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Refusing to Fail?
Masculine Over-Persistence and the Gender Gap in STEM Representation

Andrew M. Penner*
University of California, Irvine

Robb Willer
University of California, Berkeley

Abstract
Research on gender differences on representation in in science, technology, engineering, and mathematics (STEM) fields typically focuses on the underrepresentation of women, attributing these gender differences to women’s choices to avoid STEM fields. Here we investigate the role of a hitherto overlooked possibility, that men may often persist excessively in the face of negative feedback in these same fields. A laboratory and two field studies find support for this claim. Study 1 employed a novel experimental paradigm, showing that men tended to choose mathematics over verbal questions in a testing environment where the mathematics problems were extremely difficult and they were paid for performance. Studies 2 and 3 sought to establish the robustness of the male “over-persistence effect” outside the lab, showing that men are more likely to re-take a key STEM gatekeeper course (Study 2) and STEM courses in general (Study 3) after failing them in college.

*Direct correspondence to Andrew M. Penner, Assistant Professor of Sociology, 3151 Social Science Plaza A, UC Irvine, Irvine CA 92697-5100. Tel. 949-824-8411. Email: penner@uci.edu.

Math class is tough. –Barbara Millicent Roberts (aka. Barbie), 1992

I guess there's cool stuff about science…. But that stuff is so hard, it's honestly not even worth the effort. –Hideki Watanabe (faux UCLA Physics Professor), The Onion, June 5, 2002

While gender inequality along a number of dimensions has been drastically reduced over the last 100 years, women remain significantly underrepresented in mathematics- and science-intensive fields. Some researchers have even suggested that the underrepresentation of women in science, technology, engineering and mathematics (STEM) fields is the final frontier of gender inequality (Xie and Shauman 2003), and research on this issue has garnered considerable attention. Given the importance of having a well-trained and sufficiently large STEM workforce for long-term economic growth, a considerable body of research has examined issues around the underrepresentation of women in STEM fields, and sought to understand how we can encourage more women to enter and persist in these areas (e.g., National Academy of Sciences 2006).

In seeking to understand how women's participation in STEM fields can be brought into line with men's, however, research on the underrepresentation of women in STEM fields implicitly assumes that men's participation in STEM fields is at an appropriate and rational level. We suggest that this might not be the case, and that men might be over-pursuing education and employment in STEM fields. Inspired by research on gender in other domains, which critiques the invisibility of male norms and masculinity, arguing that male patterns should not be blindly accepted (e.g. Robinson 2000), we turn a critical eye towards men's pursuit of mathematics. While men, especially those who are pursuing mathematics and science intensive fields of study, are often seen as rational, cerebral, and intellectual (Andersen 2001), we provide evidence that men's pursuit of mathematics is not necessarily rational, suggesting instead that mathematics becomes a means of performing a masculine identity.

In making this argument, we draw on Charles and Bradley's (2009) work showing that one way that people "do gender" is by choosing their field of study. Charles and Bradley use international data to highlight the role of instrumental versus expressive national contexts, arguing that segregation by field of study is more pronounced in expressive national contexts, where gendered performances in choice of major are encouraged and even celebrated. However, given the observational nature of their data, they are unable to examine whether gender differences in STEM majors in expressive cultures are due to men expressing their masculinity, women expressing their femininity, or both. This conundrum is not unique to Charles and Bradley's study, but is a puzzle for research in this field more broadly. Correll's (2001) research, for example, suggests that men are more confident than women who have the same mathematical ability, but is ultimately unable to distinguish whether men are overconfident or women are underconfident.

Put simply, research using men as the counterfactual for understanding women's behavior (or women as the counterfactual for understanding men's behavior) cannot ultimately address issues of whether women or men are pursuing mathematics- and science-intensive fields and careers at rational levels. Our study advances this literature by using a unique experimental paradigm in which we manipulate whether it is rational to pursue mathematics, allowing use to ascertain whether women, men, or both are irrational in the degree to which they pursue mathematics. We then build on this experimental manipulation by examining non-experimental contexts where pursuing mathematics and science is likely to be irrational, examining students who take STEM classes after failing them. While these observational studies are subject to the same shortcomings of previous literature, in that they do not allow us to definitively establish whether women or men are behaving rationally, they build on the experimental study that does explicitly examine the rationality of women and men's decisions by enabling us to better understand how the processes documented in the experimental study play out in the important context of curricular choices.

Literature Review

Gender differences in STEM fields are typically conceptualized in terms of persistence in the STEM "pipeline." As described by Xie and Shauman (2003), the standard explanation for the gender gap in representation in STEM fields is that women leak out of the pipeline at a higher rate than men, which is interpreted as evidence that women are leaking out at too high a rate. The solution to this problem, it is argued, is to implement policies that will help bring women's persistence more in line with men's. It is simply assumed that the rate at which women are leaking out is too high, and the idea that men may not be exiting enough has not been considered.[1] That is, men's behavior in this arena is assumed to be rational and worthy of emulation, and there is no attempt to probe whether in fact this is the case. Even feminist scholarship on this issue frames the question in terms of why women drop out of mathematics

[1] One might imagine that gender equality could be gained by making STEM education and careers less attractive to men as well, although no work that we are aware of raises this alternative, presumably because it would undermine the policy goal of increasing the size of the scientific workforce.

and science more than men (see, e.g. Fausto-Sterling 1992). This study seeks to bring attention to men's invisible choices, and see what insights can be gained from recasting the under-persistence of women in science instead as the over-persistence of men. To borrow the metaphor of the STEM pipeline, we are interested in whether the science pipeline can be viewed not as leaking women, but rather as trapping men.

While research seeking to understand the gender gap in STEM fields has examined a myriad of issues ranging from discrimination to aptitude, recent research has called attention to the role that the choices made by women and men play. In a recent review of the literature on these differences Ceci and Williams (2010) conclude that the life choices made by the men and women would be scientists are the most important cause of the differences for representation in STEM careers. Drawing on this, we argue that in order to understand gender differences in STEM representation, it is important to understand not just the choices of women, but also the choices that men are making when they decide whether or not to pursue STEM fields. Below we briefly review the literature on this topic, focusing first on whether these decisions are rational, then examining the role of self-perceptions, and concluding by touching on issues of masculinity.

Rational choices to and away from STEM fields

Currently the underrepresentation of women in STEM fields is framed as a women's issue. That is, when women are found to drop out of STEM pipeline at higher rates than men, it is assumed that women's behavior ought to be modified to bring it into line with men's levels of persistence in STEM fields. Implicit in many of these ideas is the notion that women are acting irrationally with regards to their mathematical persistence. Less considered is the alternative that men are acting irrationally in their mathematical persistence. However, while there is little work arguing that men are persisting in mathematics when it is not rational, research focusing on the rationality of women's mathematical persistence typically argues that "under-persistence" of women in STEM fields is rational given the nature of the external constraints that women face.

For example, international research highlights that gender differences in mathematics achievement are sensitive to labor market gender inequality (Penner 2008, Riegle-Crumb 2005), which is congruent with the idea that women and men's pursuit of mathematics and science can be viewed as a rational response to the opportunities available to them. Likewise, Davies (2002) finds that when women who say that mathematics is important to them are reminded of the gender stereotypes present in society more broadly, they avoid math problems and choose verbal problems instead, and they are also more likely to express interest in verbal careers than quantitative careers.

Other research focuses less explicitly on context per se, but arrives at similar conclusions. Research focusing on the STEM pipeline often highlights how contextual factors can be changed to facilitate women's entry into and persistence in STEM fields, belying the assumption that women are largely making rational choices when they decide to enter or exit the STEM pipeline. For example, Frank et al. (2008) argue that girls are more likely to take mathematics courses if mathematics is popular among those around them, implying that girls' mathematical behavior is rational when we considered the larger set of objectives that face girls when they are making decisions about what courses to take.[2] Similarly, Ginther et al. (2006) argue that "women are less likely to take tenure track positions in science, but the gender gap is entirely explained by fertility decisions." Finally, the idea that women's choices are rational is also consistent with research showing that mathematically talented women typically have higher levels of skill in other domains as well, presumably corresponding to more (and more attractive) options in non-STEM domains (Webb et al. 2002). The novelty of this paper is thus not in suggesting that female behavior is rational, but rather in examining male behavior and suggesting that it might not be rational.

Of course, just because something is rational does not mean it is a desirable outcome, and much of the work on women in science tries to change the structures within which women are making decisions about pursuing STEM fields so that it is more attractive (or less unattractive) and hence more rational for women to pursue careers in this arena. But while this work recognizes the rationality of women, it typically does not examine the rationality of men making these decisions.

The role of self-perceptions

One mechanism posited for why boys leave mathematics related fields at a lower rate than girls centers on the biases in self-perceived mathematical competence. This line of argumentation highlights the relative importance of perceived competence, as presumably choices about

[2] Interestingly, Frank et al. (2005) find that while girls become more popular by taking math classes in contexts where this is valued, boys actually become less popular by doing so. While this finding is discussed, the discussion largely assumes that boys in this context are act rationally.

whether or not to persist in STEM fields are more closely related to people's perceptions of their competence than their actual competence per se. That is, if people think that they are lacking the skills necessary to be successful in a STEM field, they are unlikely to persist, regardless of whether they are actually competent. Likewise, if people believe that they have the skills necessary to be successful, they may persist even in the face of mounting evidence that they lack the skills needed. This insight raises the possibility that there may be a gap between actual and perceived competence that could inform gender differences in STEM persistence. Correll (2001) finds evidence that such a gap exists, showing that controlling for achievement boys' rate themselves better at math than do girls. This suggests that there are gender differences in how actual competence is incorporated into self-perceptions of competence, and raises the question of whether this is caused by boys rating themselves more highly than they ought, girls not rating themselves as highly as they ought, or some combination of these two phenomena. Correll (2001) shows that girls are more sensitive to feedback in creating their mathematical self-concept, suggesting that boys' self-conceptions may be less realistic than girls'.

The general processes behind gender differences in mathematical self-assessment appear to operate quite widely, as Correll (2004) shows that this pattern of gender differences in assessments exists more broadly in areas where there are gender differences. Using a contrast sensitivity test with manipulated feedback, Correll (2004) finds that when participants are told that there is a male advantage in contrast sensitivity males tend to assess themselves as more competent. In contrast, when participants are told that there are no gender differences, no differences in self-assessments are found. This suggests that gender differences in self-assessments are influenced by peoples' perception of whether this is a task that they should be good at.

While gender differences in self-assessments are not necessarily related to gender differences in persistence, Correll (2004) shows that gender differences in contrast sensitivity self-assessments lead to gender differences in aspirations surrounding contrast sensitivity. Given that the men and women received the same feedback on the number of contrast sensitivity questions they answered correctly, this suggests that beliefs about gender differences in an area can interfere with the ability to dispassionately receive feedback and impact assessments and aspirations. This provides strong evidence that beliefs about the existence of gender differences actually create gender differences in self-assessments and aspirations that are not rooted in feedback, however, it is ultimately unable to adjudicate whether males have too high of an opinion of their abilities or females have too low an opinion of their abilities. Thus, even where research indicates that it is beliefs about gender differences that impact gender differences in self-assessments and persistence, we are still unable to identify whether this is due to differences in behavior among men, women, or both.

Math and masculinity

While there is some work that critically examines men’s relationship with mathematics and mathematics-intensive fields, this work typically focuses on how math is defined and viewed culturally. Fennema’s (1977) research on mathematics as a male domain, for example, problematizes the domain identification of mathematics, but is not particularly concerned with men's mathematical behavior. There is also a large body of work problematizing the concept of rationality more generally (e.g. Bordo1986, Haraway 1988), but here again the focus is on the larger issues surrounding the rationalistic paradigm, overlooking questions around the rationality of men's persistence in mathematics-intensive fields. We acknowledge that problematizing the rationalistic approach as a whole ultimately undermines the tacit invisibility of the assumed male rationality that dictates men's mathematical persistence. However, a more immediate and narrowly focused critique of males' mathematical behavior can provide a more direct (within its smaller scope) critique of males' mathematical behavior, as it unambiguously highlights the lack of rationality in this arena. This can expose the previously invisible behavior of men, and highlight the role that men's irrationality plays in producing gender differences in mathematics.

Research suggests that larger cultural ideas about mathematics are readily adopted by individuals in STEM fields. Andersen (2001) argues that notes that objectivity, rationality, and a scientistic approach are typically culturally conceptualized as male-typed characteristics, and finds that male scientists are more likely to espouse them than female scientists. Likewise, the women interviewed in Stage and Maple's (1996) study, note that math is "the macho of the intellectual world" (29) and that in graduate school in mathematics they were asked to "be like a man" (36). Among other things, being like a man in this contexts means working in isolation (as opposed to in a group), and neglecting other relationships and responsibilities. However, while Stage and Maple do not interview men, they speculate that men may face many of the same issues, and note the possibility that both men and women's relationship to mathematics might change.

The idea that men's relationship with mathematics might change raises the interesting possibility of achieving gender parity through changing men's behavior to bring it into line with women's. This alternative is, as far as we are aware, not discussed, presumably because it would undermine the policy goal of increasing the size of the scientific workforce. However, while it is undoubtedly important to ensure the provision of a well-trained scientific workforce, it seems plausible that having men who are persisting in the face of failure in STEM fields exit STEM and enter other fields may be in the best interest of both the individual men and society as whole. Research in motivational psychology highlights the importance of intrinsic motivation for creativity and learning, as well as self-esteem and general wellbeing (e.g. Ryan and Deci 2000). Thus, to the degree that men might be pursuing mathematics not because it is intrinsically satisfying, but rather because they are seeking to enact their masculinity through pursuing a male-typed academic field, this research suggests that they will be less competent and feel more alienated.[3]

Data and Method

This paper consists of three sets of analyses: an experiment and two observational studies. The experimental study involves 190 participants from a selective public university (109 women and 81 men), the first observational study examines the coursetaking decisions a cohort of 5,500 entering students at a different selective public university, and the second observational study examines the college STEM coursetaking patterns of a nationally representative cohort of 8,000 8th grade students. The experimental study establishes the irrationality of men's mathematics

[3] Another intriguing possibility is that mathematics has become an unpopular norm for men, so that they persist in STEM fields even when they would prefer not to, and in spite of other interests, so that they are in a sense trapped in the STEM pipeline by gender norms.

choices by examining women and men's choices to answer either mathematics or verbal questions in experimental conditions where it was rational to choose either one or the other kind of question. The first observational study builds on the experimental study by examining whether there is evidence of similar processes at work in college students' decision to take a key gate keeper course after initially failing. Finally, the second observational study uses a nationally representative sample to examine women and men's likelihood of retaking any STEM class after failing. While the two observational studies cannot ultimately address whether the behavior exhibited is irrational, they provide an indication that the processes that we observe in the experimental setting are likely to have important consequences. Together, these studies allow us to 1) document the irrationality of men's mathematics persistence, 2) show that similar irrational processes may be behind the gender differences in key mathematics classes that serve as a gateway for STEM majors, and 3) show that these processes might drive STEM coursetaking in a nationally representative sample of students.

Experimental Study

Study 1. In the experiment, we present 190 college students at a large selective public university with the opportunity to answer 10 questions, in a setting where they are told that they will earn a dollar for every correct answer. The test that they are given has both mathematics and verbal questions, and before each question participants choose whether they would like to answer a math or verbal question. Participants are randomly assigned to one of two conditions. In the first condition, the mathematics questions are considerably easier than the verbal questions; in the second condition mathematics questions are considerably more difficult than the verbal questions. Manipulation checks confirm that the difficult math problems were answered correctly only 12 percent of the time, while easy math questions were answered correctly 85 percent of the time. Verbal questions were of moderate difficulty, and were answered correctly 40 percent of the time (there were no differences in the likelihood of answering a verbal question correctly across conditions). Participants are thus randomly assigned either to a condition in which it is rational to choose mathematics questions, or to a condition in which it is irrational to choose mathematics questions.

Participants are informed that they will be asked a total of ten questions and that before each question they will choose what kind of question they would like to answer. They are told that they will receive one dollar for each question that they answer correctly, and are shown two (randomly selected) examples of both the math and verbal questions. Following the test participants fill out a short survey, including information about self-perceptions of competence, and the importance of earning as much money as possible, as well as any other goals that they maybe have been trying to achieve (e.g. finishing the test as quickly as possible), to ensure that there were no gender differences in participants' goals.

Observational Studies

Study 2. The first observational study uses transcripts from an entering cohort of over 5,500 students who enrolled in a large, selective public university in 2002. These data allow us to examine the coursetaking patterns of students for the next seven years, and are particularly useful in that we can identify and examine key gatekeeper courses for STEM majors. Here we focus on the 283 students who failed calculus, a key gatekeeper course for STEM majors at this university, and examine the likelihood that they subsequently attempted to retake the class.

Study 3. The second observational study uses data from the National Education Longitudinal Study of 1988 Postsecondary Education Transcript Study (NELS-PETS). NELS follows a nationally representative cohort of 8^{th} graders beginning in the 1987-1988 school year, and the PETS study was conducted in 2000, when most respondents were between 26 and 27 years old. The PETS study includes information on over 8,000 students, and contains transcripts from multiple institutions (see Adleman et al. 2003 for more information on the PETS sample). As students in the sample attended a wide variety of institutions, we are unable to identify particular gatekeeper courses for universities, and thus examine coursetaking across STEM courses broadly. All analyses account for survey weights and the stratified sampling frame.

Results

Study1: Experimental study

Figure 1 reports the results from our experimental study. We see that the number of irrational choices made by men varies considerably between the two conditions. When it is rational to choose math, men overwhelmingly do so, and (irrationally) choose verbal questions only 12 percent of the time. However, when it is rational to choose verbal questions we find that men irrationally choose math problems 32 percent of the time. This difference is highly statistically significant (p=.001), indicating that men are more likely to irrationally choose math questions than verbal questions. By contrast, for women the difference between the likelihood choosing irrationally in the two conditions was only 1 percentage points (p=.85): Women choose math questions when they should choose verbal questions 21 percent of the time, and they choose verbal questions when they should choose math questions 22 percent of the time. Thus, in contrast to men, women are equally likely to choose math and verbal questions irrationally. Interestingly, we find no gender differences in the likelihood of rationally choosing math questions (i.e. when math is easy we find do not find a statistically significant difference between the rates at which women and men choose math), but we do find gender differences in the likelihood of irrationally pursuing mathematics. We also examined whether the interaction of quiz type and gender was statistically significant using a variety of modeling strategies (OLS, Poisson, and negative binomial regression models), all of which showed a statistically significant interaction.

[Insert Figure 1 about here.]

In order to test whether these differences were being driven by different motivations (e.g. men were less motivated to earn as much money as possible on the test), we also conducted analyses examining gender differences in the self-reported importance of a variety of potential goals. These included earning as much as possible on the test, as well as the importance of challenging oneself, finishing the test quickly, and enjoying the test. As none of these exhibit significant gender differences, we conclude that it is unlikely that our findings are driven by differences in men and women's desires to earn as much money as possible.[4] That is, it does not appear to be

[4] Interestingly, in the only case in which the gender difference in self-reported motivation approaches statistical significance, it is in the opposite direction from what we might expect: When it is irrational to do math, men are not only more likely to irrationally pick math than women, but are also somewhat more likely than women to say that their motivation in choosing questions was to earn as much money as possible ($p=.06$). If anything, this further highlights the irrationality of men choosing mathematics in this context, as both women and men in this condition

the case that men are rationally utility maximizing along other dimensions such as time or enjoyment.

Further, to test whether differences were being driven by gender differences in confidence, we examined participants' predictions regarding how likely they thought they would be to get a math or verbal question from the test correct. Again we found no significant gender differences, suggesting that male-overconfidence is unlikely to explain the pattern that we observe. It is also important to note that there were no gender differences in the likelihood of answering the mathematics and verbal questions correctly in any of the conditions.

In sum, results from the experiment show that there are no statistically significant gender differences in the rates at which men and women choose to answer mathematics questions when it is rational to choose mathematics. However, when it is irrational to choose mathematics questions, we find that men are significantly more likely to choose mathematics questions than women. Further, we find that the interaction of condition and gender is significant, indicating that the difference between the gender differences in the irrational mathematics condition and the rational mathematics condition is statistically significant. Finally, we find no evidence that our results are driven by differences in participants' goals in taking the test or their self-assessed likelihood of answering a question correctly.

To verify that men's irrational affinity for mathematics is expressed in broader contexts, we also conduct two observational studies. While the experiment allows to precisely manipulate the

correctly assess that their chances of correctly answering a verbal question are higher than their chances of correctly answering a math question.

rationality of choosing mathematics, it is difficult to know whether the findings are generalizable to other tasks and contexts. By contrast, with observational data the difficultly lie in determining whether a particular behavior is rational, but we can examine contexts that are likely to have important consequences for students' futures, and can more easily establish whether the pattern we observe holds widely. For our purposes, we examine the rates of retaking a mathematics course after failing. It is important to note, however, that as the payoff for retaking the course is unclear, we are unable to definitively conclude that this behavior is irrational.

Study 2: A gatekeeper course at a selective public university

To examine whether we can find evidence of similar patterns of male mathematical over-persistence in non-experimental settings, we next examine the likelihood of retaking a key mathematics course that serves as a gatekeeper course for STEM majors at for a cohort of students at a large public university. Figure 2 reports the percent of men and women who retook calculus after initially failing it. We find that of the 177 men who failed this class 77 percent retook the class at a later date, compared to 60 percent of the 106 women who failed. This difference is statistically significant ($p = .003$). In order to rule out that men are simply more likely to retake classes that they fail in all subjects, we also examined these results to entry level courses required for majoring in sociology, where we observe no statistically significant gender differences ($p=.85$). Unfortunately, unlike the experiment, we cannot ultimately rule out that it is rational to retake this mathematics course, particularly as the likelihood of subsequently passing is relatively high (60%) and the payoffs for passing are unknown, as we do not have information about income or other potential outcomes. However, given that students who retook and passed calculus were no more likely to major in a STEM field than either those who did not retake calculus or those who retook and did not pass,[5] we do not believe that there is a strong argument to be made for the rationality of retaking the course.

[Insert Figure 2 about here.]

Study 3: College STEM course re-taking across the United States

To document whether the pattern observed in Study 2 holds more broadly, Study 3 examines data from the Post-secondary Educational Transcript Study of the National Education Longitudinal Study of 1988. As we lack information about which specific courses serve as gatekeepers at the different universities students are attending, here we examine the 1,460 students who failed any mathematics class to see whether there were gender differences in the likelihood of retaking any mathematics class after initially failing. Like the results from Study 2, we find that men are statistically more likely to retake mathematics classes that they failed (p=.048), retaking the class 32 percent of the time after they failed, compared to the 25 percent of women who retake the class. Further, to document that this general pattern that we find is not unique to mathematics classes, we also examine whether there are gender differences in the likelihood of retaking any STEM class after initially failing. Among the 2,620 students who failed a STEM class, we again find that men retake the class 32 percent of the time, while women retake the course 25 percent of the time (p=.017). By contrast, there are no gender differences in the likelihood of retaking sociology classes. Finally, while we again cannot

[5] It is worth noting that there was also no statistically significant difference in the likelihood of having a STEM major between students who retook and failed calculus and those who did not retake it.

definitely answer whether it is rational to retake a math (or STEM) class after failing,[6] we find no statistically significant effects of retaking (or passing upon retaking) mathematics or STEM classes on income. Thus, while it is possible that students who retake courses are doing so rationally, this behavior cannot be accounted for by examining the returns in terms of income.

[Insert Figure 3 about here.]

Taken together, Studies 2 and 3 suggest that men's over-persistence in mathematics (documented in Study 1) is present in college-level coursetaking, both in key gatekeeper courses for STEM majors, as well as mathematics and STEM courses more generally. We argue that examining how students respond to failing a course provides insight into longstanding gender differences in persistence in STEM fields. In particular, it is noteworthy that we find evidence that men are more likely to retake STEM classes after initially failing them, but that they do not exhibit the same pattern for classes in the social sciences. Men are more likely than women to retake STEM classes not only when the majority of students who fail retake the class (Study 2) but also when retaking classes is less common (Study 3). Finding that men over-persist in STEM classes, exhibiting an immunity to failure, suggests that it is not just that mathematics is a male domain (e.g. Fennema and Sherman 1977), but that male behavior in STEM fields is qualitatively different from their behavior in other fields. This finding underscores the importance of understanding the behavior of both women and men in order to understand gender differences in STEM fields.

[6] As in Study 2, the likelihood of passing a class upon retaking was relatively high (54 percent for mathematics and 64 percent for all STEM courses). There were no gender differences in the likelihood of passing math (p=.87) or all STEM (p=.98) classes.

Discussion

Twenty years ago, Barbie declared that math class is tough. Ten years later The Onion questioned whether the cool stuff in science was worth the effort. These sentiments are echoed in interviews with STEM professors and students, who note that classes are supposed to be hard to so that they weed people out (Etzkowitz et al. 2000). From this perspective it is perhaps less interesting to consider why women change their major and choose to pursue other interests, than the question of why men irrationally continue on in STEM fields. However, as the academic literature on STEM persistence has overwhelmingly considered persistence in STEM fields as a desirable outcome, and thus focused on why so many women exit the STEM pipeline, there is no work that we are aware that seeks to understand why it is that so many men have remained in the STEM pipeline.

This paper thus seeks to understand why it is that men continue on in the sciences, despite the inhospitable academic climate often depicted (e.g. Etzkowitz et al. 2000). In contrast to images of men and scientists as rationally driven actors, we show that at least in some contexts men's pursuit of mathematics is irrational. In Study 1, we show that men only choose mathematics at higher rates than women when they are in a context in which it is irrational to choose mathematics questions, and that no gender differences emerge when it is rational to choose mathematics. Further, in Studies 2 and 3, we show that men's irrational behavior in the face of mathematical failure appears to extend beyond the laboratory, as male college students are more likely to retake mathematics and STEM courses after failing them.

Given that we do not find gender differences in students' self-assessments of their likelihood of answering a math or verbal question correctly, it is worth thinking about other potential explanations for why men are irrationally pursuing mathematics. We suggest that this is likely to be the result of men expressing their masculinity (e.g. Charles and Bradley 2009). From this perspective, it is not necessarily irrational for men to be choosing mathematics, as they are foregoing money to perform a gendered identity. Thus, even though it is not the optimal approach to maximize pecuniary profit in this context (a goal which men overwhelmingly endorsed)[7], overpursuing mathematics can still be rational utility maximizing behavior. That is, while pursuing mathematics at the expense of monetary payoff might not be an intelligent or prudent thing to do, given the logic of masculinity it is possible that it is still rational for men to be mathematically exuberant if they derive greater utility from their gendered performance than from the money they would have received.

These findings are important, as they suggest that encouraging women to pursue STEM fields at the same rates as men may not be good policy.[8] That is, if men were behaving irrationally in other spheres, we would not necessarily encourage women to emulate them. While policy

[7] On a scale from 0 (not at all important) to 100 (very important) men on average gave earning as much money as possible a 75. By contrast, the next highest factor, finishing quickly, had an average of 41.

[8] It is important to note that while some might suggest that rationality notwithstanding it is important to encourage both women and men into the sciences, it is not clear to us that this point should be based on gender differences in representations. This is not to say that boys and girls should not grow up aspiring to be whatever they wish to be, without undue pressure from society—clearly this should be so and is currently far from so. Rather, as Freeman Dyson and others have noted, new innovation and growth is increasingly clustered in the biological sciences (where women's underrepresentation is much less severe), and less so in the physical sciences; as such it is unclear whether society should be encouraging more women to pursue PhDs in a field where jobs are scarce and hours are long, especially when men with PhDs in physics often end up working on Wall Street. Further, research and policies suggesting that women and men should be encouraged to remain in the sciences does not typically consider the counterfactual. To take just one example, it seems unlikely that people would argue that Angela Merkel (a PhD in Quantum Chemistry, and the Chancellor of Germany) should have stayed in science.

makers might want to encourage both men and women to pursue mathematics at higher rates, our results lend support to the argument to the notion that the gender gap in STEM fields results at least in part from the over-persistence of men in STEM fields. In doing so, they suggest that there are important and policy relevant choices being made about STEM persistence by both women and men, so that while women may be under-persisting, men are over-persisting. Thus, to the degree that having a well-trained workforce in STEM fields is important to long-term economic growth, future research might consider how to change incentives so as to encourage rational and intrinsically motivated participation in STEM fields by both women and men, rather than encouraging women to participate at men's irrational levels, which might encourage counter-productive extrinsically motivated persistence.

In sum, this study addresses this question of whose mathematical behavior is irrational: men, women, or both. In light of these findings, we argue that we can think about the fact that women drop out of the science pipeline in greater numbers as a question not only of female under-persistence but also as an issue of irrational male mathematical over-persistence and immunity to failure.

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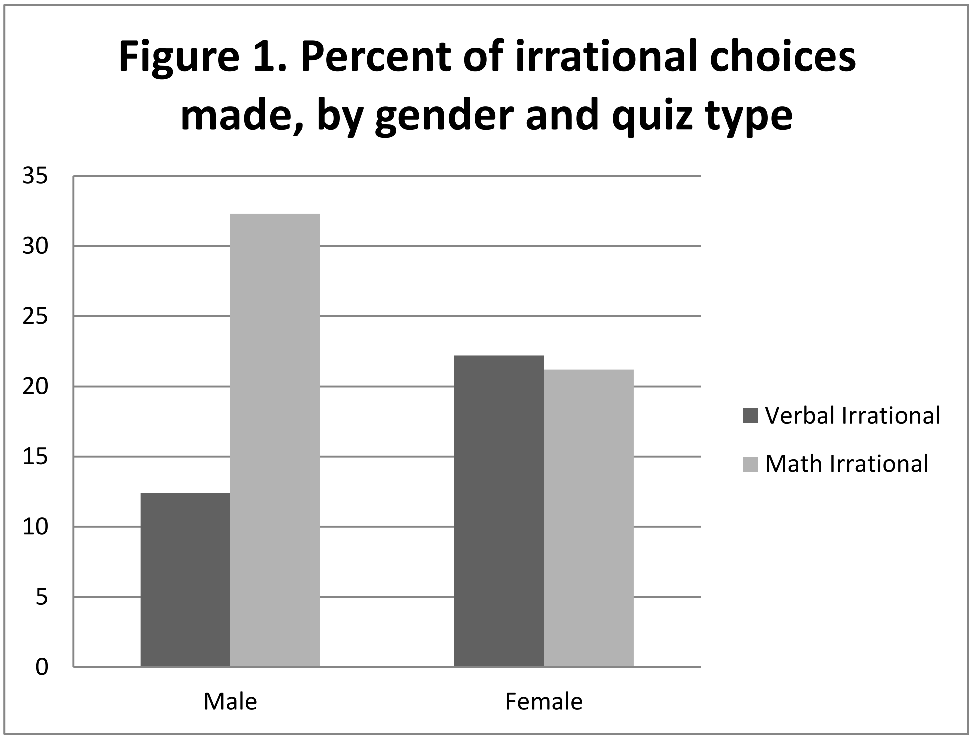
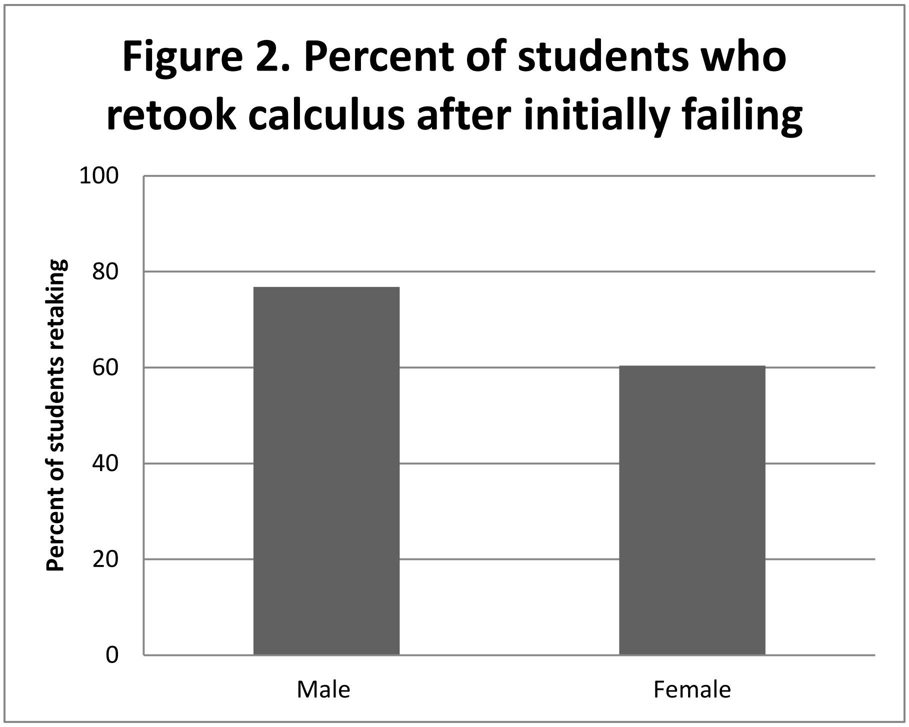
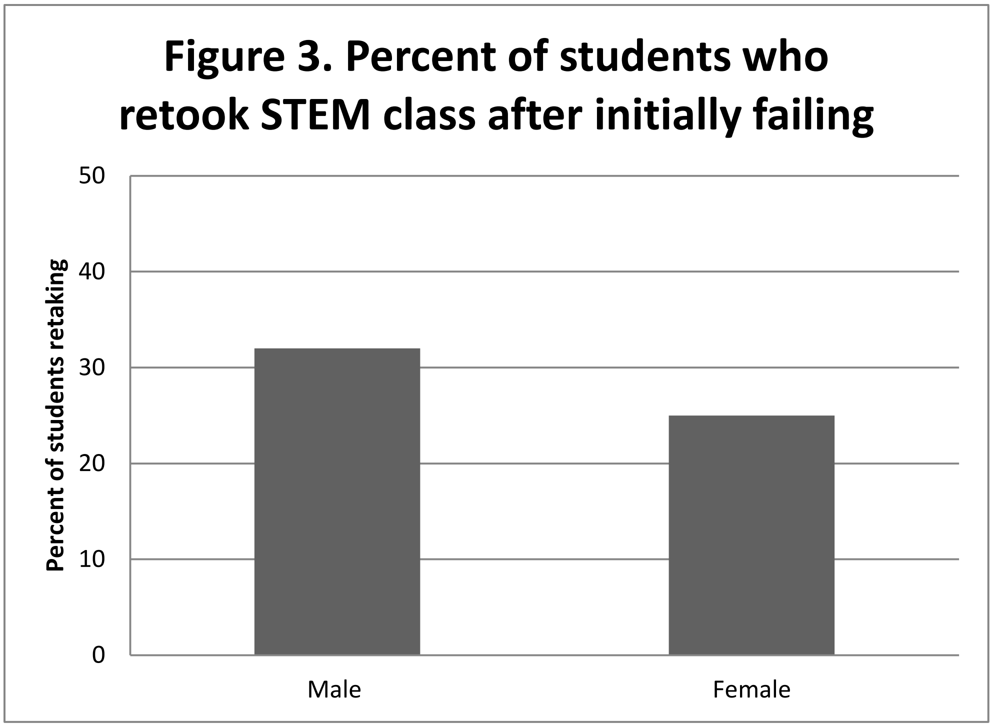


Source: Authors' calculations on experimental data from a selective west coast university.



Source: Authors' calcuations on transcript data from a selective west coast university. P=0.003, two-tailed test.



Source: Authors' calculations on NELS-PETS data. P=0.017, two-tailed test.