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Reducing Stereotype Threat in First-Year Logic Classes

Vanessa Lehan

Abstract

I examine successful strategies to diminish or eliminate stereotype threat in mathematics. Some of these include informing our students about stereotype threat, challenging the idea that logical intelligence is an "innate" ability, making students in threatened groups feel welcomed, and introducing counter-stereotypical role models. The purpose of this paper is to take these strategies that have proven successful in mathematics, and suggest specific ways to incorporate them into introductory logic classes in philosophy. I consider the possible benefit of presenting logic to our undergraduate students by concentrating on aspects of logic that do not result in a clash of schemas (i.e., logic as language and the benefit of logic as aesthetic enjoyment).

Keywords: pedagogy, women in logic, stereotype threat

The Problem

Every year that I teach introduction to logic, it seems that I have the same frustrating experience. I find that some woman in the course is giving signs that she might be interested in taking advanced logic classes—either she is doing poorly in the class but has interesting intuitions, she is doing particularly well in the course, or she seems to enjoy the subject—so I suggest that she take some of the more advanced courses in logic that our department offers. This usually ends with either the student's face contorting in abject horror, or the student fearfully asking me how difficult the upper level courses are. Rarely, if ever, do these women enter the upper level logic classes. At my university the percentage of women in the introductory logic classes is close to 50%; however, we are lucky to get a few women taking the advanced logic classes.

Based on a recent conversation on the *LogBlog* about women in logic, I take this to be a common trend, i.e., women are prevalent in the lower level logic classes but tend not to continue on in logic beyond this point. New female students flee logic after the introductory classes, and that leads to a discipline where there are very few women. For example, Richard Zack (2007) recently analyzed data from *The Journal of Philosophical Logic* on his blog. He discovered that, over the past seven

years, "out of 247 (non-unique) authors, 22, or 9%, were women. That's lower by several percentage points than any of the other publication rates for top journals reported by Sally Haslanger. . . . Out of the 94 authors from the U.S. and Canada, only 2 = 2% were women."

Both the fact that there are so few women working in logic, and the fact that there is a certain point at which female students become alienated from the subject, remind me very much of studies of the gender bias in math. For a long time, it's been obvious that there is a certain point at which girls who enjoy and are good at math suddenly stop enjoying the subject and start to do more poorly in these classes. Based on these superficial similarities, I decided to look into research on gender bias in math to see whether I could take away anything that would be helpful to me as a logic teacher. I found a great deal of work on stereotype threat in math—arguing that stereotype threat is largely to blame for the gender bias—and many studies that attempt to remove or ameliorate the effects of this threat.

I am proposing that the low numbers of women working in logic may be partially caused by stereotype threat. It is widely recognized that one of the effects of stereotype threat is that those whose identities are under threat will remove themselves from the field. As Singletary et al. argue in *Stereotype Threat: Causes, Effects and Remedies*, "In addition to affecting performance, experiencing stereotype threat may also affect an individual's choice of a college major and entry into male-typed professions" (2009, 4). Studies have also suggested that stereotype threat may influence students to choose different majors (Gupta and Bhawe 2007) or to move into a different less male-dominated field (Steele, James, and Barnett 2002). Many studies have shown a correlation between stereotype threat and persistence in a major. For example, Chang et al. (2011) argue that students who test particularly high on stereotype threat risk questions (negative racial experiences, high identification with both the subject and with the stereotyped group) were more likely to have left the program (engineering) after the first year.

Many other authors have explored the impact of stereotype threat on the underrepresentation of women in philosophy in general—e.g. Jennifer Saul's (2013) paper, "Implicit bias, stereotype threat, and women in philosophy." I think it is possible that part of the impact of stereotype threat in philosophy in general is related to the high reliance in philosophy on logic. As Saul argues, "Mathematics is strongly stereotyped as male . . . and it seems reasonable to suppose that Anglophone philosophy, with its heavy use of logic, will inherit this stereotype" (2013, 7). Many philosophy degrees require a logic component, and logic and reason are often seen as integral parts of what philosophy is. Thus, I suggest that if we want to attract more women into logic and make the discipline of philosophy as a whole more welcoming to women, we should come up with ways to reduce stereotype threat in introductory logic classes.

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Encouraging women to continue studying logic has a number of potential advantages. First, increasing the number of women in advanced logic classes will make those classes more inviting for other women. Introducing more women to advanced logic classes will hopefully increase the number of women that decide to go into the field of logic. Having more women working in logic may reduce the negative stereotypes about women in logic and the implicit biases against women in philosophy by challenging the notion that women are not logical or good reasoners. Thus, the profession as a whole stands to benefit greatly from efforts to remove the hindrances to women continuing their studies of logic at the undergraduate level.

Stereotype Threat

A possible challenge to the idea that women are underrepresented in logic due to stereotype threat is presented by Buckwalter and Stich (2014). They claim that philosophy may underrepresent women, not because there is something about the way that we are engaging in philosophy or teaching philosophy that makes the area unwelcoming to women, but simply because women have different philosophical intuitions. This argument could also apply to logic, where one might argue that women simply have intuitions that are in conflict with the way we teach logic. Anecdotally, it seems obvious to me that this claim is false. I've spoken to many other logic teachers over the years, and they tend to agree that women do just as well in logic courses as men do and that the cases of interesting intuitions (by which I mean intuitions that don't agree with the standard truth-functional account of logic that we teach in first year courses) are mixed between male and female.

More convincingly, there are a number of studies that have challenged the conclusions drawn by Buckwalter and Stich; serious questions have been raised about their methodology and the repeatability of their results. For example, Adleberg et al. (2014) failed to replicate Buckwalter and Stich's results. They argue, "Our results, as well as our methodological concerns about Buckwalter and Stich's results, suggest that their hypothesis that women leave philosophy because they have different intuitions about philosophical thought experiments is unlikely to be correct" (16). I think it is not incorrect intuitions that keep women from logic but rather a combination of implicit bias and stereotype threat that is impacting the numbers of women in logic. Certainly, there seems enough reason to attempt to ameliorate the effects of stereotype threat in introductory logic classes and see whether this has the benefit of encouraging more women into our discipline. There are many psychological studies that have shown effective ways to reduce the effects of stereotype threat in math classes, and some of these strategies should be implemented when teaching logic and critical reasoning.

Stereotype threat occurs when a person believes that they will be judged on the basis of some group-based stereotype. *They do not need to believe the*

stereotype, and the stereotype itself doesn't even need to be prevalent in their current environment. All that is necessary to activate this particular social identity threat is that a person believes that others will treat them negatively or evaluate them unfairly on the basis of one of their social identities (Steele 1997; Steele and Aronson 1995). For example, a woman who thinks either that "women are not logical" is true or that many other people believe this to be true may find that such a belief impacts her performance on logical tasks or enjoyment of these tasks. As Aronson et al. (2009) claim, "The logic behind stereotype threat is that because of an awareness of negative stereotypes presupposing academic inferiority, Black and other minority students may worry that they could confirm the intellectual inferiority alleged by such stereotypes" (2).

In her paper, "Changing the Ideology and Culture of Philosophy: Not by Reason (Alone)," Sally Haslanger (2008) outlines the predictors for stereotype threat. There is often a strong identification with the subject (considering oneself a "woman who is good at logic" for example), a strong identification with the social group that is stereotyped (so someone who strongly identifies as female is more likely to experience stereotype threat where the stereotype targets women), and "high stigma consciousness," which is the extent to which stereotypes in this area are prevalent (2008, 218). Students do not have to be consciously aware of stereotypes in the area to have their performance impacted by stereotype threat. For example, a female student in a logic class may be subjected to stereotype threat even if she does not consciously associate the subject with stereotypes about illogical women.

I think it very clear that logic is an area where women are subject to stereotype threat. The strong predictors—that women be a minority group in this area and that there are negative stereotypes about women's performance in this area—are certainly met. Cheshire Calhoun (2009) speculates that undergraduates have conflicting schemas for "woman" and "philosopher" before ever entering a philosophy classroom; likewise, students entering a logic classroom likely already have conflicting schemas for "woman" and "logician/reasoner." It is also important to examine the prevalent pop cultural ideas of women and logic because, as Audrey Yap points out in "Teaching Logic, Fighting Stereotypes" (2013), most students who enter introduction to logic classes don't know much about the field of logic itself but have preconceived ideas about logic from popular culture. This is consistent with Calhoun's suggestion that "the major locus of women's under-representation in professional philosophy seems to be further back in women's educational careers, namely at the moment when female students ask themselves, 'What shall I major in?'" (2009, 216). In the paragraphs that follow, I outline some of the specific stereotypes that concern women and logic in popular culture, philosophy as a whole, and in logic classes specifically.

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Stereotypes about Logic

There is a definite, pervasive, popular stereotype that women are illogical or that women's logic is different from men's logic (men's logic here corresponding to what we typically think of as good reasoning). This can be evidenced by some of the Urban Dictionary's definitions of "female logic" and "women's logic." For example, "Male logic (or just plain logic) follows a direct path, clearly tying the consequences of action to the actor. Female logic doesn't follow a direct path,"[1] and "The un-logical *sic* decision, that either is a contradiction to the original decision or doesn't make sense."[2] The "women are illogical" stereotype is so pervasive that there was even a game show in the nation of Georgia called "Women's Logic" featuring "leggy models dressed in skimpy clothing as its contestants, paired up with fully-clothed male contestants" (Gray 2012). The host asked the women a series of trivia questions and the men had to try to untangle the "women's logic" to figure out which of the (presumably incorrect) answers their female partner would give. The male contestants won when they could successfully "comprehend the world of 'women's logic'" (Gray 2012).[3]

The concept of "women's logic" even forms a fairly popular Internet meme. The images from repeated searches on the term tend to be sketches or stock images with writing that explains or laments "women's logic." For example, one image is a little boy asking, "Dad can you explain women's logic?" The Dad replies, "You're grounded!" and when the boy asks why, the Dad replies, "Peanut Butter." Here we have women's logic being associated with non sequitur. Shared features of the images and pages that come up in searches on "women's logic" include the association of men's logic with the traditional logical virtues taught in logic and critical reasoning classes and association of women's logic with some violation of these virtues. It is not a stretch to imagine that these images, jokes, and stereotypes leave an impression on our female students.

There is also a great deal of work on the conflict between femininity and

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[1] *Urban Dictionary*, term "female logic" retrieved from: http://www.urbandictionary.com/define.php?term=female%20logic.

[2] *Urban Dictionary*, term "women's Logic" retrieved from: http://www.urbandictionary.com/define.php?term=Women%20Logic. I have eliminated typos in this quote order to make the definition easier to read.

[3] The game show appears to have since been cancelled; for further reading, see also Giorgi Lomsadze (April 9, 2012), "Georgia: TV Show that Explores 'Women's Logic' Sparks Debate On Women's Rights," Eurasianet.org, http://www.eurasianet.org/node/65242.

reason in the history of philosophy. In *Gendered Reason,* Phyllis Rooney (1991) gives historical examples showing the division between the emotional/rational where female is explicitly or symbolically associated with the emotional. Rooney argues that "the parameters and politics of 'rational' method, discourse, and voice are defined in ways that still subtly but powerfully diminish women's voices" (1991, 96). In Genevieve Lloyd's *The Man of Reason* (1993), there is also a description of the split between emotion (female) and rationality (male) in the works of Descartes and Hume. The close association between logic and reason makes it likely that our female philosophy students are coming away from studying these texts with the stereotype that reason, and thus logic, is masculine.

Inside the logic classroom, students have for generations been subjected to examples and ideas that trigger their stereotyped identity. Some examples given by Noretta Koertge in The Feminist Critique [Repudiation] of Logic (2010) are:

> No photograph of a lady ever fails to make her simper or scowl (Carroll 1958, 101).
> A good husband is always giving his wife new dresses (Carroll 1958, 121).
> Whoso findeth a wife findeth a good thing (Copi 1979, 71).
> All popular girls are good conversationalists (Copi 1968, 159).
> All successful executives are intelligent men (Copi 1968, 134).
> Single women are decorous only if they are chaperoned (Kalish and Montague 1964, 98).
> Women without husbands are unhappy unless they have paramours (Kalish and Montague 1964, 98).

Thankfully, our current students are unlikely to be subjected to the above phrases as most of these textbooks are no longer widely used. However, these are the texts from which current instructors learned logic. While lecturing, many instructors draw from examples they remember from when they learned logic; thus, these types of examples can again rear their ugly heads (unless we, as instructors, make specific efforts to guard against this).

The examples above show how implicit biases—which Jost et al. define as "attitudes, stereotypes, and prejudices in the absence of intention, awareness, deliberation, or effort" (2009, 43)—held by instructors and textbook authors can create environments that are conditioned for stereotype threat. Any attempt to reduce stereotype threat also requires reducing the implicit biases held by those in the field. This paper concentrates specifically on stereotype threat but recognizes that the problem outlined in the first section of this paper—exceptionally low numbers of women working in logic—will not be resolved without also concentrating on reducing implicit bias.

Reducing Stereotype Threat

There is still some debate about the mechanism involved in stereotype threat, but it is generally agreed that the anxieties and reduced psychic resources experienced by students suffering from stereotype threat are largely situational. This means that while it is the pervasive social stereotypes that set students up to be vulnerable to stereotype threat, the triggers for stereotype threat are primarily situations that occur in our classrooms. If this is the case, then there should be things we can do in our classrooms to reduce the effects of stereotype threat. As Murphy et al. (2007) argue, "A person's vulnerability to identity threat need not be inherent to him or her. Instead, situational cues may contribute to experiences of social identity threat among groups potentially stereotyped in a setting—even when targets are interested, confident, proven achievers in the relevant domains" (879).

One of the factors most often cited in the literature as impacting stereotype threat is the belief that intelligence in a particular area is innate. Many female students are aware of stereotypes about women being poor at math. However, the knowledge of this stereotype primarily affects women who believe that mathematical ability is innate. Carol Dweck found that knowledge of the stereotype that women are bad at math "had little impact on women who viewed their math ability as something they could augment. In contrast, feeling surrounded by a negative stereotype had a strong impact on women who thought of their math ability as a gift" (Dweck 2007, 51). Perhaps one effective way to reduce stereotype threat is to remind students that intelligence isn't innate. In the studies cited by Dweck (2007), students were given a geometry lesson with descriptions of mathematical geniuses (Euclid and Reimann). In one section the innate ability or natural talent of these mathematicians was highlighted, and in another their hard work and dedication was highlighted. In this particular study, "when females got the lesson that conveyed the idea that math skills are developed, [their scores] equaled the males" (2007, 53).

The fact that concentrating on innate ability can trigger stereotype threat is one of the reasons why teaching introduction to logic as though students are being given the keys to good reasoning (rationality with a capital R) can, I think, be extremely counter-productive and damaging. I am reminded of the anecdotal example of a professor who likes to introduce his logic section by telling students that he is about to give them the magical insight to the Platonic realm of rationality.[4] This may trigger stereotype effects for some students who are in marginalized groups. It also frames logic as an innate ability since students don't typically think of

[4] Personal communication.

"rationality" as something that is worked on. And if it is innate, then it suggests to students who may find first order predicate logic counter-intuitive that they are wrong or that something is wrong with them. Students should be reminded in intro to logic classes that they are learning only one system (and one that is counter-intuitive in many ways). A student's perceived failures in this particular system may show that they have more appetite for other areas of logic rather than that they have no logical ability.

We can reduce stereotype threat in introduction to logic classes by making sure that, when we introduce role models for our students, we concentrate less on "genius" and "innate talent" and more on the time and hard work that goes into mathematical and logical discoveries. Audrey Yap (2013) argues relatedly that stereotype threat interferes with student performance, and suggests that "a role model whose intellectual ability is seen as too far beyond that of the student's would be discouraging, rather than encouraging" (6). We can ensure that students know that their own abilities will develop with time and effort. I spend some time in logic and critical reasoning classes describing the "aha moment" that comes after enough time working on derivations. I try to make sure that students know that it is perfectly normal to spend a great deal of time working with a system before everything clicks into place. The metaphors of learning to play an instrument[5] or learning a new language may help to illustrate to students that everyone needs to put in time where the activity is effortful before they become proficient.

Another successful method for reducing stereotype threat is "external attribution," informing students about what stereotype threat is and how it might impact their performance (Singletary et al. 2009, 6). In one study, students were told about stereotype threat and advised that any anxiety they feel is likely due to negative stereotypes about women and math and not about their own abilities, because "giving individuals an external attribution for the anxiety they feel reduces stereotype threat and results in performance that is at the level of the non-threatened group. In these examples, female students perform just as well as male students on mathematics tests" (2009, 7).

Most logic teachers give a brief "what is logic?" discussion in the first class of an intro to logic section, where they disabuse students of the idea that they will be taught to think "logically" in the colloquial sense of the term. This seems an appropriate place to bring up stereotypes about logic, to have students fill in what they think logic is and what "thinking logically" entails. We should speak about gender stereotypes around thinking logically and how stereotypes, even if we don't

[5] This particular example is thanks to Carla Fehr who suggested that my previously preferred metaphor of playing a sport may be gendered.

believe they are true, can impact performance and cause anxiety.

Another successful method for reducing stereotype threat is the introduction of counter-stereotype role models. One way to do this is to introduce students to members of the stereotyped group who have done well in the area. For example, "when female students are exposed to women that have performed successfully in mathematics and science related fields, they perform better than female students who do not have examples of women with such performance" (Singletary et al. 2009, 6). One study showed that reading essays about women who are successful in math can reduce the negative effects of stereotype threat (McIntyre et al. 2005). "Thus, direct and indirect exposure to women that have successfully navigated the field can be enough to reduce the negative impacts of stereotype threat for female students" (Singletary et al. 2009, 7).

This suggests the importance of highlighting women in logic. As Lockwood and Kunda argue, "the direction of [the] impact [of role model introduction] depends on the believed attainability of their success: Models of attainable success can be inspiring and self-enhancing, whereas models of unattainable success can be threatening and deflating" (1997, 101). In the interest of attainability, it is also extremely important to mention women currently working in logic such as Audrey Yap, Penelope Maddy, Dorothy Edgington, Susan Haack, and many others conveniently listed on the Women in Logic list.[6] Relatedly, having teachers who are members of the stereotyped group demonstrably reduces stereotype threat as well. For example, Singletary et al. observe, "women will experience less stereotype threat on a math test if the test is administered by a female teacher, just as African Americans will experience less stereotype threat if the test is administered by an African American teacher. . . . This research underscores the importance of having a diverse teaching and administrative staff" (2009, 6). In philosophy, a correlation was found between the number of female faculty in a philosophy department and the number of female philosophy majors in that department (Paxton, Figdor, and Tiberius 2012).

When giving exams we can also reduce stress for stereotyped groups. In Haslanger's words, "Logic tests do not capture logical intelligence" (2008, 219). For example, we can be careful to frame the task so that it doesn't trigger stereotypes, and make sure prior to giving an exam that we aren't triggering membership in stereotyped groups. Certainly, singling out a student on the basis of their social

[6] That list can be found at: http://loriweb.org/women-in-philosophy-of-logic-and-philosophical-logic/.

identity in order to assure them that they will do fine in spite of this identity[7] would do far more harm than good. Another strategy that has proven to be successful during tests is to tell students that the test they are being given has no gender difference. In one study, students were told prior to taking a test that the test is gender-fair, i.e., there is no gender difference in the results. "Because individuals are assured that the test does not show any gender differences, women are likely to perform as well as their male counterparts" (Singletary 2009, 5). This can also be adopted as a general strategy for the evaluation of the course itself. I often remind students that there is no gender gap in grades for the introduction to logic class. This helps (I hope) to slightly ameliorate the "male students are the only ones speaking" phenomenon that sometimes happens. For example, it may remind students that there are female students who are doing just as well in the course and who also know the answers to the derivation but may just be too shy to speak up.

There are alternative ways to introduce logic that don't result in such a clash of schemas and that don't trigger stereotype effects. By using these methods, we may not get the same gratitude from the students as we would if we pretended that we were giving them the magical keys to supreme rationality, but hopefully these methods can make logic more accessible to students of all genders and races. We can present logic to our undergraduate students by concentrating on aspects of logic that highlight logic as language. In my classes, I remind students that they have mastered at least one natural language, the rules of which are much more complex than those of formal logic. I also speak about modelling natural language using logic as though we are learning a code to simplify the structure that we already know is there. Rather than reflecting of our logic or rationality, the course is simply measuring how good students get at using the code. My hope is that this reminds students of the "secret codes" most of them developed as children, when such things were inherently fun. It is admittedly idiosyncratic to find logic fun and to take aesthetic pleasure in symbolic logic. I hope these strategies can reduce stereotype threat to the point where our female students can enjoy logic free of the anxiety that their success or failure reflects on their entire gender. If this leads to more women entering advanced logic classes and more women studying logic, then so much the better.

I hope that these strategies – introducing counter stereotype role models, speaking to students about stereotype threat, and introducing logical ability as a learned rather than innate skill – help to reduce stereotype threat for our female

[7] I am reminded of an anecdote of a professor who went up to a female student prior to a test and said that she need not worry about being a woman – she would still do well on the test (presumably in spite of her gender).

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students in logic classes. I am also optimistic that the current popularity of research on stereotype threat will result in even more strategies that we can implement. Jennifer Saul concludes her paper on implicit bias and stereotype threat by listing a number of colleagues who are going to try to reduce the impact of stereotype threat in their logic and philosophy classes. I hope this number grows and that we start to see an increase in the number of women becoming interested in logic.

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