Article

Negative Gender Ideologies and Gender-Science Stereotypes Are More Pervasive in Male-Dominated Academic Disciplines

Sarah Banchefsky * and Bernadette Park [ID]

Department of Psychology and Neuroscience, University of Colorado Boulder, Boulder, CO 80309, USA; bernadette.park@colorado.edu
* Correspondence: banchefs@colorado.edu

Abstract: Male-dominated work environments often possess masculine cultures that are unwelcoming to women. The present work investigated whether male-dominated academic environments were characterized by gender ideologies with negative implications for women. A survey of 2622 undergraduates across a variety of academic majors examined how gender imbalance within the major corresponded with students' gender ideologies. We hypothesized that men in male-dominated domains might justify their dominance and prototypical status by adopting gender ideologies and stereotypes that denigrate women and treat men as the normative and superior group. Confirming this hypothesis, men in increasingly male-dominated academic majors were more likely to endorse Assimilationism—that women should adapt and conform to masculine work norms in order to succeed—and Segregationism—that men and women should pursue traditional social roles and careers. Moreover, they were less likely to endorse Gender Blindness—that attention to gender should be minimized. They were also more likely to agree with the gender-science stereotype that men do better in math and science than women. In contrast, gender imbalance in the major did not influence women's gender ideologies, and women in increasingly male-dominated majors were significantly *less* likely to endorse the gender-science stereotype.

Keywords: gender stereotypes; gender bias; women in STEM; gender representation; academic majors

1. Introduction

One professor told [classmates] not to present themselves as women first if they wanted to be taken seriously as "engineers."—Female undergraduate in engineering (Walton et al. 2015)

> As a coping and advancement strategy, women in [Science, Engineering, and Technology] fields tend to adopt traditionally masculine attitudes and attributes. In short, women tend to behave like men. One woman we spoke with said she learned to stop wearing skirts and makeup early on in order to increase her credibility at work. She reflected that increasingly she had developed a "discomfort with being a woman." (Hewlett et al. 2008)

Why have some academic and work sectors remained stubbornly male-dominated whereas others have made notable progress towards gender parity? One obstacle gaining attention is the masculine culture that pervades many male-dominated environments (Mundy 2017). Broadly, workplace culture is defined by the values and traditions within that workplace, which reciprocally relate to individual attitudes, behaviors, interactions, and structural features, including workplace policies (Markus and Hamedani 2007). Cheryan and colleagues conceptualized "masculine cultures" as "features of a field (e.g., beliefs, norms, values, structures, interactions) that can cause women to feel a lower sense of belonging or be less successful than their male counterparts" (Cheryan et al. 2016, p. 6). They noted

three features of masculine cultures that deter women's belonging and success: a lack of female role models, stereotypes of people in the field that are incompatible with stereotypes of women (e.g., brilliant, nerdy, socially awkward; (Carli et al. 2016; Eagly and Steffen 1984)), and stronger and more problematic stereotypes about women's abilities (Cheryan et al. 2016; Leslie et al. 2015; see also (Danbold and Huo 2017; Murphy et al. 2007)). At best, fields with masculine cultures are unsupportive towards women; at worst, they are downright hostile (Hewlett et al. 2008; Seymour 1995; Seymour and Hewitt 1997).

The current research aims to address a feature of masculine cultures that has not been examined in prior research—gender ideologies. Gender ideologies are prescriptive sociopolitical beliefs about how to approach gender differences in order to avoid intergroup conflict and hostility. Here, we propose that "negative" gender ideologies that are unwelcoming to women are more commonplace in male-dominated fields. Apfelbaum et al. (2016, p. 1) coined the term "diversity approach" to refer to the set of prevailing beliefs about how diversity and social group differences ought to be handled within an organization. These so-called diversity approaches "provide a blueprint for intergroup processes and relations at work—how to think, feel, and interact with individuals from different backgrounds to be successful." A work environment can explicitly adopt an approach in their diversity policy statement (Apfelbaum et al. 2016), or the attitudes about diversity among majority group members might be subtly communicated to the non-dominant group. For example, racial minority group members reported lower workplace engagement and greater perceived bias in proportion to White coworkers' reported belief that minorities should assimilate to Whites (Plaut et al. 2009). In either case, the diversity approach within a given environment is related to racial minorities' attraction to and engagement with the workplace (Purdie-Vaughns et al. 2008), the perceived level of racial bias among colleagues (Plaut et al. 2009), and ultimately, retention of racial minorities and women (Apfelbaum et al. 2016).

Despite an abundance of research on ethnic and racial ideologies, work on gender ideologies is minimal (see Hahn et al. 2015; Koenig and Richeson 2010; for exceptions). Furthermore, no research we are aware of has investigated whether endorsement of specific intergroup ideologies within a given field (regarding either race/ethnicity or gender) corresponds to the numeric representation of the social groups in that field. We propose that male-dominated environments attract and reinforce gender ideologies that support a masculine status-quo and discourage women from joining, influencing, or remaining within that environment. To test this hypothesis, we examine students' gender ideologies and examine how these ideologies correlate with the gender representation within their academic field (i.e., their academic major). We hypothesize that the prevailing "diversity approach," captured vis-à-vis espoused gender ideologies, depends on the actual gender diversity within a given academic field, and in turn is related to gender-science stereotype endorsement. To examine these hypotheses, we conducted a survey of 2622 undergraduates across a variety of academic majors and examined how gender representation within academic majors corresponds with students' gender ideologies.

We found that men in increasingly male-dominated academic majors were more likely to endorse Assimilationism—that women should adapt and conform to masculine work norms in order to succeed—and Segregationism—that men and women should pursue traditional social roles and careers. Moreover, they were less likely to endorse Gender Blindness—that attention to gender should be minimized. Men in male-dominated academic majors were also more likely to agree with the gender-science stereotype that men do better in math and science than women. In contrast, women's gender ideologies were unrelated to the gender representation in their major, and women in increasingly male-dominated majors were significantly *less* likely to endorse the gender-science stereotype. We conclude with implications and recommendations for creating more positive environments for women in male-dominated fields.

2. Literature Review

2.1. Gender Ideologies

Hahn et al. (2015) described four distinct gender ideologies that emerge from crossing two key intergroup attitudinal dimensions: (1) whether differences between men and women should be attended to or ignored, and (2) whether the "subordinate" or lower status group—women—is positively or negatively evaluated. The first dimension captures one's emphasis on and desire to preserve gender categories: Is gender meaningful and important in how one ought to treat others, or should we instead focus on similarities between the genders rather than their differences? A second and largely neglected dimension of diversity approaches is the extent to which individuals possess positive and respectful versus negative and dismissive attitudes towards the lower status subordinate social group—in this case, women (see Kimball 1994). Thus, whereas the Gender Blind ideology focuses on similarities and seeks to avoid category distinctions (e.g., "All humans are fundamentally the same, regardless of their gender"), its negative counterpart, Assimilationism, maintains that gender *can* be ignored so long as women accept the norms and values of the cultural majority (men), and emulate their behavior to succeed (e.g., "Women in the corporate world should embrace a masculine work ethic"). Similarly, whereas Gender Awareness maintains that the differences between men and women should be acknowledged and celebrated (e.g., "Men and women have different but equally useful ways of accomplishing tasks"), its negative counterpart, Segregationism, argues that gender differences are so substantial that society and the workplace function better when men and women simply stick to their separate spheres of traditional "expertise" (e.g., "Men and women are naturally suited to different jobs and should continue to do those").

We hypothesize that the negative ideologies should be more prevalent among men in male-dominated fields, whereas the positive ideologies should be less prevalent. As discussed previously, men in male-dominated fields benefit from a masculine culture in which they are presumed to be superior and get to set the rules. For example, children and adults tend to draw men when asked to draw a scientist (a male-dominated field, (Chambers 1983)), and men and women not only automatically associate men with STEM fields (which are male-dominated) more than women (Nosek et al. 2009), they also believe that men and boys are naturally more gifted than women and girls in male-dominated fields (Leslie et al. 2015; Räty et al. 2002). Furthermore, male-dominated environments generally are shaped by and reflect the particular norms and culture of the male-majority of those fields (Cheryan et al. 2009). In other words, men in male-dominated environments determine the normative professional demeanor, beliefs and attitudes (Cheryan et al. 2009; Danbold and Huo 2017; Moscovici 1976; Wood 2000), which bestows upon them a greater sense of belonging (Lewis et al. 2016) and self-efficacy (see (Eddy and Brownell 2016) for a review) compared to women.

Thus, compared to other men, those in male-dominated environments should be more likely to subscribe to the negative gender ideologies that support and legitimize their status as prototypical group members. Specifically, they should be more likely to espouse Segregationism, which discourages women from entering such fields in the first place, and Assimilationism, which maintains that if women do enter, they should conform to the field's traditional (male established) norms. In contrast, both Gender Blindness—which maintains that women are the same as men—as well as Gender Awareness—which maintains that men and women may approach the same task differently but in equally valuable and important ways—call into question men's dominance and presumed superiority in male-dominated fields. These positive ideologies should therefore be less commonplace among men in male-dominated fields compared to men in other fields. Along these lines, a recent study found that among male undergraduates majoring in STEM, those who legitimized their prototypical status (e.g., "Men are naturally better at my major than women") were more likely to believe that women should assimilate to men (e.g., "Women in my major should adapt to the values and practices of men in my major"; (Danbold and Huo 2017)). These ideas form the underlying rationale for Hypothesis 1,

that men in increasingly male-dominated majors will express greater agreement with the two negative ideologies, and less agreement with the two positive ideologies.

It is less clear whether to expect a relationship between gender imbalance in academic majors and women's gender ideologies. System justification theory suggests that those disadvantaged by a given system nevertheless support and defend it (Jost et al. 2003). Research indicates that some women assimilate to masculine norms in male-dominated fields as a coping mechanism—to be taken seriously, avoid harassment, and advance their career (Hewlett et al. 2008; Pronin et al. 2004). At the same time, given that the negative focus of the ideologies is directly aimed at them, it is reasonable to expect that regardless of the gender make-up of their major, women will be more likely than men to disagree with the negative gender ideologies, and agree with the positive gender ideologies.

2.2. Gender Ideologies and Gender Stereotypes

Gender ideologies are part of a broader set of attitudes about what groups are like, including agreement or disagreement with stereotypic portrayals of group members (see Wolsko et al. 2000). Of particular relevance to this research is the stereotype that men are better at math and science than women (i.e., gender-science stereotypes; (Good et al. 2008; Spencer et al. 1999)). This stereotype is highly relevant and consequential to women's experiences and success in male-dominated fields, many of which are STEM fields that require math and science skills. Hypothesis 2 concerns the relationship between gender ideology endorsement and agreement with the gender-science stereotype that men are better at math and science than women. Because both Assimilationism and Segregationism devalue women in traditionally masculine domains, we hypothesized that both would be related to stronger gender-science stereotypes. On the other hand, those who more strongly endorse Gender Blindness (which both minimizes gender differences and holds women in relatively positive regard), should possess weaker gender-science stereotypes.

Although Gender Awareness acknowledges that gender differences exist, suggesting stronger stereotype endorsement, it also holds women in positive regard, suggesting weaker stereotype endorsement given that the gender-science stereotype is decidedly negative toward women. Consequently, we did not have a strong hypothesis about how Gender Awareness would relate to gender-science stereotypes. We expect that there is a great deal of variance in terms of what gender differences those who subscribe to Gender Awareness prefer to celebrate and emphasize, which may create a non-significant relationship between Gender Awareness and gender-science stereotypes.

There was no reason to expect that the gender ideologies would relate to gender-science stereotypes differently for men and women. While we expected mean differences in ideology endorsement (that women would endorse the positive ideologies more than men, and the negative ideologies less than men, replicating (Hahn et al. 2015)), the *relationship* between ideology and stereotype endorsement should not depend on gender: for both women and men, the more strongly they agreed with, for example, Assimilationism, the more we expected they would endorse gender-science stereotypes.

2.3. Male-Dominated Fields and Gender-Science Stereotypes

If it is the case that men in male-dominated majors seek to protect their privileged status, they should subscribe more to gender-science stereotypes, both compared to women in their own major, and to men in other majors. Indeed, Nosek and Smyth (2011) found that undergraduate men enrolled in STEM courses showed the strongest endorsement of the "men are better at math" stereotype. In contrast, women's ability to persist and succeed in math and science intensive spheres requires rejecting gender-science stereotypes in order to protect their self-concept and self-esteem (Schmader et al. 2004; see also Stout et al. 2011). Because gender-science stereotypes are derogatory toward women's performance in math and science and evoke stereotype threat, we anticipated that women in those fields would disagree with the stereotype both more than the men in their fields, and more than women in less male-dominated (and largely less math and science focused) majors. These proposed gender

differences in gender-science stereotype endorsement as a function of gender imbalance in the major constitute Hypothesis 3.

3. The Present Study

We assessed gender ideology endorsement and gender-science stereotypes among a large number of men and women undergraduates whose academic majors captured a vast range of gender representation. We quantified "male-dominance" of the major as the percentage of men within that given major at the University level. A summary of the hypotheses described in the introduction follows. Importantly, we note that this is a correlational study and causal relationships necessarily cannot be tested or inferred. It is likely that each of the relationships described below is bidirectional in nature. Still, we view these correlational relations as important for understanding the environment in which women in male-dominated academic majors are attempting to succeed.

3.1. Hypothesis 1. For Men, Gender Ideologies Correlate with Male-Dominance of the Major

Men should endorse the negative gender ideologies—Assimilationism and Segregationism—more strongly in male-dominated environments, whereas they should endorse the positive gender ideologies—Gender Blindness and Gender Awareness—less strongly in male-dominated environments. The core hypothesis was this predicted pattern for men; predictions for women were equivocal given the competing dynamics previously discussed.

3.2. Hypothesis 2. Gender Ideologies Correlate with Gender-Science Stereotypes

The negative gender ideologies will be related to stronger gender-science stereotypes, whereas Gender Blindness will be related to weaker gender-science stereotypes. We did not have a strong hypothesis for Gender Awareness as it both acknowledges gender differences but simultaneously views women positively. Gender interactions will be explored but are not expected (see Hahn et al. 2015).

3.3. Hypothesis 3. The Gender Gap in Gender-Science Stereotypes is Stronger in Male-Dominated Majors

Although men will endorse gender-science stereotypes more than women on average, this will be exacerbated in male-dominated majors. Men in male-dominated majors will be more likely, and women less likely, to endorse gender-science stereotypes.

4. Method

4.1. Participants

A convenience sample was used to collect a large sample of students from across a broad variety of academic majors. All participants (*n* = 2684) were enrolled in General Psychology at our University, a large public institution in the Intermountain Region of the United States. General Psychology is required for students majoring in Psychology. The course is also very popular among students who are not majoring in Psychology, and is used to fulfill elective requirements for a broad array of other majors both within the College of Arts & Sciences, as well as other schools (e.g., the School of Engineering). Participants opted to complete measures during mass testing sessions (pre-screens) at the beginning of each academic semester over the course of two years. As researchers in the psychology department, we were able to submit questions to this pre-screen and subsequently access the pre-screen data. This enabled us to examine the relationship between the Gender Ideologies and the gender representation in each student's major. Because General Psychology is a very popular course that attracts students from across the entire University, the sample provided a fairly broad sample of the student body.

Four participants took the survey twice in two different semesters; their second set of responses was removed. Participants who only answered a single item (*n* = 28) were removed for lack of attention; the remaining participants answered all or nearly all of the items. Finally, 29 participants who were

younger than 18 years of age (per IRB requirements), and one person who did not report their gender, were removed, resulting in a final sample of 2622 participants.

The sample was 61.4% female and mostly White (77.28%), followed by Asian or Asian-American (9.3%), Latino/a or Hispanic (7.51%), and African-American (1.5%). The remaining participants selected "other." The mean age was 19.03 years (*sd* = 1.61, min = 18, max = 36). Participants were primarily freshmen (61.15%), followed by sophomores (21.39%), juniors (9.64%), seniors (6.52%), and advanced seniors (1.3%).

Academic Major and Percent Men in the Major

Students reported their academic major(s) in an open-ended text box. To quantify the extent to which each student's major was male-dominated, we first systematically recorded each declared major (or majors, if they reported two). We then referenced institutional records on gender representation in each academic major to define the percentage of men ("percent men") in each student's academic major(s) during the semester of data collection. The results showed that 2186 (83.34%) of students' self-reported majors could be categorized. Of the entire sample, 437 participants (16.66%) either did not provide an academic major or reported that they were "undecided" or "open option"; we were therefore unable to determine the percent men in their major and they did not receive a score for this variable. For students that reported a second major (209 people, 9.56%), the percentage of men in each major was averaged (results were the same if only the first reported major was used to calculate percent men in the major). Seventy-nine different majors were reported as a first major and 44 different majors as a second major. During data collection, there were between 103 and 118 available majors (the university added more majors throughout the four semesters of data collection), indicating that a large percentage of the possible majors at the university were represented in our sample. This continuous measure of male-dominance (i.e., percent men in the major) is both theoretically superior to categorizing students dichotomously into a STEM versus non-STEM major (Cheryan et al. 2016; Leslie et al. 2015), and provides greater statistical power than choosing a cut-off point by which to categorize majors as male-dominated or not (Irwin and McClelland 2003).

4.2. Measures

4.2.1. Gender Ideologies

The 18-item gender ideology scale developed by Hahn et al. (2015) assesses the four gender ideologies described above (see Appendix A). Each ideology is composed of 4–5 items. Participants rated their agreement with each item on a 7-point scale ("strongly disagree" to "strongly agree"). The gender ideologies were collected in all four semesters. Note that Hahn et al. (2015) present data from three of these four semesters (*n* = 1618) to establish the measurement properties (i.e., reliability and validity) of the ideology scales. The present results add a fourth semester of data collection, along with two semesters of the gender-science stereotype questions (not reported in (Hahn et al. 2015)), and all of these measures are examined as a function of the gender diversity in the student's academic major (not considered in (Hahn et al. 2015)).

First, a confirmatory factor analysis was conducted with each of the 18 items loading onto the appropriate gender ideology. Factor variances were constrained to one to identify the model. Fit was evaluated using suggestions provided by Hu and Bentler (1999): ideally, CFI should be around 0.95, RMSEA should be lower than 0.06, and SRMR should be below 0.08. In the initial CFA, the RMSEA and SRMR fulfilled these guidelines: $\chi^2(129) = 999.653$, *CFI* = 0.911, *RMSEA* = 0.050, 90% CI = [0.048, 0.053], *SRMR* = 0.048; moreover, all item loadings were highly significant. To improve model fit, modification indices were examined. The largest modification index suggested fit would be substantially improved by allowing two Gender Blind items (2 and 3, both of which explicitly mentioned the sameness or similarity of the genders, see Appendix A), and two Assimilationism items (1 and 4, both of which explicitly mention adopting masculine qualities, customs or behaviors) to share residual covariance.

This improved the fit and the CFI, $\chi^2(127) = 780.209$, *CFI* = 0.933, *RMSEA* = 0.044, 90% CI = [0.041, 0.047], *SRMR* = 0.044. The other substantial modification indices suggested having certain items load onto more than one factor (e.g., having Segregationism item 5 load onto the Gender Aware factor). We did not want to go this route as it violated the theoretical four-factor theory of intergroup ideologies described and validated in Hahn et al. (2015). Thus, this was the best fitting model consistent with our theoretical framework.

By averaging the appropriate items, scales were constructed for Gender Blindness ($\alpha = 0.56$), Gender Awareness ($\alpha = 0.71$), Assimilationism ($\alpha = 0.79$), and Segregationism ($\alpha = 0.63$). Notably, alpha for both Gender Blindness and Segregationism are somewhat lower than desired. These lower alphas were due in part to the small number of items per scale, and to the broad content covered with the items measuring each ideology (see (Hahn et al. 2015), for a more detailed discussion of these points, p. 1648). The alphas could be increased by adding items that are slight variations of the included items. However, the shorter scales increase the feasibility of including the full 18-item set in research projects (indeed we had severe limitations on the number of items we could include in the pre-screens). Because our intention is that the 18-item scale described here (and validated in (Hahn et al. 2015)) is utilized in future research, we treat the gender ideologies as observed variables. It is important to keep in mind the varying levels of reliability for the scales (specifically, the somewhat lower alphas for Gender Blindness and Segregationism) in interpreting the findings reported in the Results section, as differences in the amount of measurement error for the scales can contribute to differences in the magnitude of correlations with other variables of interest.

4.2.2. Gender-Science Stereotypes

Due to limitations on the number of items that could be included in the pre-screens, a single gender-science stereotype item was included in two of the four data collection semesters (*n* = 1233). The item asked about personal gender-science stereotypes ("According to my own personal beliefs, I generally expect men to do better in math and science than women"). Participants rated their agreement on a 7-point scale ("strongly disagree" to "strongly agree"). In addition to personal gender-science stereotypes, one item assessed *perceived* societal gender-science stereotypes. Because of social desirability concerns, people may be sensitive about reporting sexist responses, but be willing to report sexism among society at large (Klonis et al. 2005; Nederhof 1985). Participants were in fact willing to report personal gender-science stereotypes, and the perceived societal ratings showed less consistent patterns. Given that personal stereotype endorsement was the construct we wanted to measure, analyses for the perceived societal stereotypes are reported only in the Supplemental Materials.

4.2.3. Demographics

Each semester, the pre-screen survey includes standardized demographic questions. Each question had an opt-out response which read "Check this box if you do not want to provide an answer for this question." Demographics relevant to this research included gender ("What is your gender?" with responses "Male" and "Female"), and self-reported academic major(s) ("What is your college major?"). Other demographics collected included age, ethnicity, and year in school.

4.3. Procedures

The gender ideology scale was included in all four surveys. In the first two surveys, all items were presented on the same page in randomized order. In the second two surveys, items were pre-randomized onto four different pages (due to programming constraints), with 4–5 items on each page. They were then randomized on each page for each participant. The gender-science stereotype item was included in the second and third collection semesters. It was always presented after the gender ideology items, and separated from them by other measures included by other researchers.

5. Results

Preliminary analyses consisted of examining mean gender differences and correlations among the variables, as well as the distribution of students into different academic majors. Formal analyses utilizing path models were then conducted. Standardized betas (β) are presented to convey effect sizes. Please contact the authors for access to raw data and analysis scripts.

5.1. Mean Gender Differences and Correlations

Descriptive statistics and correlations for all variables are presented in Table 1. Mean gender differences, significance tests, and effect sizes are presented in the bottom row of Table 1. Replicating prior research, men endorsed the negative ideologies (Assimilationism and Segregationism) more than women, $\beta = -0.047$, $SE = 0.020$, $t(2620) = -2.374$, CI = $[-0.086, -0.008]$, $p < 0.0001$, and the positive ideologies (Gender Blindness and Gender Awareness) less than women, $\beta = 0.016$, $SE = 0.002$, $t(2620) = 7.835$, CI = $[0.012, 0.021]$, $p < 0.0001$. Furthermore, men endorsed gender-science stereotypes more than women, $\beta = -0.069$, $SE = 0.0123$, $t(1230) = -5.481$, CI = $[-0.094, -0.044]$, $p < 0.0001$ (see Table 1). As is clear in Table 1 and Figure 1, participants endorsed the positive ideologies far more than the negative ideologies, $\beta = 0.871$, $SE = 0.008$, $t(2620) = -102.70$, CI = $[0.103, 0.136]$, $p < 0.0001$.

The correlations provided initial support for our hypotheses (see Table 1). In accordance with Hypothesis 1, men in increasingly male-dominated majors were more likely to agree with the two negative ideologies (Assimilationism and Segregationism) and less likely to agree with the positive ideology, Gender Blindness. Agreement with Gender Awareness unrelated to percent men in the major for men. We did not have a strong prediction for these relationships for women, and as Table 1 shows, none of the four ideologies was significantly related to percent men in the major for women.
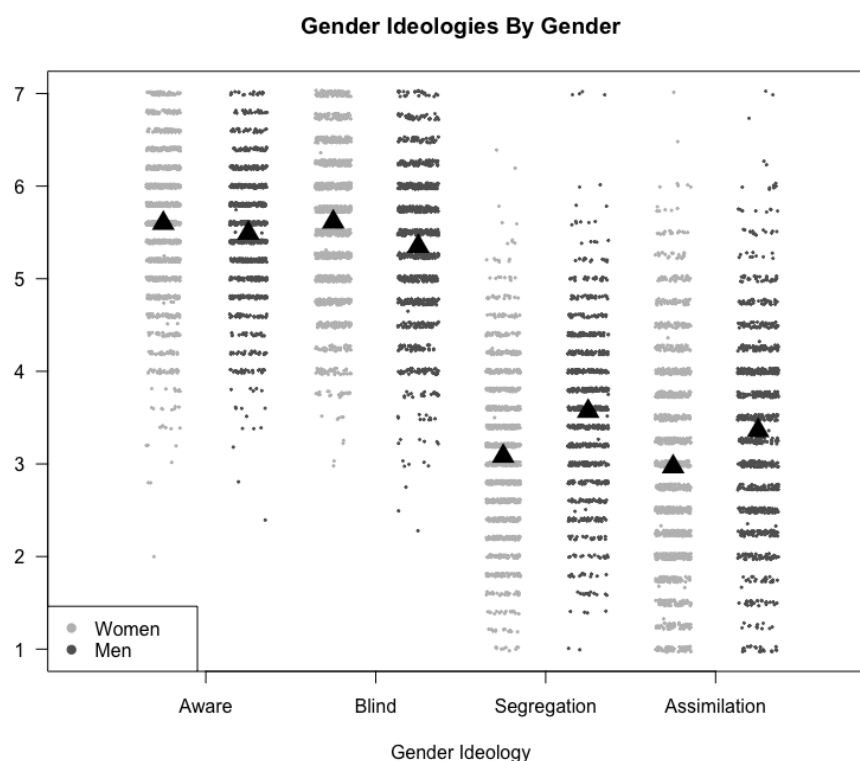

Figure 1. Endorsement of the gender ideologies by gender. Each dot represents a data point. *n* for women was 1610, *n* for men was 1012. Triangles represent the average endorsement of each ideology for men and women.

Table 1. Descriptive Statistics and Bivariate Correlations among the Gender Ideologies, Stereotypes, and Percent Men in the Major by Gender.

	Gender Blind	Gender Aware	Assimilation	Segregation	Gender-Science Ster.	Percent Men
1. Gender Blind	–	0.12 **	−0.12 **	−0.25 **	−0.21 **	−0.03
2. Gender Aware	0.22 **	–	−0.04	0.07 $^+$	0.00	−0.03
3. Assimilation	−0.27 **	−0.12 **	–	0.45 **	0.30 **	0.04
4. Segregation	−0.26 **	0.03	0.54 **	–	0.35 **	0.01
5. Gender-science ster.	−0.21 **	0.01	0.40 **	0.42 **	–	−0.12 *
6. Percent men	−0.08 *	−0.01	0.12 *	0.09 *	0.15 **	–
Alpha	0.56	0.71	0.79	0.63	NA	NA
Women's Mean (*SD*)	5.61 (0.77)	5.60 (0.75)	2.97 (10.09)	3.08 (0.82)	3.10 (10.58)	39.4 (15.36)
Men's Mean (*SD*)	5.35 (0.85)	5.49 (0.71)	3.36 (1.08)	3.57 (0.87)	3.60 (1.49)	55.3 (20.02)
Test of the Gender Difference	$t(2620) = 8.19$ $p < 0.0001$	$t(2620) = 3.55$ $p < 0.001$	$t(2620) = -8.96$ $p < 0.0001$	$t(2620) = -14.45$ $p < 0.0001$	$t(1230) = -5.48$ $p < 0.0001$	$t(2178) = -20.89$ $p < 0.0001$
Cohen's *d*	0.32	0.15	0.36	0.58	0.33	0.89

Note. $^+$ $p < 0.10$, * $p < 0.05$; ** $p < 0.001$. Correlations for women are above the diagonal, correlations for men are below the diagonal. Ster. refers to gender-science stereotype. Percent men refers to the percent men in the student's self-reported academic major(s). If two majors were reported, it is the average percent men across the two majors. The *n* for women = 1610, the *n* for men = 1012. NA = not applicable because only a single item was used.

Supporting Hypothesis 2, the gender ideologies were related to gender-science stereotypes, and in the same manner for men and women: Gender Blindness was negatively related to gender-science stereotypes, and Assimilationism and Segregationism were both positively related to gender-science stereotypes. As noted above, we did not have a strong prediction for Gender Awareness as it both acknowledges gender differences but simultaneously views women positively.

Finally, supporting Hypothesis 3, men agreed with gender-science stereotypes more strongly than women, and this difference was exacerbated in increasingly male-dominated majors. For men, agreement with gender-science stereotypes increased significantly as percent men in the major increased, whereas for women it decreased significantly.

5.2. Percent Men in the Major

Figure 2 shows the gender composition of the most frequently declared academic majors in our sample (majors declared by at least one percent of participants as either their first or second major). Notably, most of the male-dominated majors were pSTEM (physical-science, technology, engineering, and math) majors (e.g., mechanical engineering, aerospace engineering, computer science), but some were not (e.g., economics, finance). The correlation between a major being coded as a pSTEM major and percent men in the major was $r = 0.65$. The average percentage of men in a major for all students was 45.53% ($sd = 18.95\%$); for men it was 55.3% ($sd = 20.02\%$), and for women it was 39.4% ($sd = 15.36\%$), a significant and expected difference, $\beta = -0.161$, $SE = 0.008$, $t(2178) = -20.89$, 95% CI = $[-0.176, -0.146]$, $p < 0.0001$.
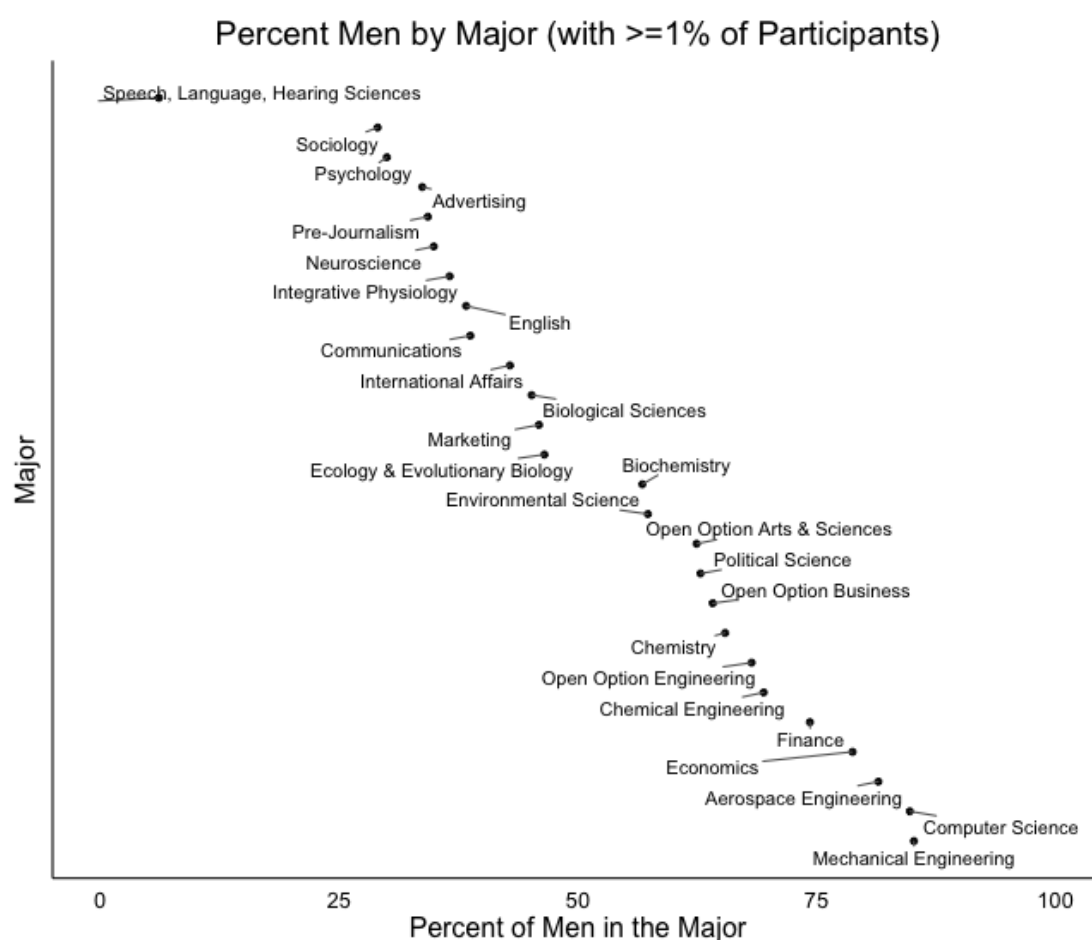

Figure 2. Gender representation in common academic majors within the sample (i.e., that is, majors declared by at least one percent of participants in the sample ($n = 26$).

5.3. Path Models

Path models were used to formally examine relationships among the variables (participant gender, percent men in the major, gender ideologies, and gender-science stereotypes). A path model framework was employed because it enables simultaneous testing of variables as both predictors and outcomes (Ullman 2006). Additionally, it permits the use of full information maximum likelihood estimation (FIML), which can implicitly cope with missingness and provide less biased parameter estimates (Baraldi and Enders 2010; Enders 2010). Notably, results were statistically and substantively equivalent (i.e., significant findings remained significant, non-significant results remained non-significant, and the conclusions were the same) if the models were estimated using list-wise deletion, which removes participants missing responses on any variable in the model.

Our general approach to the path models was as follows: gender, percent men in the major, and their interaction were examined as predictors of gender ideologies, which in turn were examined as predictors of gender-science stereotypes (see Figure 3). It is important to keep in mind that the relationships among the gender ideologies and gender-science stereotypes are likely mutually reinforcing and bidirectional. However, this particular specification of the path model (i.e., having all four ideologies predict the gender-science stereotype) enabled us to test the partial relationship of each ideology with gender-science stereotypes while statistically controlling for the other gender ideologies. Moreover, here we are theoretically interested in how the gender representation of one's academic major is further is related to one's gender ideology, and thus percent men was treated as a predictor of gender ideologies. It is likely the case, however, that gender ideologies also guide a student's choice of college academic major. Regardless of our specification, it is important to keep in mind that these data are cross-sectional and therefore the tested paths do not imply or test causality.

Because the gender ideologies are interrelated, they were allowed to correlate with one another, although results were statistically and substantively equivalent whether they were correlated or not.. Participant gender was contrasted coded as (+1) for females and (−1) for males, and continuous predictors were mean centered. Because undergraduate education is related to increasingly egalitarian gender beliefs and sociopolitical attitudes (Bryant 2003; Campbell and Horowitz 2016), participants' academic year (e.g., freshman, sophomore) was statistically controlled (as a continuous, centered variable). The semester in which the data were collected was also included as a covariate (as a continuous, centered variable) in order to account for dependences in the data based on collection semester.

There were several significant relationships between data collection semester, student's academic year, and the key variables of interest. These were not of theoretical interest, nor did the inclusion of exclusion of the two covariates change any other effects. Nevertheless, these relationships are detailed in the Supplemental Materials for completeness.

5.3.1. Hypothesis 1: Gender Ideologies Correlate with Male Dominance of the Major

The models presented in Figure 3 were used to test Hypothesis 1. Figure 3 depicts the parameter estimates between percent men, gender ideologies, and gender-science stereotypes separately for men and women. Path analysis with invariance testing was used to examine whether the percentage of men in the major differentially predicted gender ideologies for women and men. This entails comparing the fit estimates of a model estimated separately for each gender (as in Figure 3), to a model in which each path of interest is constrained to be the same for men and women. A significant decrease in chi-square goodness of fit would indicate that the paths were significantly different for men and women.

Supporting Hypothesis 1, as seen in the bottom half of Figure 3, men's endorsement of Gender Blindness, Assimilationism, and Segregationism each corresponded to the gender representation of their major (see coefficients for paths from percent men in the major to gender ideologies)—men in more male-dominated domains were significantly less likely to espouse Gender Blindness, and more likely to espouse the negative ideologies Assimilationism and Segregationism. For women, the relationships between percent men in the major and the gender ideologies was non-significant.
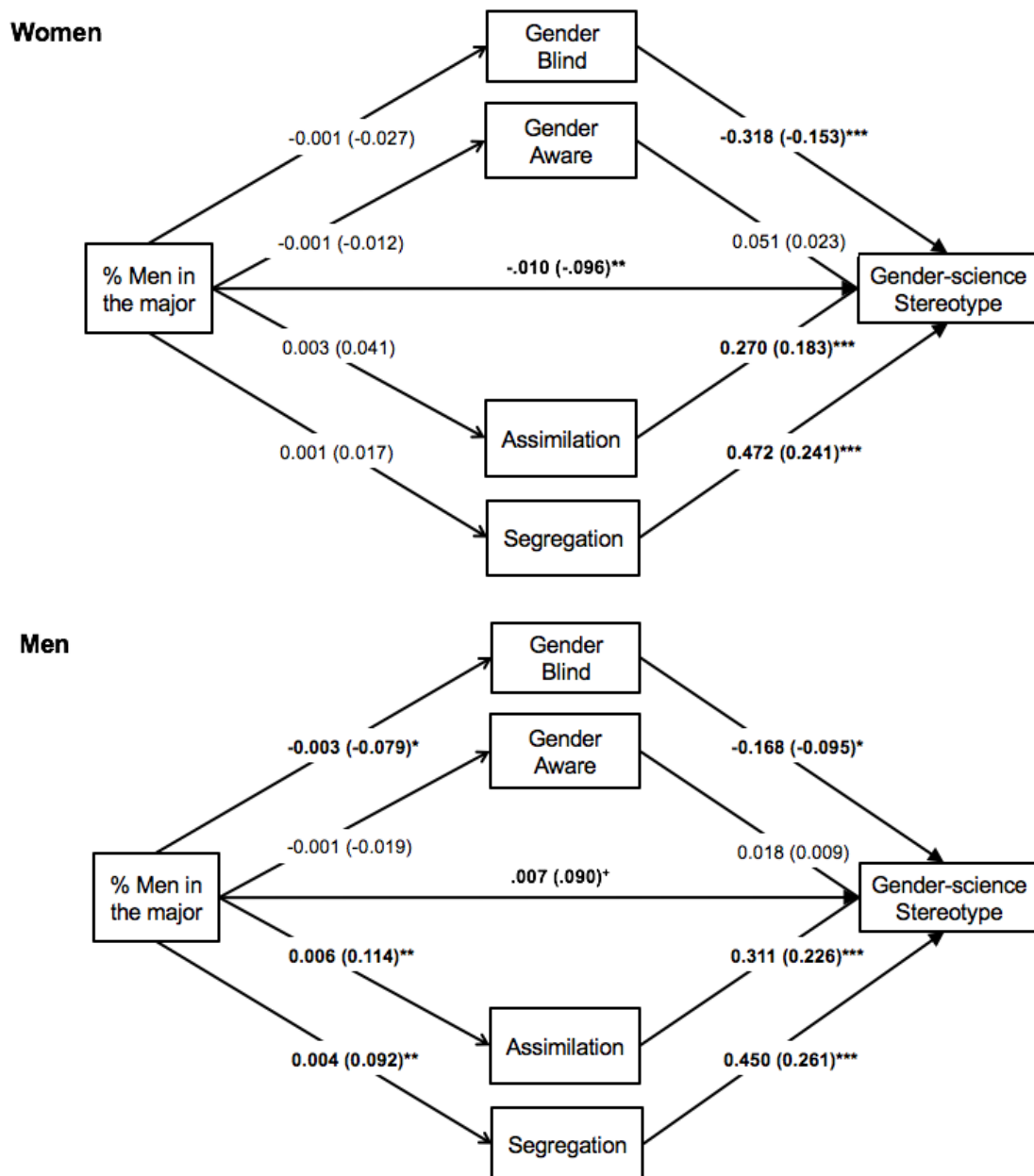
Figure 3. A path analysis of the relationship between percent men in the major and gender-science stereotypes for women and men. Although not depicted for simplicity, covariates included semester collected and academic year; moreover, ideologies were allowed to correlate with one another. Unstandardized regression coefficients are provided outside of parentheses; standardized regression coefficients are provided in parentheses. Asterisks indicate significance of relationships (* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$). The relationship between percent men in the major and gender-science stereotype endorsement was significantly different for women and men; all other paths were not significantly different.

Notably, however, gender invariance tests suggested that model fit did not significantly worsen when each path between percent men and gender ideology was constrained to be equal for men and women. Thus, there was no evidence that the relationships between percent men in the major and gender ideology were statistically different for men and women, all $\chi^2\Delta(1) \leq 2.292$, $ps > 0.13$. In summary, although the paths from percent men to gender ideology were significant for men (for all but Gender Aware), and non-significant for women, the paths for men were not significantly different

from those for women. Figure 3 clarifies that this is because (1) the direction of the relationships for men and women is the same, and (2) the relationships for men, while significant, were not particularly large in magnitude.

5.3.2. Hypothesis 2: Gender Ideologies Correlate with Gender-Science Stereotypes

We found support for Hypothesis 2. As seen in Figure 3 (the right side), Assimilationism and Segregationism were indeed each related to possessing stronger gender-science stereotypes. In contrast, Gender Blindness was related to possessing weaker gender-science stereotypes. Only Gender Awareness was unrelated to gender-science stereotypes. Furthermore, gender invariance tests found no statistical evidence that relationships between the gender ideologies and gender-science stereotypes differed for men and women, all $\chi^2\Delta(1) \leq 1.906$, $ps \geq 0.167$.

5.3.3. Hypothesis 3. The Gender Gap in Gender-Science Stereotypes is Stronger in Male-Dominated Majors

As hypothesized, gender-science stereotypes were significantly stronger among men in male-dominated majors (effect for men: $\beta = 0.150$, $SE = 0.052$, $z = -2.985$, $p = 0.004$; see Figure 4). For women, gender-science stereotypes were significantly weaker among women in male-dominated majors (effect for women: $\beta = -0.104$, $SE = 0.038$, $z = -2.718$, $p = 0.007$). An invariance test comparing these paths (between percent men in the major and gender-science stereotypes) indicated that they were significantly different for men and women; that is, model fit was significantly worse when constrained to be the same across genders, $\chi^2\Delta(1) = 15.208$, $p < 0.0001$.
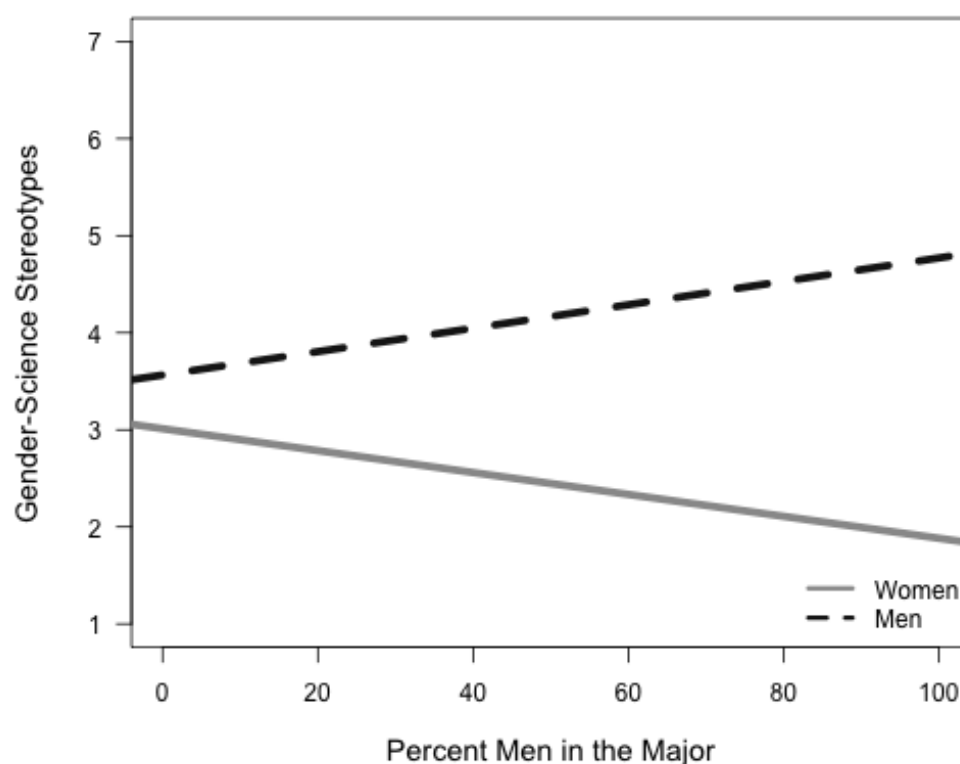

Figure 4. The relationship between percent men in the major and gender-science stereotype, by gender. Regression lines represent partial relationships controlling for academic year and semester of data collection. For men, gender-science stereotypes increased as percent men in the major increased. For women, gender-science stereotypes decreased as percent men increased.

6. Discussion

Every human environment carries with it an underlying and often unspoken culture containing messages about who belongs, who is a prototypical and therefore "normal" group member, and who is not a particularly good fit. In this research, our goal was to elucidate one aspect of academic cultures, specifically, ideological beliefs regarding similarities versus differences, and strengths versus weaknesses, of the genders. We hypothesized and found that as academic majors became more numerically dominated by men, the gender ideologies prominent in those environments became more negative and less accepting towards women. Specifically, the men in male-dominated majors were not the same as those in gender-neutral or female-dominated majors: compared to other men and to women, they were less likely to agree that gender can be ignored (Gender Blindness), and more likely to agree that women ought to approach work like men (Assimilationism) or stick to gender traditional fields (Segregationism).

Moreover, these ideological perspectives were related to gender-science stereotypes such that the more one endorsed Assimilationism or Segregationism, or disagreed with Gender Blindness, the more one agreed that men are better at math and science than women. Although men and women showed the same pattern of relationships between the ideologies and gender science stereotypes, at a mean level, men were more likely to endorse such stereotypes than women (Cohen's d = 0.33), and because men in high percent men majors were increasingly likely to agree with the stereotype, whereas women in these majors were increasing likely to disagree, the gender difference in gender science stereotype endorsement became magnified as the academic major became more male dominated.

The effect sizes for gender differences in mean endorsement of the gender ideologies and gender-science stereotypes was sizable (see Cohen's d in Table 1). However, the effect sizes of the relationships between gender representation and gender ideologies were quite small (see standardized betas on the left side of the path models presented in Figure 3). For example, the strongest relationship was that between percent men and Assimilation for men (standardized beta = 0.114). This indicates that for each standard deviation increase in percent men in the major for men (which translates to 20.02% more men), men's endorsement of assimilation increased by 0.114 standard deviations (which amounts to 0.12 on the 7-point Assimilationism scale).

6.1. Implications

Gender-science stereotypes and masculine culture have recently been designated as two key factors that contribute to the lack of women in male-dominated STEM fields such as physics and engineering (Cheryan et al. 2016; Moss-Racusin et al. 2012). We believe the greater prevalence of negative gender ideologies and associated gender-science stereotypes contribute to adverse consequences for women. For example, women in male-dominated workplaces believe that they are more likely to be stereotyped (Cohen and Swim 1995), report greater discrimination, experience greater stereotype threat, and perceive greater gender inequality (King et al. 2009; Inzlicht and Ben-Zeev 2000; Steele et al. 2002). In one study, women in heavily male-dominated STEM fields (10% women), relative to STEM fields where they constituted a so-called "critical mass" (20% women), were more likely to feel overwhelmed by daily adversities, anticipate less success, and perform worse in class (Walton et al. 2015).

Moreover, to the extent that women in male-dominated fields also adopt the negative gender ideologies (perhaps to justify the status quo; (Jost et al. 2003)), women established in the field may avoid displays of femininity (Seymour 1995; Pronin et al. 2004), or distance themselves from, stereotype, or denigrate other women who perceivably fail to conform to male standards (Hewlett et al. 2008; Rhoton 2011; Ellemers et al. 2004), thus reinforcing the workplace norms and culture. In a study of women in corporate science, technology, and engineering fields, 53% agreed that behaving like a man improves their prospects for advancement (Hewlett et al. 2008). Not surprisingly, this strategy was often ineffective for these women—those who attempt to join the "old boys' club" often found it impossible, and at the same time came to distrust, distance themselves from (Hewlett et al. 2008), or denigrate other women (Ellemers et al. 2004). Our work provides evidence that gender ideologies and

corresponding gender-science stereotypes that bolster a masculine status quo may arise due to, and then ironically reinforce, the gender representation within a given field, contributing to the prejudice and discrimination women experience in attempting to enter male-dominated fields.

Other research examining intergroup ideologies suggests that members of stigmatized groups are importantly affected by the ideologies present in their work environment. Ethnic and racial minorities felt less engaged, perceived greater bias, and were more inclined to leave work environments in which either leaders or members of the dominant group endorsed an assimilationist rather than multicultural intergroup ideology (Plaut et al. 2009; Meeussen et al. 2014). Women have reported being explicitly informed that they should downplay their gender or try to "be one of the guys" in order to succeed (Hewlett et al. 2008; Walton et al. 2015), which may lead them to abandon their own femininity (Pronin et al. 2004), experience identity threat, and/or question whether their gender is valued and compatible with their academic major or career. These concerns can harm women's performance (Ahlqvist et al. 2013; Settles et al. 2002; Settles 2004; Shapiro and Williams 2012) and lead them to leave the field altogether (Woodcock et al. 2012). Future research should explore these potential consequences.

Critically, gender ideologies are malleable and can be influenced by diversity policy statements, social norms, and messages about which approach is ideal for intergroup dynamics. Indeed, "One powerful tool at organizations' disposal is their ability to shape the cultural context of the workplace (Avery et al. 2007; Jansen et al. 2015; Wilton et al. 2015)—a key component of which is how diversity and social group differences are discussed ... " (Apfelbaum et al. 2016, p. 1). Exposure to arguments for a given intergroup ideology can in fact change implicit intergroup prejudice as well as explicit attitudes towards and stereotyping of ethnic minorities (Richeson and Nussbaum 2004; Wolsko et al. 2000). Having a multiplicity of viewpoints is one of the reasons scholars argue for the value of diversity in organizations (e.g., Nielsen et al. 2017). It helps brings a balance of broader ideological perspectives. In this specific case, it allows a greater number of students to see themselves as viable and legitimate group members, and that in turn should aid in increasing diversity in gender representation.

We caution, however, against a "one size fits all" approach to gender ideologies in the workplace (Apfelbaum et al. 2016). In general, people likely seek to have valued aspects of their identity recognized, either in diversity beliefs or numeric representation, but they do not want one component of their identity (e.g., gender, race) to become defining or limiting (Brewer 1991). While it seems clear that the negative ideologies are uniformly harmful to women, it is not yet clear whether a Gender Blind or Gender Aware approach may be more beneficial to women in male-dominated fields. Moreover, the adopted approach would need to be appealing to men, who may feel excluded by a gender ideological approach that does not value their identity as men (Plaut et al. 2011).

6.2. Limitations and Future Directions

The goal of this study was to examine the relationship among gender ideologies, gender-science stereotypes, and gender representation in one instantiation of work environments—academic majors at a university. Although we collected a large sample, the study certainly has limitations. First, the sample was not representative of the entire university. Ideally, future research would collect a more representative sample to make inferences about how gender diversity within a given field relates to gender ideology. In this first study on the relationship between gender diversity and gender ideologies, we employed a convenience sample of students enrolled in General Psychology. Although these students represented the majority of academic majors offered at our university, they nevertheless were a specific sample of students who decided to enroll in this course. To increase the generalizability of these findings, it is our hope that future research examines gender ideologies and their relationship to gender representation in other contexts, such as in the workforce (see Plaut et al. 2009), or between different STEM fields (for example comparing physics to biology, see (Cheryan et al. 2016)).

Second, we were only able to include a small number of measures in the pre-screen surveys. This limited our ability to examine questions, for example, about how these ideologies impact women's

experiences in their major, or how the ideologies are related to other theoretically relevant constructs. Future research should certainly examine how the prevailing gender ideologies impact women's experience of male-dominated fields, for example, do women accurately perceive which ideologies prevail, and does this have consequences for their engagement, level of trust, and retention within these fields?

Furthermore, an analysis of student's race and its interrelations with the gender ideologies was beyond the scope and data of this paper. An important remaining question is whether racial ideologies within a given environment also change as a function of racial diversity. We would expect that environments with more Whites would also be more prone to Assimilationist and Segregationist racial ideologies than those with fewer Whites. Along these lines, Danbold and Huo (2017) found that Whites concerned that they would no longer represent America due to their numerical decline were more likely to assert that minorities culturally assimilate. Another pressing question that remains to be explored is how both prevailing racial and gender ideologies might interact and impact people with intersectional identities, such as women of color. Different norms exist around bringing attention to gender versus race (Apfelbaum et al. 2016), and interestingly, political liberals are more likely to support multiculturalism (celebrating interracial differences) but gender blindness (ignoring gender differences; see (Hahn et al. 2015)). While much more research is needed to pin down the nuances of an ideal diversity approach, it seems certain that the negative racial and gender ideologies are consistently harmful for racial minorities and women alike (see (Plaut et al. 2009) for evidence that Assimilationism leads to greater perceived bias and workplace disengagement among racial minorities). For both race and gender, the negative ideologies position the dominant subgroups—White men—as superior and normative, further marginalizing women and racial minorities. Although the focus of this research and the gender ideology scale is on subordinate groups, it would also be interesting and worthwhile to explore how gender ideologies shape men's experience in female-dominated roles and fields.

This research was cross-sectional and correlational in nature. Thus, inferences about causality or the temporal development of gender ideologies, gender-science stereotypes, and the gender make-up of an academic area await future longitudinal and experimental research. It is likely that gender diversity, gender ideologies, and gender-STEM stereotypes are each reciprocally reinforcing of one another. Our ongoing research involves manipulation gender ideologies to examine their causal consequences for attitudes and stereotypes towards minority groups (see Wolsko et al. 2000). However, it is also likely that people strategically use the ideologies to justify existing gender disparities or gender-science stereotypes (Jost and Hunyady 2005; Kay et al. 2009; Knowles et al. 2009), which is another research question worth exploring. While the gender diversity of a given major may stoke or reinforce a certain set of gender ideologies, it is also the case that the individuals who select into male-dominated environments arrive with a given set of gender ideologies.

Finally, there was no evidence that Gender Awareness was related to percent men in the major, nor to personal or perceived gender-science stereotypes. The predictive value of this ideology remains to be established. It would be worth further examining the types of gender differences people have in mind when endorsing Gender Awareness. It may also be the case that the Gender Aware perspective is more relevant to attitudes concerning non-work-related contexts, such as the domestic sphere, romantic relationships, or childcare responsibilities (see Koenig and Richeson 2010).

6.3. Conclusions

As far as we are aware, this is the first research to demonstrate that gender ideologies—beliefs about how to deal with gender diversity—vary between environments as a function of gender diversity. Although overall subscription to the negative ideologies was low even in male-dominated fields, people in male-dominated academic majors were nonetheless more likely to harbor precisely the gender ideologies that devalue women in masculine fields. Not only are women in male-dominated contexts already outnumbered by men, they are importantly outnumbered by colleagues more prone to endorse alienating beliefs that further marginalize women—that women do not belong in the

first place (Segregationism), that they ought to conform to male established patterns of behavior (Assimilationism), and that gender cannot be ignored (lower Gender Blindness). Moreover, men in these environments are more likely to say that women have lesser ability (gender-science stereotypes). Ultimately, these beliefs and the lack of women likely become reinforcing (see Cheryan et al. 2016).

On a more optimistic note, this research suggests another strategy to mitigate male-dominated cultures and get more women into male-dominated fields: adopting explicit diversity policies that welcome women and value their contributions and influence, and not tolerating ideologies that encourage women to become more like men. Research indicates that diversity strengthens innovation, design, and productivity (Nielsen et al. 2017), but we have to ensure that diverse voices are both at the table and invited to speak. Segregationism keeps these voices at bay, whereas Assimilationism tells them they can speak so long as they say the same things as the majority group. It is our hope that changes in ideologies could be another way to gain small increases in the number of women in male-dominated fields, which in turn should help decrease the prevalence of negative gender ideologies and diminish gender-science stereotypes in a cyclical manner that further increases the appeal of these environments to other women. Over time, such changes have the capacity to substantially alter gender disparities in representation across fields.

Appendix A

Gender Ideology Items

Gender Blindness

1. You can find commonalities with every person no matter what their gender is.
2. All humans are fundamentally the same, regardless of their gender.
3. In order to achieve a harmonious society, we must stop thinking of men and women as different from each other, and instead focus on what makes us similar.
4. It is important to pay attention to the individual characteristics that make a person unique rather than his or her gender.

Gender Awareness

1. Learning about the different ways that men and women resolve conflict will help us create a more harmonious society.
2. The differences between men and women should be acknowledged and celebrated.
3. If we want to help create a harmonious society, we must recognize that men and women have a right to maintain their own unique perspectives.
4. We must appreciate the unique characteristics of men and women in order to have a cooperative society.
5. Men and women have different but equally useful ways of accomplishing tasks.

Assimilationism

1. Children from both genders should be taught that success in the business world comes from adopting masculine personality qualities.
2. Women in the corporate world should embrace a masculine work ethic.

3. In order for the American workforce to be internationally competitive, women must better adapt to the ways of masculine corporate culture.
4. If a woman decides to enter a traditionally masculine field, she will be more successful if she adopts the prevailing male customs and behaviors.

Segregationism

1. Having men and women work side-by-side increases the likelihood of conflict.
2. Boys and girls have different learning styles and therefore it makes sense if they go to separate schools.
3. People are naturally more comfortable working and interacting with others of their same gender.
4. Men and women are naturally suited to different jobs and should continue to do those.
5. It is important to maintain some all male and all female groups to preserve gender specific interests and traditions.

Note: Answer options ranged from 1—"strongly disagree" to 7—"strongly agree."

References

Ahlqvist, Sheana, Bonita London, and Lisa Rosenthal. 2013. Unstable identity compatibility how gender rejection sensitivity undermines the success of women in science, technology, engineering, and mathematics fields. *Psychological Science* 24: 1–9. [CrossRef] [PubMed]

Apfelbaum, Evan P., Nicole M. Stephens, and Ray E. Reagans. 2016. Beyond one-size-fits-all: Tailoring diversity approaches to the representation of social groups. *Journal of Personality and Social Psychology* 111: 547–66. [CrossRef] [PubMed]

Avery, Derek R., Patrick F. McKay, David C. Wilson, and Scott Tonidandel. 2007. Unequal attendance: The relationships between race, organizational diversity cues, and absenteeism. *Personnel Psychology* 60: 875–902. [CrossRef]

Baraldi, Amanda N., and Craig K. Enders. 2010. An introduction to modern missing data analyses. *Journal of School Psychology* 48: 5–37. [CrossRef] [PubMed]

Brewer, Marilynn B. 1991. The social self: On being the same and different at the same time. *Personality and Social Psychology Bulletin* 17: 475–82. [CrossRef]

Bryant, Alyssa N. 2003. Changes in attitudes toward women's roles: Predicting gender-role traditionalism among college students. *Sex Roles* 48: 131–42. [CrossRef]

Campbell, Colin, and Jonathan Horowitz. 2016. Does college influence sociopolitical attitudes? *Sociology of Education* 89: 40–58. [CrossRef]

Carli, Linda L., Laila Alawa, YoonAh Lee, Bei Zhao, and Elaine Kim. 2016. Stereotypes about gender and science: Women ≠ scientists. *Psychology of Women Quarterly* 40: 244–60. [CrossRef]

Chambers, David Wade. 1983. Stereotypic images of the scientist: The draw-a-scientist test. *Science Education* 67: 255–65. [CrossRef]

Cheryan, Sapna, Victoria C. Plaut, Paul G. Davies, and Claude M. Steele. 2009. Ambient belonging: How stereotypical cues impact gender participation in computer science. *Journal of Personality and Social Psychology* 97: 1045–60. [CrossRef] [PubMed]

Cheryan, Sapna, Sianna A. Ziegler, Amanda K. Montoya, and Lily Jiang. 2016. Why are some STEM fields more gender balanced than others? *Psychological Bulletin* 143: 1–35. [CrossRef] [PubMed]

Cohen, Laurie L., and Janet K. Swim. 1995. The differential impact of gender ratios on women and men: Tokenism, self-confidence, and expectations. *Personality and Social Psychology Bulletin* 21: 876–84. [CrossRef]

Danbold, Felix, and Yuen J. Huo. 2017. Men's defense of their prototypicality undermines the success of women in STEM initiatives. *Journal of Experimental Social Psychology* 72: 57–66. [CrossRef]

Eagly, Alice H., and Valerie J. Steffen. 1984. Gender stereotypes stem from the distribution of women and men into social roles. *Journal of Personality and Social Psychology* 46: 735. [CrossRef]

Eddy, Sarah. L., and Sara E. Brownell. 2016. Beneath the numbers: A review of gender disparities in undergraduate education across science, technology, engineering, and math disciplines. *Physical Review Physics Education Research* 12: 020106. [CrossRef]

Ellemers, Naomi, Henriette Heuvel, Dick de Gilder, Anne Maass, and Alessandra Bonvini. 2004. The underrepresentation of women in science: Differential commitment or the queen bee syndrome? *British Journal of Social Psychology* 43: 315–38. [CrossRef] [PubMed]

Enders, Craig K. 2010. *Applied Missing Data Analysis.* New York: Guilford Press.

Good, Catherine, Joshua Aronson, and Jayne Ann Harder. 2008. Problems in the pipeline: Stereotype threat and women's achievement in high-level math courses. *Journal of Applied Developmental Psychology* 29: 17–28. [CrossRef]

Hahn, Adam, Sarah Banchefsky, Bernadette Park, and Charles M. Judd. 2015. Measuring intergroup ideologies: Positive and negative aspects of emphasizing versus looking beyond group differences. *Personality and Social Psychology Bulletin* 41: 1646–64. [CrossRef] [PubMed]

Hewlett, Sylvia Ann, Carolyn Buck Luce, Lisa J. Servon, Laura Sherbin, Peggy Shiller, Eytan Sosnovich, and Karen Sumberg. 2008. *The Athena Factor: Reversing the Brain Drain in Science, Engineering, and Technology.* New York: Center for Work–Life Policy.

Hu, Li-tze, and Peter M. Bentler. 1999. Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal* 6: 1–55. [CrossRef]

Inzlicht, Michael, and Talia Ben-Zeev. 2000. A threatening intellectual environment: Why females are susceptible to experiencing problem-solving deficits in the presence of males. *Psychological Science* 11: 365–71. [CrossRef] [PubMed]

Irwin, Julie R., and Gary H. McClelland. 2003. Negative consequences of dichotomizing continuous predictor variables. *Journal of Marketing Research* 40: 366–71. [CrossRef]

Jansen, Wiebren S., Menno W. Vos, Sabine Otten, Astrid Podsiadlowski, and Karen I. van der Zee. 2015. Colorblind or colorful? How diversity approaches affect cultural majority and minority employees. *Journal of Applied Social Psychology* 46: 81–93. [CrossRef]

Jost, John T., and Orsolya Hunyady. 2005. Antecedents and consequences of system-justifying ideologies. *Current Directions in Psychological Science* 14: 260–65. [CrossRef]

Jost, John T., Brett W. Pelham, Oliver Sheldon, and Bilian Ni Sullivan. 2003. Social inequality and the reduction of ideological dissonance on behalf of the system: Evidence of enhanced system justification among the disadvantaged. *European Journal of Social Psychology* 33: 13–36. [CrossRef]

Kay, Aaron C., Danielle Gaucher, Jennifer M. Peach, Kristin Laurin, Justin Friesen, Mark P. Zanna, and Steven J. Spencer. 2009. Inequality, discrimination, and the power of the status quo: Direct evidence for a motivation to see the way things are as the way they should be. *Journal of Personality and Social Psychology* 97: 421–34. [CrossRef] [PubMed]

Kimball, Meredith M. 1994. The worlds we live in: Gender similarities and differences. *Canadian Psychology* 35: 388–404. [CrossRef]

King, Eden B., Michelle R. Hebl, Jennifer M. George, and Sharon F. Matusik. 2009. Understanding tokenism: Antecedents and consequences of a psychological climate of gender inequity. *Journal of Management* 36: 482–510. [CrossRef]

Klonis, Suzanne C., E. Ashby Plant, and Patricia G. Devine. 2005. Internal and external motivation to respond without sexism. *Personality and Social Psychology Bulletin* 31: 1237–49. [CrossRef] [PubMed]

Knowles, Eric D., Brian S. Lowery, Caitlin M. Hogan, and Rosalind M. Chow. 2009. On the malleability of ideology: Motivated construals of color blindness. *Journal of Personality and Social Psychology* 96: 857–59. [CrossRef] [PubMed]

Koenig, Anne M., and Jennifer A. Richeson. 2010. The contextual endorsement of sexblind versus sexaware ideologies. *Social Psychology* 41: 186–91. [CrossRef]

Leslie, Sarah-Jane, Andrei Cimpian, Meredith Meyer, and Edward Freeland. 2015. Expectations of brilliance underlie gender distributions across academic disciplines. *Science* 347: 262–65. [CrossRef] [PubMed]

Lewis, Karyn L., Jane G. Stout, Steven J. Pollock, Noah D. Finkelstein, and Tiffany A. Ito. 2016. Fitting in or opting out: A review of key social-psychological factors influencing a sense of belonging for women in physics. *Physical Review Physics Education Research* 12. [CrossRef]

Markus, Hazel Rose, and Maryam G. Hamedani. 2007. Sociocultural psychology: The dynamic interdependence among self-systems and social systems. In *Handbook of Cultural Psychology*. Edited by Kitayama, Shinobu and Dov Cohen. New York: Guilford Press, pp. 3–46.

Meeussen, Loes, Sabine Otten, and Karen Phalet. 2014. Managing diversity: How leaders' multiculturalism and colorblindness affect work group functioning. *Group Processes & Intergroup Relations* 17: 629–44. [CrossRef]

Moscovici, Serge. 1976. *Social Influence and Social Change*. London: Academic Press, vol. 10.

Moss-Racusin, Corinne A., John F. Dovidio, Victoria L. Brescoll, Mark J. Graham, and Jo Handelsman. 2012. Science faculty's subtle gender biases favor male students. *Proceedings of the National Academy of Sciences* 109: 16474–79. [CrossRef] [PubMed]

Mundy, Liza. 2017. Why Is Silicon Valley So Awful to Women? The Atlantic. Available online: https://www.theatlantic.com/magazine/archive/2017/04/why-is-silicon-valley-so-awful-to-women/517788/ (accessed on 4 April 2017).

Murphy, Mary C., Claude M. Steele, and James J. Gross. 2007. Signaling threat how situational cues affect women in math, science, and engineering settings. *Psychological Science* 18: 879–85. [CrossRef] [PubMed]

Nederhof, Anton J. 1985. Methods of coping with social desirability bias: A review. *European Journal of Social Psychology* 15: 263–80. [CrossRef]

Nielsen, Mathias Wullum, Sharla Alegria, Love Börjeson, Henry Etzkowitz, Holly J. Falk-Krzesinski, Aparna Joshi, Erin Leahey, Laurel Smith-Doerr, Anita Williams Woolley, and Londa Schiebinger. 2017. Opinion: Gender diversity leads to better science. *Proceedings of the National Academy of Sciences* 114: 1740–42. [CrossRef] [PubMed]

Nosek, Brian A., and Frederick L. Smyth. 2011. Implicit social cognitions predict sex differences in math engagement and achievement. *American Educational Research Journal* 48: 1125–56. [CrossRef]

Nosek, Brian A., Frederick L. Smyth, Natarajan Sriram, Nicole M. Lindner, Thierry Devos, Alfonso Ayala, Yoav Bar-Anan, Robin Bergh, Huajian Cai, Karen Gonsalkorale, and et al. 2009. National differences in gender-science stereotypes predict national sex differences in science and math achievement. *Proceedings of the National Academy of Sciences* 106: 10593–597. [CrossRef] [PubMed]

Plaut, Victoria C., Kecia M. Thomas, and Matt J. Goren. 2009. Is multiculturalism or color blindness better for minorities? *Psychological Science* 20: 444–46. [CrossRef] [PubMed]

Plaut, Victoria C., Flannery G. Garnett, Laura E. Buffardi, and Jeffrey Sanchez-Burks. 2011. "What about me?" Perceptions of exclusion and Whites' reactions to multiculturalism. *Journal of Personality and Social Psychology* 101: 337–53. [CrossRef] [PubMed]

Pronin, Emily, Claude M. Steele, and Lee Ross. 2004. Identity bifurcation in response to stereotype threat: Women and mathematics. *Journal of Experimental Social Psychology* 40: 152–68. [CrossRef]

Purdie-Vaughns, Valerie, Claude M. Steele, Paul G. Davies, Ruth Ditlmann, and Jennifer Randall Crosby. 2008. Social identity contingencies: how diversity cues signal threat or safety for African Americans in mainstream institutions. *Journal of Personality and Social Psychology* 94: 615–30. [CrossRef] [PubMed]

Räty, Hannu, Johanna Vänskä, Kati Kasanen, and Riitta Kärkkäinen. 2002. Parents' explanations of their child's performance in mathematics and reading: A replication and extension of Yee and Eccles. *Sex Roles* 46: 121–28. [CrossRef]

Rhoton, Laura A. 2011. Distancing as a gendered barrier understanding women scientists' gender practices. *Gender and Society* 25: 696–716. [CrossRef]

Richeson, Jennifer A., and Richard J. Nussbaum. 2004. The impact of multiculturalism versus color-blindness on racial bias. *Journal of Experimental Social Psychology* 40: 417–23. [CrossRef]

Schmader, Toni, Michael Johns, and Marchelle Barquissau. 2004. The costs of accepting gender differences: The role of stereotype endorsement in women's experience in the math domain. *Sex Roles* 50: 835–50. [CrossRef]

Settles, Isis H. 2004. When multiple identities interfere: The role of identity centrality. *Personality and Social Psychology Bulletin* 30: 487–500. [CrossRef] [PubMed]

Settles, Isis H., Robert M. Sellers, and Alphonse Damas Jr. 2002. One role or two? The function of psychological separation in role conflict. *Journal of Applied Psychology* 87: 574–82. [CrossRef] [PubMed]

Seymour, Elaine. 1995. The loss of women from science, mathematics, and engineering undergraduate majors: An explanatory account. *Science Education* 79: 437–73. [CrossRef]

Seymour, Elaine, and Nancy M. Hewitt. 1997. *Talking about Leaving: Why Undergraduates Leave the Sciences*. Boulder: Westview Press.

Shapiro, Jenessa R., and Amy M. Williams. 2012. The role of stereotype threats in undermining girls' and women's performance and interest in STEM fields. *Sex Roles* 66: 175–83. [CrossRef]

Spencer, Steven J., Claude M. Steele, and Diane M. Quinn. 1999. Stereotype threat and women's math performance. *Journal of Experimental Social Psychology* 35: 4–28. [CrossRef]

Steele, Jennifer, Jacquelyn B. James, and Rosalind Chait Barnett. 2002. Learning in a man's world: Examining the perceptions of undergraduate women in male-dominated academic areas. *Psychology of Women Quarterly* 26: 46–50. [CrossRef]

Stout, Jane G., Nilanjana Dasgupta, Matthew Hunsinger, and Melissa A. McManus. 2011. STEMing the tide: Using ingroup experts to inoculate women's self-concept in science, technology, engineering, and mathematics (STEM). *Journal of Personality and Social Psychology* 100: 255–70. [CrossRef] [PubMed]

Ullman, Jodie B. 2006. Structural equation modeling: Reviewing the basics and moving forward. *Journal of Personality Assessment* 87: 35–50. [CrossRef] [PubMed]

Walton, Gregory M., Christine Logel, Jennifer M. Peach, Steven J. Spencer, and Mark P. Zanna. 2015. Two brief interventions to mitigate a "chilly climate" transform women's experience, relationships, and achievement in engineering. *Journal of Educational Psychology* 107: 468–85. [CrossRef]

Wilton, Leigh S., Jessica J. Good, Corinne A. Moss-Racusin, and Diana T. Sanchez. 2015. Communicating more than diversity: The effect of institutional diversity statements on expectations and performance as a function of race and gender. *Cultural Diversity and Ethnic Minority Psychology* 21: 315–25. [CrossRef] [PubMed]

Wolsko, Christopher, Bernadette Park, Charles M. Judd, and Bernd Wittenbrink. 2000. Framing interethnic ideology: effects of multicultural and color-blind perspectives on judgments of groups and individuals. *Journal of Personality and Social Psychology* 78: 635–54. [CrossRef] [PubMed]

Wood, Wendy. 2000. Attitude change: Persuasion and social influence. *Annual Review of Psychology* 51: 539–70. [CrossRef] [PubMed]

Woodcock, Anna, Paul R. Hernandez, Mica Estrada, and P. Schultz. 2012. The consequences of chronic stereotype threat: Domain disidentification and abandonment. *Journal of Personality and Social Psychology* 103: 635–46. [CrossRef] [PubMed]