurred __ Yes __ No
   Were positive the event never occurred __ Yes __ No

3. Were inspired by a teacher

   A memory of a specific listed event above __ Yes __ No
   Believed it may have occurred __ Yes __ No
   Were positive the event never occurred __ Yes __ No

What do you believe the purpose of this study was?

_____

_____

Appendix J: Dean's Office Email

Dear Regis Student,

You are receiving this email as an invitation to participate in Alexa Jayne's Psychology Senior Thesis Project. If you are a female over the age of 18, you are eligible to participate. This study will be assessing your preferences for different types of classes.

If you agree to participate, there will be two surveys that you will take. The link to the first survey is attached below. The second survey will be sent to your email a week after you complete the first survey. You will receive $5.00 for your participation in the first survey, and another $5.00 for completing the second survey.

Thank you for your time and consideration!

(Link to first survey will be attached here)

Thanks,
Alexa Jayne

Appendix K: Payment Information

Please enter in your email to confirm your participation in this study and in order to receive payment. NOTE: if you completed this experiment to fulfill your research credit for a course, you will not receive payment for your participation. If you were a volunteer, please visit Alexa Jayne in the Psychology and Neuroscience Suite (SCI 105-112) at any of the following times to receive your payment:

Tuesdays - 11:00am - 2:00pm
Wednesdays - 12:30pm - 2:00pm
Thursdays - 2:00pm - 4:00pm
Fridays - 12:00 - 1:00pm

If none of these times work, please contact Alexa at ajayne@regis.edu for more information. Thank you for your participation.

Email: _____

Appendix L: Participant ID

To ensure that your answers remain anonymous, please enter a code name using the following instructions. Use your first and last name initials followed by the date of your birth. (Example: if my name was John Smith and my birthday was on the 22nd, my code would be JS22). This same code name will be used in the second survey.

Code: _____