Rationality is Gendered

Olivia Pavco-Giaccia, Martha Fitch Little, Jason Stanley and Yarrow Dunham

Shared rationality is the common ground of scientific progress. However, some theorists have argued that this common ground may not be level, in that subtle assumptions embedded within lay views of rationality marginalize some would-be participants. Specifically, feminist philosophers have argued that rationality is associated with male rather than female discourse. This claim has frequently been dismissed as incoherent, but a straightforward interpretation is readily available: The concept reason is semantically associated with the concept male. We support this hypothesis in four studies (total $N > 900$), finding that at both the explicit and implicit level, reason is preferentially associated with male, feeling is preferentially associated with female, male faces prime unrelated judgments of reason/rationality, and gendered associations are related to interest in academic disciplines as well as estimates of the (mis)representation of women within those disciplines. Implications for gender stereotyping and the representation of women in different fields are discussed.

**Keywords:** gender roles; gender stereotyping; implicit cognition

From the first moments of life children are bombarded with rich cues that pervasively convey gender roles and stereotypes. From the color of congratulations cards and nursery walls to the toys, names, and clothing they are exposed to, gender is presented as an important cultural distinction that must be mastered (Bridges, 1993). Further, the world also sees children through a prism of gender: from early infancy male and female babies, though difficult to tell apart in the absence of imposed gender cues such as clothing or names, are interpreted quite differently by observers, with infants thought to be male interpreted as more active and agentic, and infants thought to be female as more delicate and sweet (Rubin, Provenzano, & Luria, 1974). It is little surprise then, that gender becomes a defining feature of life, affecting friendship patterns (Howes & Phillipsen, 1992), clothing (Cox & Dittmar, 1995), and play preferences (Francis, 2010). Beyond these relatively benign and presumably voluntary gender-typed preferences, gender also becomes a source of inequality. Most strikingly, in the United States gender correlates with a significant pay gap (Blau & Kahn, 2006), unequal professional advancement opportunities (Bohnet, Van Geen, & Bazerman, 2016), unequal division of household labor (Bird, 1999), and occupational segregation (Charles & Grusky, 2004).

Many factors underlie these disparities, but likely sources include subtle forms of gender stereotypes that associate women with less prestigious, agentic, or lucrative roles. For example, women appear to be judged as greater in warmth and lesser in competence than men (Cuddy et al., 2009), a state of affairs sometimes referred to as “benevolent sexism” (Glick & Fiske, 2011). Further, women are associated with the home over the workplace (Rudman & Phelan, 2010) and with weakness over strength as well as diminished authority (Leach, Carraro, Garcia, & Kang, 2015; Rudman, Greenwald, & McGhee, 2000; Rudman & Glick, 2001; Rudman & Kiliński, 2000). One overarching framework for considering these differences is that of agency versus communality, and indeed gender stereotypes associating men with agency and women with communality appear both strong and temporally stable over the last several decades (Haines, Deaux, & Lefaro, 2016). To the extent that these attributes are perceived as differentiating professional spaces, women may even seek to avoid occupations that downplay or elide aspects of personhood that are important to them (such as communal goals; Diekmann, Brown, Johnston, & Clark, 2010; Eccles, 2011a), as further suggested by evidence that women are preferentially associated with the humanities and men with the sciences (Kiefer & Sekaquaptewa, 2007; Nosek, Banaji, & Greenwald, 2002a). These considerations may also extend to the gender wage gap. For example, women are thought to seek jobs requiring less effort and to be less concerned with professional progress and intellectual challenge, including the assumption that intellectual work deserves higher pay than other, more “practical” forms of work, such as care-giving (Blau & Ferber, 1991). Thus the intellectual – practical divide, where women are associated with the care-giving professions, and men with the “intellectual” ones, could play a role in the structural gender injustice that we see in the United States today. This is a
possibility bolstered by recent findings that gender gaps in STEM participation extend to which success in that field is thought to depend on brilliance (Leslie, Cimpian, Meyer, & Freeland, 2015).

Here we seek to contribute to these discussions by examining how conceptual associations that may support the maintenance and acceptance of unequal treatment in professional domains, especially professional domains that place rational discourse at their center. More specifically, we hypothesize that women’s everyday associations with emotion and feeling are semantically associated with emotion and feeling and men are semantically associated with reason and thinking. Interestingly, while it has rarely made contact with feminist thought, interpreting an argument of just this sort has been central to longstanding Feminist philosophical criticisms of gender roles. As early as 1892 the civil rights activist Anna Julia Cooper gave voice to what would later become the central claim of the concept of gendered rationality: “The man is more noble in reason, so the woman is more quick in sympathy. That as he is indefatigable in pursuit of abstract truth, so she is in ‘striving tenderly and lovingly,’ (Hutchinson, 1892: 78). Feminist philosophers have also argued that the everyday concept of reason itself is gendered (Lloyd, 1979), creating a dilemma for women who seek advancement in intellectual domains. If women want to participate in “reason,” they must give up/distance themselves from some vital aspect of their “femaleness.” This view also dovetails with recent research seeking to explain the gender gap in math and science as stemming from perceived incompatibility with prevailing gender stereotypes (Cvenneik, Meltzoff, & Greenwald, 2011), as well as findings that some scientific disciplines are perceived as masculine (Young, Rudman, Buettner, & McLean, 2013).

The Feminist critique offered by Lloyd and others elicited a backlash, with some critics (Nussbaum, 1994) suggesting that the very notion of gendered rationality is incoherent because science is rigorously grounded in evidence and is self-correcting (Padovani, Richardson, & Tou, 2010). Here we argue that this backlash misses the mark, that science and philosophy can be examined in tandem in examining whether implicit and explicit associations are controlled associations as well as associations that our respondents might be unaware of or even actively disavow. Further, it allows us to test the relationship between those who value analytical, i.e., to examine whether implicit and explicit associations are correlated. Whether these constructs and the relationships between them further differ by respondent gender is also of interest, as we might imagine that these gendered associations could be stronger in men, who most directly benefit from the inequalities that could result from associating male with reasoning and female with emotion.

To summarize our empirical program of research, Study 1a uses the Implicit Association Test (IAT; Greenwald, McGhee, & Schwartz, 1998) as well as explicit measures of semantic associations to examine whether implicit associations related to men and women’s associations with the concepts of thinking and feeling. Study 1b modified a new IAT procedure to decompose that relative inquiry into independent associations between men and thinking more than feeling between female and feeling more than thinking. Study 2 provides a conceptual replication again using explicit measures as well as an alternative implicit measure, a priming procedure, to investigate whether the rapid presentation of photographs of men (women) make concept related to thinking more accessible while preserving influence on explicit judgments. Further, Study 3 explores the consequences of these gendered associations through a pre-registered investigation of whether these explicit or implicit associations relate to men and women’s interest in and estimates of the relative prevalence of men and women in several academic disciplines. Taken together, these results provide evidence that rationality is semantically associated with thinking and more specifically, we evaluate whether the relative prevalence of gendered associations, and that these associations could be consequential for individual interest in and perceptions of various professional disciplines.

Study Participants

Study 1a involved 124 adults (male = 69, female = 54, unknown = 1; M = 18 years, SD = 12 years). Table 2 provides complete details concerning word selection and the complete list of words used in this and subsequent studies and are in the online supplement.

To summarize our empirical program of research, Study 1a involved 124 adults (male = 69, female = 54, unknown = 1; M = 18 years, SD = 12 years). Table 2 provides complete details concerning word selection and the complete list of words used in this and subsequent studies and are in the online supplement.

To summarize our empirical program of research, Study 1a involved 124 adults (male = 69, female = 54, unknown = 1; M = 18 years, SD = 12 years). Table 2 provides complete details concerning word selection and the complete list of words used in this and subsequent studies and are in the online supplement.

To summarize our empirical program of research, Study 1a involved 124 adults (male = 69, female = 54, unknown = 1; M = 18 years, SD = 12 years). Table 2 provides complete details concerning word selection and the complete list of words used in this and subsequent studies and are in the online supplement.
were conducted as part of our investigation of gendered rationality, with the exception of a pilot study investigating the use of a lexical decision task to explore gendered associations. Because we were unable to replicate a basic lexical decision effect (outside the realm of gendered associations) in an online environment, perhaps due to the more precise reaction time recording necessary for that task, we did not continue developing this paradigm to test our main questions of interest, instead shifting to the approach described in Study 2.

**Study 1a: Relative associations between gender and rationality**

Standard exclusion criteria (A. G. Greenwald et al., 2003) led to the exclusion of 8 participants who had an excessive number of fast trials (>10% at <300 ms), generally indicative of rapid key pressing in order to move rapidly through the task. Thus, we base all analyses on the 116 participants with complete data. Results indicated a robust relative association between male and thinking and female and feeling relative to the opposite pairings, $D = .33$ ($SD = .31$), $t(115) = 11.50$, $p < .0001$, 95% CIs [0.28; 0.39] (Figure 1). There was no evidence of a difference between male participants ($M = 33$) and female participants ($M = 34$). Welch’s $t(102.87) = 2.3$, $p = .02$. To better quantify potential support for the null hypothesis of no difference based on participant gender, here and elsewhere in this paper we employ Bayes Factors, in particular the BF01 statistic, indicating in this case the relative strength of evidence in support from the relative rationality advantage for males. This relative gender index correlated modestly with the IAT, $r(114) = .23$, $p = .011$, indicating that individuals who more strongly endorsed gendered rationality at the explicit level also tended to have stronger implicit associations between male and rational and relative to female and emotional, though we note that the creating of a difference score to index explicit gendered associations raises some issues concerning the quantification of unreliability (Furr, 2017).

A limitation of the standard IAT in the present context is that it provides a relative rather than an absolute index of gendered associations. That is, the IAT $D$ score does not tell us whether the association is driven by associations between male and rationality, female and emotionality, or both. To address this limitation, we first attempted a data analytic approach by fitting a multinomial processing tree model of IAT errors that allows the independent estimate of the male-rational and female-emotional associations. This approach, known as the Quadruple Process Model (Conrey, Sherman, Gawronski, Hugenberg, & Groom, 2005), suggested that both the male-thinking and female-feeling associations contributed to IAT performance. However, model fit was not satisfactory, and while it has been argued that these fit statistics are overly conservative for this type of model, we nonetheless elected to conduct Study 1b to confirm this result (as a source of converging evidence we provide details of the processing tree approach in the online supplement).

**Study 1b: Independent associations between each gender and rationality versus emotionality**

The B-IAT drops one of the comparison categories and so provides an estimate of the association between one target category (either male or female) and the two properties (rational versus emotional). Participants completed one of those two B-IATs; standard exclusion criteria (Greenwald et al., 2003) led to the exclusion of 16 participants who had an excessive number of fast trials (>10% at <300 ms), and one participant who terminated the study before providing complete data. Thus, we base analyses on the 185 participants with complete data ($N_{male} = 98$, $N_{female} = 87$). Results indicated that male was preferentially associated with reason over emotion, $D = .23$ ($SD = .31$) and also that female was preferentially associated with emotion over reason, $D = .28$ ($SD = .36$), both $t > 7.1$, $p < .0001$; see Figure 1, right panel. The strength of these two associations did not differ, Welch’s $t(172.28) = 1.10$, $p = .27$, nor was there any evidence that the strength of each association differed by participant gender both $t < 1.2$, $p > .24$, BF01 = 3.5. Participants self-reported associations between gender and thinking versus feeling demonstrated evidence of a similar gendered pattern, depicted in Figure 2, right panel, with male associated with thinking ($M = 70.78$, $SD = .20.22$) more than feeling ($M = 49.39$, $SD = 22.25$) and female associated with feeling ($M = 78.65$, $SD = 17.60$) more than thinking ($M = 66.23$, $SD = 21.21$); all pairwise comparisons between these ratings were significant at $p < .0001$, except the comparison between male-thinking and female-thinking, which, while still statistically significant, was notably smaller, paired $t(184) = 2.49$, $p = .014$. In this sample there was stronger evidence that these ratings might differ by participant gender, especially for the two scales focusing on females; females indicated a stronger association between both female and thinking ($M = 83.31$) and female and thinking ($M = 72.42$) than did males ($M = 74.63$ and 59.41, respectively), $p < .003$. Male participants also somewhat more strongly associated male with thinking (Welch’s $t(80.36) = 1.98$, $p = .049$, but there was no gender difference for explicit associations between male and feeling, $p = .63$, BF01 = 5.6. Unlike in Study 1a, implicit and explicit gender associations did not relate to one another for either the thinking or feeling test, both $|r| < .06$, $p > .63$, BF01 > 3.6. Given somewhat conflicting findings on these correlations across studies, we return to patterns of implicit-explicit correlation at some length in the General Discussion. Overall, then, Study 1b indicates that US adults, whether measured with implicit or explicit measures, associated both male with rationality and female with emotionality.

**Study 2**

Study 2 sought a conceptual replication and extension of the main finding of Study 1 using an alternative measure that is more closely linked to the primary phenomenon of interest, namely semantic associations between concepts as assessed by the Affect Misattribution Procedure (AMP; Payne et al., 2014), which measures whether one concept (in this case male or female) increases test accessibility of other concepts (in this case thinking or feeling). Participants were primed with photographs of men and women and then decided whether Chinese characters had meanings related to rationality versus emotionality. If photographs of men (women) activate semantic associations relating to rationality (emotionality), those associations might be misattributed to the Chinese character, a complex, ambiguous stimulus about which the participant has no direct knowledge. Thus, we predicted that more characters would be judged as being about rationality if preceded by a male prime and about emotionality if preceded by a female.
prime. By including neutral primes our design also includes a baseline comparison allowing us to examine both effects (male—rationality, female—emotionality) independently.

Participants
Study 2 involved 219 adults (male = 111, female = 106, unknown = 2; M_ages = 34 years (S = 12 years), White = 74%, Black = 9%, other = 17%) recruited via Amazon’s Mechanical Turk online labor market. Recruitment was restricted to IP addresses within the United States and to workers with greater than 95% approval on prior tasks.

Measures
The primary dependent measure was the Affect Misattribution Procedure (AMP; Payne, Cheng, Govorun, & Stewart, 2005), a procedural variant of evaluative or semantic priming in which participants make forced choice judgments concerning the valence (or in this case, the meaning) of unfamiliar Chinese characters after being primed with images expected to affect those judgments. The AMP consisted of a short block of 10 practice trials followed by a test block of 60 trials. Each trial involved the presentation of a prime for 75 ms followed by a blank screen for 125 ms, followed by a Chinese character for 100 ms, followed by a noise mask which remained on the screen until the participant responded by pressing a left or right response key, indicating their decision concerning whether they thought the character had a meaning related to thinking or feeling. Primes were full-color frontal photographs of six White men or six White women or a grey square which served as a neutral prime; Chinese characters were randomly selected without replacement from a set of 100. Participants completed 20 trials with each prime type. Photographs were neutral faces of adults drawn from the Chicago Face Database (Ma, Correll, & Wittenbrink, 2015) and approximately matched on unusualness, age, attractiveness, happiness, and sadness based on the ratings provided by those authors. Details of stimulus items are provided in the online supplement. We acknowledge that the use of solely White faces is a limitation on the generalizability of the present study.

Procedure
The procedure was identical to that described in Study 1, above, except that the task always began with the AMP instead of an IAT, and a brief cover story was provided. The cover story indicated that the research focused on whether people can intuit the meaning of Chinese characters through their historical link with pictograms; the primes were described as signals that indicated a target character would appear, and participants were warned to try to avoid having the primes influence their responses (Payne et al., 2005). Following the AMP participants completed the same set of demographic and explicit items described in Study 1 and an additional item asking whether they had familiarity with a language that made use of Chinese characters (9 participants answering yes’ to this question were excluded, leaving a total of 210 participants in the AMP portion of the study).

Results and Discussion
Demographic data for one participant was lost due to a data recording error and so that participant does not figure in any analyses involving demographic factors. Overall, and as predicted, participants were most likely to judge a character to be associated with rationality when it was preceded by a male prime (53%), followed by a neutral prime (50%), followed by a female prime (48%; Figure 3). To respect the dichotomous nature of the AMP (forced choice judgments of rationality versus emotionality) data were analyzed in a mixed logistic regression with trials nested within participants, with a suppressed intercept so that each parameter reflects a comparison to chance responding (50%). This analysis confirmed the trends visible in Figure 3: participants were more likely to judge characters as relating to rationality following male primes, b = .14, CI [.055; .22], p < .0003. While not significant, they trended towards being less likely to judge characters as relating to rationality following female primes, b = -.062, CI [-.14; .020], p = .11. Neutral primes did not appear to be related to judgments, b = .01, CI [-.075; .088], p = .86. Odds ratios can be used to quantify these effects more intuitively: participants were 1.22 times as likely to categorize a character as relating to rationality if it was preceded by a male as compared to a female prime, a difference which was statistically significant, b = .20, CI [.11; .29], p < .0001. In summary, Study 2 provides converging evidence concerning a semantic association between male and rational, and is suggestive of a weaker link between female and emotional.

Participants self-reported associations between gender and thinking were similar to those in Study 1 and are depicted in Figure 4. Participants associated male with thinking (M = 66.05, SD = 22.97) more than feeling (M = 46.59, SD = 23.51) and female with feeling (M = 74.74, SD = 20.68) more than thinking (M = 61.06, SD = 23.87); all pairwise comparisons between these ratings were significant, paired t > 4.97, p < .0001. These ratings also differed by gender in the case of the two ratings associated with thinking: females associated female with thinking (M = 69.59) more than did males (M = 52.72), p = .0001, and also associated male with thinking (M = 61.29) less so than did males (M = 70.91), p = .002. Females also associated female with feeling (78.19) somewhat more than did males (71.54), p = .017. The self-reported association between male and feeling did not differ by gender, p = .81, BF01 = 6.6.

To compare implicit and explicit responses we computed each participant’s implicit gendered association by subtracting the percent of characters judged as rational following female primes from the percent judged rational following male primes and correlated that value with the same participant’s explicit scores, specifically the relative male-rationality advantage described in Study 1a, above. As in that study, a modest correlation was revealed, r(208) = .19, p = .0048.

Study 3
While the prior studies demonstrate the presence of gendered associations with thinking and feeling, whether or not these associations are related to more face-valid
outcomes remains unknown. Given their close potential connections to various occupations, in this study we investigate whether individuals with stronger implicit or explicit gendered associations regarding rationality also have consonant views of various academic career paths. We elected to focus on academic disciplines because this allowed us to build on prior work looking at representation of women as perceptions of the attributes predicting success in the academy (e.g. Leslie et al., 2015). Thus, in addition to studying individuals’ implicit and explicit views concerning gendered rationality, we also assessed participants’ interest in a range of fields in the social sciences, natural sciences and humanities that were first rated by existing students. Participants were asked to show less interest in fields that provide a potential mismatch with their own gender, and would also tend to underestimate the prevalence of women in fields associated with thinking as compared to feeling. Prevalence of women was measured via participant estimates of the percent of PhDs earned by women as well as the percentage of women at the top of the profession, as indicated by tenure-track faculty lines at top departments in that discipline.

Participants
50 adults were recruited via Amazon’s Mechanical Turk online labor market to provide initial ratings of 10 professions, as described below. Two of these participants did not complete the survey and so were dropped, leaving 48 adults with 14, M = 342 (SD = 11.0). White = 69%, Asian = 17%, Black = 8%, other = 6%) in the initial ratings study. 409 adults (male = 213, female = 188, unspecified = 8, M = 37.8 years (SD = 11.6 years). White = 71%, Black = 10%, other = 19%) recruited via Amazon’s Mechanical Turk participated in the main study. As above, recruitment was restricted to IP addresses within the United States and to workers with greater than 95% approval on prior tasks.

Measures
Discipline ratings pre-study
We selected 10 academic disciplines (chemistry, engineering, English, history, linguistics, molecular biology, neuroscience, philosophy, physics, and psychology) by choosing the fields that varied in terms of participation rate by women as indicated in the National Science Foundation’s Survey of Earned Doctorates (available at https://www.nsf.gov/statistics/srvydoctorates/). We submitted to Principal Components Analysis, which strongly suggested a two-factor solution (fully detailed in the online supplement). The first factor related to the thinking dimension, with high loadings on common, emotional sensitivity, intuition, and warmth. We thus extracted rotated component scores for these two components to serve as indices of each discipline’s position in thinking versus feeling space. Prevalence of women in each discipline was then rated by an independent group of participants concerning the extent to which they perceived as requiring attributes associated with thinking versus feeling. For our pre-registered analysis we created a difference score to index a discipline’s position in the thinking-feeling space by subtracting the feeling score from the thinking score (a plot of each discipline in this two-dimensions component space is included in supplemental materials). In addition to these participant ratings we secured the percentage of women earning PhDs in each discipline via the National Science Foundation’s Survey of Earned Doctorates (available at https://www.nsf.gov/statistics/srvydoctorates/) to compare to the estimates provided by participants as described below. To estimate the percentage of women who were at the top of each discipline we calculated the percentage of tenured or endowed professor faculty who were women in each of the top 20 schools in each discipline, as ranked by professional ranking organizations and as described in more detail in the online supplement. While this method is certainly imperfect, it is the most common in use. Participant ratings were of the same form as the input, except the median position on each discipline was expected to lie between 0 and 100, with 0 indicating that the discipline is very high in thinking and 100 indicating it is very high in feeling. One potential limitation is that this method would be inclined to overestimate the proportion of women in fields highly associated with thinking.

Main study
Participants completed the same gendered rationality IAT described in Study 1, a set of survey items relating to the 10 academic disciplines, the same set of explicit ratings, and the same set of demographics from prior studies. The academic discipline items presented each of the 10 disciplines, one at a time in a random order, each on its own survey page, and asked participants to indicate their interest in the field on a 9-point scale (“Imagine you were choosing a new career. How interested would you be in a career in this field?”). Their estimate of the percent of PhD students in the field that are female, and their estimate of what percent of the best 5% of people working in that field are female. Participants were asked to rate their interest in each field on the IAT, and then to indicate their interest in the field on a 9-point scale (“Imagine you were choosing a new career. How interested would you be in a career in this field?”), their estimate of the percent of PhD students in the field that are female, and their estimate of what percent of the best 5% of people working in that field are female.

Procedure
The procedure was identical to that described in prior studies with the following exceptions relating to task order: the explicit gendered rationality ratings always immediately followed the IAT, and those two tasks were presented either immediately before or immediately after the discipline ratings, with that order counterbalanced across participants. Demographics were always presented last.

Results and Discussion
We provide summary statistics to parallel the results of prior studies and then turn to confirmatory analyses (http://aspeeded.org/blind.php?x=kk4ku4), followed by some additional exploratory analyses.

Descriptive Statistics
Results of the implicit and explicit gendered association items were similar to those provided above. Beginning with the IAT, 403 participants completed the IAT portion of the study, of whom data for 57 (14%) had to be excluded via standard exclusion criteria relating to an excessive number of fast trials, leaving usable data for 346 participants. Results indicated a robust relative association between male and thinking and female and feeling relative to the opposite pairings, D = .35 (SD = .33), (345) = 19.79, p < .0001, 95% CI [.32, .38]. There was not a hint that this association was somewhat stronger in male participants (M = .38) than female participants (M = .32), Welch’s (334.54) = 1.70, p = .09, but this was a relatively small effect, d = .18 that in fact provided slight evidence in favor of the null of no difference BF10 = 2.1. Further, the association itself was robust in both male and female participants, both t > 12, p < .001.

Participants self-reported associations between thinking and gendered parallel ratings described above, with male-associated thinking (M = 71.25, SD = 21.90) more than feeling (M = 49.77, SD = 24.10) and female-associated thinking (M = 79.11, SD = 19.05) more than male-associated feeling (M = 66.57, SD = 23.14); all pairwise comparisons between these ratings were significant, paired (t401) = 2.91, p < .004. Participant gender differences were evident in all of these ratings except for the explicit gendered association, since scoring between male and female (Welch’s (386.5) = 1.07, p = .29, BF10 = 5.2) always in the direction of stronger stereotypical gender associations in men than women (all Welch’s t > 3.35, p < .0009, d > .34). As in Study 1, implicit and explicit gendered associations were modestly correlated, r(343) = .23, p < .001.

Because the explicit measures were identical across all three data collections, and because patterns of participant gender differences in explicit responses were not wholly consistent across studies, we provide some additional analyses combining all explicit data, including figures focusing on gender differences, in the online supplement. This analysis strongly suggests that explicit gendered associations are stronger in male than female participants.

Predicting interest in disciplines
Because interest ratings can be considered clustered within participants as well as within disciplines, we fit a linear mixed model (using the lme4 package in R). However, instead of predicting interest in a particular field from participant gender, the discipline’s relative thinking versus feeling score calculated as described above, and the participant’s relative explicit gendered association, centered at the sample mean, with random intercepts for both participant and discipline. As predicted, this analysis revealed a 3-way interaction between these terms, b = .0032, CI [.0012, .0052], p = .0009. This relationship is depicted in Figure 5, and suggests that explicit gendered rationality negatively predicted women’s interest in fields highly associated with thinking and men’s interest in fields highly associated with feeling, but did not predict women’s interest in fields highly associated with feeling or men’s interest in fields highly associated with thinking. Thus, explicit beliefs about gendered rationality predicted tenure-track faculty associations in a field that “mismatched” the participant’s gender in terms of these characteristic associations. Visual inspection of Figure 5 suggests that over the range of available data this effect constituted a difference of about 2 scale points in interest, which amounts to a shift from the median up to the first quartile or down to the third quartile of interest.

Turning to a parallel analysis with implicit gendered rationality (IAT), contrary to prediction the 3-way interaction between implicit gendered rationality, participant gender, and the discipline’s relative thinking versus feeling.
score did not reach significance, $b = -17$, CI $[-47; 12]$, $p = .242$. The only significant terms included gender, the discipline’s relative thinking versus feeling score, and their interaction, $b = 43$, CI $[34; 50]$, $p < .0001$, indicating that as fields increased in being seen as highly thinking (by independent raters) and less men were generally less interested in them. However, there was no evidence that the IAT increased our ability to predict this relationship over and above the independent ratings of the field’s relationship with thinking and feeling.

Predicting estimates of representation in disciplines

Descriptively, participant estimates of gender representation in the top 20 institutions were at least somewhat calibrated to actual representation taken from the NSF Survey of Earned Doctorates, as evidenced by a mixed linear model predicting estimates (nested within participants) from explicit gendered associations and calibration. Only the effect of actual representation was significant, $b = .49$, CI $[.46; .52]$, $p < .0001$(note that as these are unstandardized beta $\hat{\beta}$ values, a 1 unit change in which estimates were perfectly calibrated with actual representation). Estimates of gender representation at the top of the field were better calibrated to actual representation, as evidenced by a mixed linear model predicting estimates (nested within participants) from gender and actual representation, in which the effect of actual representation in top departments was strong, $b = .74$, CI $[.70; .78]$, $p < .0001$. Here there was also a significant gender effect, $b = .47$, CI $[.43; .51]$, $p < .0001$. The stronger effect of actual representation in the top 20 institutions, we again start with the impact of explicit gendered associations. In similar fashion to what was described for PhD representation, we observed an association between gendered associations and gender representation at the PhD level by 8.7% and at the top of the discipline by 6.8%.

For our main analysis of representation at the PhD and top of the field we focus on predicting miscalibration, i.e. the extent to which a participant thought there were more or less women in the field than are actually present. We start with the impact of explicit gendered associations and calibration, this model surprisingly revealed a main effect of gender: men estimated there to be about 4% more women at the top of field, $b = 4.26$, CI $[4.18; 4.34]$, $p = .008$. We also note that in general participants underestimated the representation of women in the disciplines at the PhD level by 8.7% and at the top of the discipline by 6.8%.

For our main analysis of representation at the PhD and top of the field we focus on predicting miscalibration, i.e. the extent to which a participant thought there were more or less women in the field than are actually present. We note that in our preregistered analysis plan miscalibration was described as a secondary analysis, with the primary analysis being predicting estimates of the representation of women. However, because analyzing miscalibration merely involves subtracting a constant (i.e., actual representation) from participant ratings for each discipline, these analyses are fundamentally identical, and because miscalibration is more germane to the question of whether gendered associations bias thinking than are estimates, we focus on them here.

In our first analysis of the IAT, we examined each of the three possible interactions between gender, explicit gendered associations, and calibration, and found that none were significant. We then examined the interaction between implicit gendered associations and the field’s position in thinking versus feeling, $b = -.181$, CI $[-.279; -.09]$, $p < .0001$. This interaction shows that those with stronger implicit gendered associations were more miscalibrated, i.e. the extent to which a participant thought there were more women in those disciplines to a greater degree, $b = .46$, CI $[.43; .49]$, $p < .0001$. This interaction shows that for PhD representation, we observed an association between implicit gendered associations and the field’s position in thinking versus feeling, $b = -.025$, CI $[-.032; -.019]$, $p < .0001$. As before, this indicated that those higher in explicit gendered associations were more miscalibrated for fields thought of as relatively high in thinking (by independent raters) and less miscalibrated for fields thought of as relatively high in feeling. Turning to a parallel model with implicit gendered associations, the interaction between implicit gendered associations and participant gender, and the field’s relative thinking score, $b = -.331$, CI $[-.513; -.135]$, $p = .0008$. Decomposing by participant gender, men showed the same pattern described above, trending to be more miscalibrated for fields ranked high in relative thinking and less miscalibrated for fields ranked low in relative thinking (as indicated by the interaction between IAT scores and the fields’ position in thinking vs. feeling, $b = -.276$, CI $[-.405; -.136]$, $p < .0002$. By contrast, women’s estimates were not significantly related to both implicit and explicit gendered associations. We have observed a boundary effect in several domains, for example in race bias, in which most White Americans hold relatively egalitarian explicit views, but more negative views when measured with explicit measures (e.g., Noke et al., 2002). This pattern emerges in large part because men hold stronger explicit gendered stereotypes in this domain (see supplement for analysis aggregated across all studies), an important finding in its own right given that, as an explicitly endorsed stereotype, those who hold it (e.g., in teaching, advising, hiring, mentoring, and so on).

Our partial focus on implicit social cognition opens up to us some of the critiques concerning that literature. For example, Arkes & Tetlock (2004) argue that results of the IAT and other implicit measures do not necessarily reflect individual beliefs (even unconscious ones) but rather reflect past exposure to cultural stereotypes and thereby shape expectations. Moreover, they argue that results provide evidence of robust semantic associations between both these pairs of concepts, thereby putting empirical teeth to a straightforward interpretation of a longstanding claim that implicit priming is a measure of meta-analytic evidence that the relationship between these measures and behavior are relatively weak (Onslow, Mitchell, Blanton, Jacard, & Tellock, 2013). But also see a association between implicit and explicit measures that might suggest that both men and implicitly associated male with rationality and female with emotionality more than vice versa. Study 1b decomposed this result into a parallel model with implicit gendered associations, i.e., a link between male and a tendency to associate female with emotionality more than male; these two tendencies were of roughly equal magnitude and similarly present in both men and women. Study 2 provided convergent evidence by replicating the primary effect of interest, i.e. a link between male and rationality, with a measure derived directly from semantic priming, though its results were more equivocal concerning the link between female and emotionality. Self-reported associations between gender and reason/emotion also reflected these same stereotypical links, though even more strongly (see online supplement for an analysis of self-report data aggregated across all studies). Finally, Study 3 provided evidence that explicit gender associations relate to implicit gendered associations as estimates of the gendered representation of women versus men in these academic disciplines. However, contrary to hypothesis, implicit gender associations did not relate to interest in the disciplines, though they did relate to estimates of the prevalence of women. One reason for this discrepancy could be that judgments of interest could be previously held views that are merely reported as an explicit judgment; if so, this might explain why they relate to explicit rather than implicit views, and so we do not over-interpret here, but it may be that in a case like the present one where both patterns of association are on average of equal magnitude, the weaker index of the broader pattern of associations and so is less reliably linked to explicit associations. Our results complement recent work by past researchers interested in how gender stereotypes relate to occupational
stereotypes as well as occupational choices (Eccles, 2011, a,b, 2012; Home, Constance, Cimpian, & Leslie, 2016). For example, some of this work finds that fields that are believed to most centrally require brilliance are more likely to be male dominated, whereas fields that are believed to be friendly or hard work are more likely to have greater gender balance. Our work contributes to the understanding of this phenomenon by demonstrating that the underlying factor driving brilliance is stereotypically associated with maleness, potentially butting head or even underlying this gender divide. It also raises interesting future questions, such as whether exposure to female role models in STEM disciplines, if they are linked to more positive identification with and positive attitudes towards those disciplines; Young et al., 2013) might prevent gender associations from forming as powerfully or otherwise mitigate some of the points of contact between conceptual links between male and science and female and humanities (Kifer & Sekaquaptewa, 2007; Nosek et al., 2002a). We might expect that the driving force behind these links in fact the associations explored here, i.e. the broader conception of gendered rationality. Of course, other possibilities should be acknowledged. As a correlational study, our Study 3 is open to third variable critiques in which an independent factor predicts both a greater gendered associations and views of the different disciplines included here. This issue might be particularly thorny in the present case given that, as we discuss further below, we did not exhaustively distinguish the thinking versus feeling dichotomy from other potentially related constructs that have previously been used to characterize gendered stereotypes versus community. This raised the possibility that one of those beliefs might drive both gendered associations as well as beliefs about the relevant fields.

Another related possibility concerns stereotype accuracy (for discussion, see Jusim et al., 2009), which could itself serve as a critical third variable. The issue here is that if stereotypes concerning the gendered nature of rationality are accurate, then the beliefs in question are largely accurate, those two factors will relate but not in a manner that suggests a causal link between them. While our analysis of gendered representation does assess accuracy or lack thereof, we did not assess the accuracy of stereotypes linking gender to rationality. However, we would argue that assessing the accuracy of such stereotypes is difficult absent much more precise operationalizations of what it means to be “more rational” or “more emotional”. Further, efforts to assess these links are made more difficult given the very semantic associations we document here, which show that stereotypically linked concepts co-activate one another. Indeed, a dissociation between these two things might be predicted if observers think that some disciplines are more or less accepting of people like them. Further, we used only a small set of academic disciplines that are unlikely to span the full range of fields in thinking versus feeling space. How results would look with a larger range of fields, or with professions outside the academic, remains an open question. Richer and more varied sets of measures, or even more powerfully, actual behavior observed subsequent to assessment, would presumably provide a more powerful window into how these associations impact real-world professional choices. Nonetheless, we do believe that our findings strongly support that gendered associations can result from tasks related to the content of a domain more or less interesting than they are to the actual pursuit of professional life in that domain. Further, we would argue that assessing the accuracy of stereotypes linking gender to rationality, most notably the link between gender and agency versus community (e.g. Haines, Deaux, & Lefaro, 2016). We would expect that assessments of stereotypes concerning community vs. agency would be related; indeed, we would expect them to be closely linked in the semantic network of individuals and cultures. However, determining which is strongest or most central or most predictive would be a daunting challenge given the reliability of implicit measures and the extent to which semantically associated concepts co-activate one another. Relatively, in an ideal world the scales we used to measure thinking versus feeling in Studies 1 and 2 used in the implicit measures in Study 2, would have been validated more thoroughly prior to use. Such efforts would not only increase our confidence in the science, but we can make on the basis of our findings but might also go some way towards showing whether and if so how our constructs differ from the past work alluded to above. Importantly, researchers interested in gendered representation here are compatible with a longstanding feminist critique that has been influential in philosophy and other areas of the humanities, namely that gender informs concepts of reason and rationality. Such views have been hotly contested and even trenched in (Nussbaum, 1994; Padnoswnti et al., 2010). While our work does not address all interpretations of the gendered rationality perspective, it does provide a cognitively grounded interpretation of one such claim, which is fully supported by the available empirical evidence. Philosophy and perhaps perhaps in additional areas such as feminist theory and critical race theory, have long been concerned with inequality, marginalization, and the power of ideology and stereotypes. These topics are of direct relevance to social and political philosophy, and we hope scholars in the social sciences will begin to mine their insights with more regularity. Further, they can be frequently translated into straightforward psychological and empirical research questions. Such efforts are not only needed to field us forward (e.g. Jost, 2006). We hope our work will help to build bridges across fields that share topical interest in areas such as prejudice and discrimination but are not necessarily connected across the disciplinary divides that separate them.

In closing, we note that the general strategy employed here, that of identifying a philosophically motivated, reinterpretating it in light of the contemporary science of the mind, and then subjecting it to testing with psychological tools, is one that could fruitfully be employed more broadly.

Data Accessibility Statement

Data from all studies in this paper, as well as code to generate the primary results and figures, is available at https://doi.org/10.1525/collabra.274.s1

Contributed to conception and design of Studies 1–2: ML, JS, YD

Contributed to conception and design of Study 3: JD, ML

Contributed to data collection and analysis: OP, JS, JD, ML

Contributed to data analysis and interpretation: OP, JS, JD, ML

Approved the revised version of the article: OP, JS, JD, ML

Competing Interests

The authors have no competing interests to declare.

Author Contributions

• Contributed to conception and design of Studies 1–2: OP, JS, JD

• Contributed to conception and design of Study 3: JD, ML

• Performed analysis: JD

• Contributed to interpretation of data: OP, JS, JD, ML

• Drafted and revised article: OP, JS, JD, ML

References


Prentice, D. A., & Carranza, E. (2002). What Women and Men Should Be, Shouldn’t be, are Allowed to be, and don’t Have to Be: The Contents of Perscriptive Gender Stereotypes. Psychology of Women Quarterly, 26(4), 269–281. DOI: https://doi.org/10.1111/1471-6402.10100-100066


