



# Messages about brilliance undermine women's interest in educational and professional opportunities



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## ABSTRACT

Pervasive cultural stereotypes associate brilliance with men, not women. Given these stereotypes, messages suggesting that a career requires brilliance may undermine women's interest. Consistent with this hypothesis, linking success to brilliance lowered women's (but not men's) interest in a range of educational and professional opportunities introduced via hypothetical scenarios (Experiments 1–4). It also led women more than men to expect that they would feel anxious and would not belong (Experiments 2–5). These gender differences were explained in part by women's perception that they are different from the typical person in these contexts (Experiments 5 and 6). In sum, the present research reveals that certain messages—in particular, those suggesting that brilliance is essential to success—may contribute to the gender gaps that are present in many fields.

## 1. Introduction

Notions of brilliance and genius are stereotypically associated with men, not women (e.g., Bian, Leslie, & Cimpian, 2017; Bennett, 1996, 1997; Elmore & Luna-Lucero, 2017; Kirkcaldy, Noack, Furnham, & Siefen, 2007; Lecklider, 2013; Stephens-Davidowitz, 2014; Tiedemann, 2000; Upson & Friedman, 2012). These cultural notions are likely to affect women's involvement in a variety of professions. In particular, the idea that “brilliance = men” may discourage women from pursuing activities that are believed to require high levels of intellectual ability. The six experiments reported here support this proposal and provide clues regarding the mechanisms involved.

### 1.1. The theoretical model

The present research investigates the Field-specific Ability Beliefs (FAB) model (see Fig. 1 for a schematic depiction), which was proposed to explain the distribution of gender gaps in representation across a wide range of fields (Cimpian & Leslie, 2015, 2017; Leslie, Cimpian, Meyer, & Freeland, 2015; Meyer, Cimpian, & Leslie, 2015; Storage, Horne, Cimpian, & Leslie, 2016). According to this model, women's involvement in a field is influenced by the *ability beliefs* prevalent in that field (see Fig. 1, right)—the beliefs shared by its members concerning

which characteristics are important for success. In particular, the model focuses on a field's beliefs about whether exceptional intellectual ability (“brilliance”) is needed to make meaningful contributions to the field. Messages suggesting that brilliance is important for success in a field are likely to affect women more than men in part because of the stereotype that associates this characteristic with men (Fig. 1, left; e.g., Bennett, 1996, 1997; Kirkcaldy et al., 2007).

Consistent with this model, Leslie, Cimpian, and their colleagues (2015) found that academic fields whose practitioners believed that success depends on brilliance had fewer women PhDs (see also Cimpian & Leslie, 2015; Meyer et al., 2015; Storage et al., 2016). This was true both for fields in the natural sciences and engineering (STEM) and for fields in the social sciences and humanities. Leslie, Cimpian, et al. (2015) also found that a field's beliefs about ability predicted women's representation above and beyond other variables commonly invoked as explanations for gender gaps, such as differences among fields in work-life balance or the extent to which they focus on people vs. abstract systems (e.g., Ceci, Ginther, Kahn, & Williams, 2014; Ferriman, Lubinski, & Benbow, 2009). Subsequent work replicated these results with a different measure of a field's emphasis on brilliance: namely, the frequency of the words “brilliant” and “genius” in anonymous reviews of college instructors on [RateMyProfessors.com](http://RateMyProfessors.com) (Storage et al., 2016).

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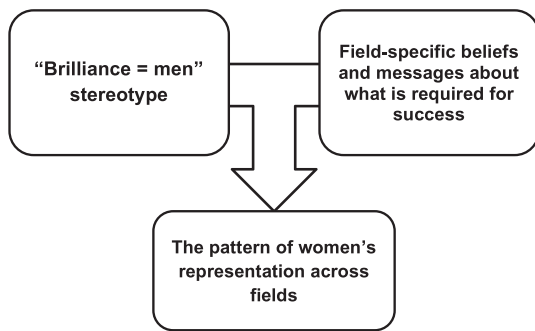


Fig. 1. Diagram of the Field-specific Ability Beliefs (FAB) theoretical model.

## 1.2. Do messages about brilliance undermine women's interest?

Although beliefs about brilliance predict women's participation across a wide range of fields, the evidence to date leaves open the crucial question of whether these beliefs *cause* gender gaps in participation. The experiments reported here begin to investigate this issue by testing whether brilliance-focused messages undermine women's *interest* in a field. Interest is a crucial precursor to participation in a field (e.g., Cheryan & Plaut, 2010; Cheryan, Ziegler, Montoya, & Jiang, 2017; Hulleman & Harackiewicz, 2009; Malgwi, Howe, & Burnaby, 2005; Morgan, Isaac, & Sansone, 2001; Wigfield & Eccles, 1992). Moreover, differences between men and women in their level of interest in various fields emerge early and contribute to some of the largest and most persistent gender gaps in academia and industry (e.g., Cheryan et al., 2017; Dasgupta & Stout, 2014; Wigfield & Eccles, 1992). Thus, examining whether men's and women's interest is differentially affected by whether an activity is said to require brilliance provides an important test of the FAB model.

The model predicts that messages that link success in a field to brilliance will undermine women's interest in that field, in part because of the cultural association between brilliance and men (e.g., Bian et al., 2017; Kirkcaldy et al., 2007). Moreover, the model predicts that messages about brilliance will have these effects regardless of the actual content of the field. In prior work, an emphasis on this trait predicted women's underrepresentation both in STEM and in the social sciences and humanities (Leslie, Cimpian, et al., 2015).

In addition to testing for a causal effect of brilliance-focused messages on women's interest, the present studies explored the psychological mechanisms underlying this effect. Specifically, we investigated two possible mechanisms: one that operates via judgments of (dis)similarity with relevant others (i.e., prototype matching; Niedenthal, Cantor, & Kihlstrom, 1985) and another that operates via the threat of being negatively stereotyped (i.e., stereotype threat; Steele, 2013).

### 1.2.1. Potential mechanism #1: (mis)matching a prototype

One reason why messages about brilliance might lower women's interest is that women may perceive themselves to be dissimilar to the people in fields where brilliance is valued (e.g., Eagly & Karau, 2002; Heilman, 1983, 2012; Ibarra & Petriglieri, 2017; Niedenthal et al., 1985; Oyserman, 2008). According to *self-to-prototype matching theory* (e.g., Niedenthal et al., 1985; Setterlund & Niedenthal, 1993), many important life choices (e.g., about which careers to pursue) are informed by a comparison between the self and the prototypical person in the context being considered. Given that the cultural prototype of the “brilliant person” excludes women, they are likely to perceive a mismatch with the members of brilliance-oriented fields. This mismatch might lead women to be apprehensive about joining such fields; it might also raise concerns about belonging. Anxiety and lack of belonging could ultimately undermine women's interest (e.g., Cheryan & Plaut, 2010; Cheryan, Plaut, Davies, & Steele, 2009; Dasgupta, 2011; Good, Rattan, & Dweck, 2012; Hannover & Kessels, 2004; Walton &

Cohen, 2007, 2011; Walton, Cohen, Cwir, & Spencer, 2012).

### 1.2.2. Potential mechanism #2: stereotype threat

Just as comparisons between the self and the prototypical person in a field can influence interest, so can judgments about whether one's *group* is likely to be welcome and valued in a field. Messages about the importance of brilliance may act as a situational cue to *stereotype threat*—the threat of being judged through the lens of a negative stereotype about one's group (e.g., Davies, Spencer, Quinn, & Gerhardtstein, 2002; Emerson & Murphy, 2015; Murphy, Steele, & Gross, 2007; Steele, 2013). As with the prototype matching mechanism, the threat of being stereotyped might give rise to feelings of anxiety (e.g., Murphy et al., 2007; Osborne, 2007) and of not belonging (e.g., Good et al., 2012), which might in turn lower women's interest.

### 1.3. Relation to prior findings

Several prior studies have investigated whether women's aspirations are influenced by “environmental” beliefs about success—that is, by what they perceive to be common ideas regarding the characteristics one needs to succeed. We briefly summarize these findings and then outline how our research contributes to this literature.

A longitudinal study by Good et al. (2012) revealed that female calculus students who perceived others in their class to have a *fixed mindset* about mathematical ability (viewing it as a stable trait; see Dweck, 1999, 2006) reported lower belonging and weaker intentions to take mathematics courses after a semester—especially if they also perceived others to endorse negative stereotypes about women's mathematical abilities. Similarly, Emerson and Murphy (2015) found that when women imagined being in a consulting firm that espoused a fixed (vs. growth) mindset, they anticipated being judged on the basis of their gender and, as a result, exhibited less trust and more defensive behavior in the face of negative feedback from the company. Consistent with these other studies, Smith, Lewis, Hawthorne, and Hodges (2013) found that when women considered an unfamiliar STEM major that espoused a growth mindset (i.e., that considerable effort is required of anyone who wants to succeed), they expressed more interest in this major and felt a greater sense of belonging in it relative to a no-information control condition.

The present research, and our theoretical model more generally, extends this prior work in four respects. First, it investigates a distinct set of environmental beliefs: namely, beliefs about the importance of brilliance to success. Lay notions of brilliance are conceptually distinct—and empirically distinguishable—from lay notions of mathematical ability and general intelligence (Cimpian & Leslie, 2015; Meyer et al., 2015; Rattan, Savani, Naidu, & Dweck, 2012). For instance, the idea that exceptional intellectual ability (which is what we term “brilliance”) is in part a matter of genetic potential and therefore identifiable at a young age (e.g., child prodigies) is considerably more common than the idea that general intelligence is fixed and immutable (e.g., Rattan, Savani, et al., 2012). In fact, these beliefs are only weakly correlated among US participants,  $r \approx 0.20$  (Rattan, Savani, et al., 2012). (Note that people are able to conceive of brilliance without assuming a genetic basis; our claim here is simply that in our culture the “default,” most accessible conception of brilliance has a biological component.) Thus, prior research on environmental beliefs about intelligence may not be straightforwardly informative about the effects of environmental beliefs about brilliance.

Second, the present research is novel because it investigates environmental beliefs about exceptional ability, whereas prior work has focused mainly on beliefs about “typical” ability. However, possessing ability at the “one in 10,000” level (i.e., the right tail of the distribution) is often claimed to be a prerequisite for success in many prestigious careers in academia and beyond (e.g., Summers, 2005), so investigating the effects of environmental messages about such top-level ability on women's aspirations fills an important gap in the literature.

Third, the present research investigates educational and professional contexts beyond those in which women's underrepresentation has typically been studied (mainly, business and STEM; e.g., Emerson & Murphy, 2015; Good et al., 2012). Brilliance is not a domain- or field-specific characteristic; in fact, an emphasis on brilliance predicts women's representation across a broad range of fields, including fields in the social sciences and humanities (e.g., Leslie, Cimpian, et al., 2015; Storage et al., 2016). Thus, we expected that messages about brilliance might undermine women's interest in a similarly broad range of fields.

Fourth, the present research explores a broad set of processes by which messages about brilliance might have their effects. In addition to measuring women's expectations of being negatively stereotyped (i.e., the stereotype threat pathway; see Emerson & Murphy, 2015), we measured whether women perceive a mismatch with the prototype of the successful person in brilliance-focused contexts (i.e., the prototype matching pathway). Further, to understand how stereotype threat and/or prototype (mis)matching might undermine women's interest, we also measured women's anticipated feelings of anxiety and sense of belonging.

#### 1.4. Overview of experiments

We investigated the hypothesis that messages about the value of brilliance undermine women's interest in a variety of educational and professional opportunities (see Fig. 2 for a graphical summary). In addition to testing this causal link (Experiments 1–4), we explored what might mediate the negative effects of brilliance-focused messages on women's interest, focusing specifically on whether these messages heighten women's anxiety and reduce their sense of belonging (Experiments 2–5). We then went a step further in our investigation of mechanisms, comparing two possible routes to these effects (prototype matching vs. stereotype threat; Experiments 5 and 6).

To explore the generalizability of our claims, we varied a number of dimensions across the six experiments: the type of activity described (an internship vs. a major vs. a job), the content matter associated with it (STEM vs. social sciences and humanities), and the participant populations tested (college students vs. Mechanical Turk workers). We also investigated—and were able to rule out—several competing explanations for our results (e.g., gender differences in modesty or desire for status).

A final goal of the present research was to begin exploring the conditions that might alleviate the negative effect of messages about brilliance. In Experiment 6, we tested whether simply portraying brilliance as a malleable quality would be sufficient: Since the potential to be brilliant is usually seen as a matter of genetic endowment (Rattan, Savani, et al., 2012), sending a more growth-oriented message might

help buffer women's interest against these messages.

Together, the six experiments reported here support the claim that messages about the importance of brilliance to success undermine women's interest and provide clues about the mechanisms underlying these negative effects.

## 2. Experiment 1: Do messages about the importance of brilliance undermine women's interest?

In this experiment, we explored the effect of messages about the value of brilliance on college students' interest in an internship opportunity. Participants were told about a company looking to recruit either interns who are brilliant (“brilliance” condition) or, for comparison, interns who are dedicated (“dedication” condition). We used dedication-focused messages as a comparison in this and the next three studies in part because these messages are also common in academia (Leslie, Cimpian, et al., 2015; for a comparison against a neutral control condition, see Experiment 5). Thus, by pitting brilliance- and dedication-focused messages against each other in an experiment, we were able to test the causal effects of naturally occurring variability in field-specific beliefs about success. Relative to brilliance, effort and dedication are typically viewed as being under one's control, which may level the playing field for women (e.g., Good, Aronson, & Inzlicht, 2003; Smith et al., 2013). Thus, we predicted that women's interest in this internship would be higher when dedication is emphasized than when brilliance is; men's interest, on the other hand, should not be substantially affected by this manipulation.

### 2.1. Method

The data for this study, as well as all other studies reported here, are available on Open Science Framework: [https://osf.io/ca3yx/?view\\_only=ee796e20211e42269f4d9abb294c070e](https://osf.io/ca3yx/?view_only=ee796e20211e42269f4d9abb294c070e). All measures, manipulations, and exclusions in this and subsequent studies are disclosed. For all studies, the final sample size was determined a priori with a power analysis using effect sizes from studies with similar methodologies (e.g., Smith et al., 2013).

#### 2.1.1. Participants

Participants ( $N = 199$ ;  $M_{age} = 19.43$ ; 126 women, 73 men) were recruited from the undergraduate subject pool of a large public university. Participants were tested online (via Qualtrics) and were given course credit for participation.

#### 2.1.2. Procedure and materials

Participants were asked to consider and evaluate an internship

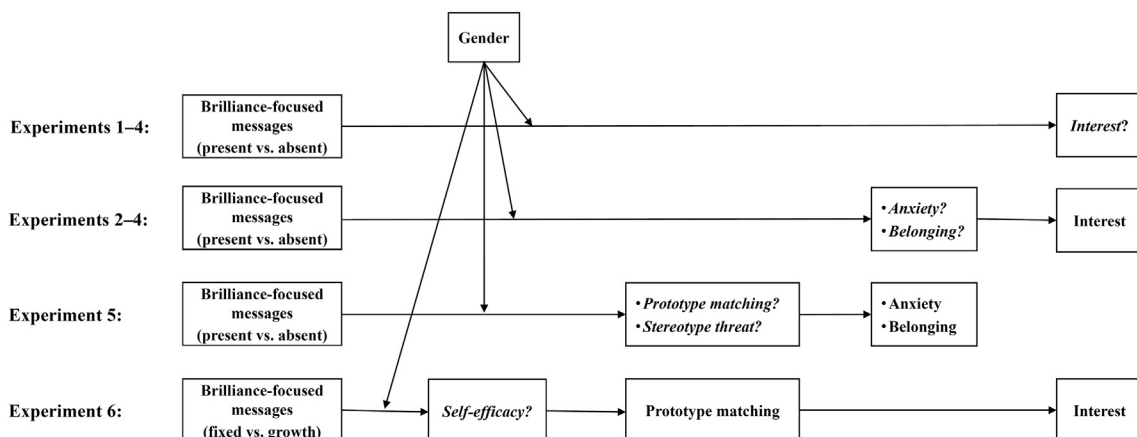


Fig. 2. Graphical outline of the hypotheses tested across our six experiments. The terms that are italicized and followed by a question mark refer to the variables that are the main focus of each experiment.

program:

“A well-known company is planning to provide a new internship program. Since this is a new program, the local newspaper is interviewing the representatives of the company to ask about the types of interns that would best fit the positions they are offering.”

After a brief demographics questionnaire, participants were shown the top characteristics ostensibly mentioned by the representatives of the company during their interviews. These characteristics were either brilliance-related (e.g., “intellectual firecracker,” “at ease with complex, abstract ideas,” “sharp, penetrating mind”) or dedication-related (e.g., “great focus and determination,” “passionate about the job,” “someone who never gives up”).

The phrases used in this study (as well as Experiments 2–5) did not consistently suggest either a fixed or a malleable perspective on the characteristics said to be required; participants were thus free to interpret these requirements as they ordinarily would if they encountered them outside the lab, which highlights the real-world applicability of our findings. However, we did validate our assumption that the dedication-related requirements would be interpreted as more malleable and more under one's control than the brilliance-related requirements. A separate sample of 38 participants on Mechanical Turk (21 women, 17 men) were shown the two lists of characteristics (with their left/right position randomized across participants) and asked to choose which list contains more characteristics that are (1) malleable or changeable, and (2) under one's control (adapted from Dweck, 1999). The dedication-related characteristics were chosen 73.7% of the time ( $SD = 25.3$ ) across these two questions, which was significantly more often than expected by chance (50%),  $t(37) = 5.77$ ,  $p < .001$ . We performed validation studies for Experiments 2–5 as well, with similar results—the dedication-related characteristics were consistently rated as more malleable and controllable (see Appendix S1 in the Supplementary Online Materials [SOM]).

After exposure to this information, participants answered three questions that gauged their interest in the internship (e.g., “Assuming you were looking for an internship, how interested would you be in finding out more about this particular internship program?”; 1 = “not at all interested” to 9 = “extremely interested”; see Table S1 in the SOM). These items were averaged into an overall interest score ( $\alpha = 0.81$ ).

We also asked participants to provide justifications for their answers to these items. Justifications were collected for three purposes. First, they were intended to encourage thoughtful responses on the scale items, which constituted our main dependent variable. Second, these justifications served as a rough comprehension check. Because participants were purposely provided with minimal information about the internship (other than its focus on brilliance vs. dedication), we wondered whether they found it difficult to answer our questions. However, almost none of the participants reported such difficulties in their justifications, suggesting that the experimental scenario was easy to understand. Third, we used participants' justifications to perform an additional test of our main prediction about the effects of brilliance-focused messages. Specifically, we submitted participants' open-ended responses to the linguistic analysis program Linguistic Inquiry and Word Count (LIWC2007, version 1.12; Pennebaker, Booth, & Francis, 2007) and then compared the frequency of certain types of words (e.g., anxiety-related words) across conditions for men and women (see Appendix S2 in the SOM for details). These analyses provided converging evidence for the prediction that messages about brilliance have negative effects on women but not men.

To explore whether participants drew different inferences about the content of the internship from the requirements associated with it (e.g., assuming that an internship said to require brilliance is in STEM), at the end of the study participants were asked whether the description of the internship had made them think of a particular type of company or job. Participants' guesses were coded blind to condition (brilliance vs.

dedication) and were assigned to one of four categories, depending on the inferred content of the internship: business (40.7% of all participants), STEM (15.1%), social sciences and humanities (0.5%), and other (8.5%). The remaining participants indicated that no particular type of internship came to mind. A second researcher independently coded participants' guesses to assess reliability. Inter-coder agreement ranged between 93.5% and 99.0% across the four categories. Disagreements were resolved via discussion. When entered as an additional factor in our analyses, participants' guesses did not moderate the predicted results. Specifically, the magnitude of the crucial gender  $\times$  condition interaction (see below) did not vary significantly depending on the inferred content of the internship. We performed analogous checks for Experiments 2, 5, and 6 as well, with similar results—participants' inferences did not significantly moderate the predicted gender  $\times$  condition interactions (see Appendix S3 in the SOM).

## 2.2. Results and discussion

We predicted that women would express less interest in the internship opportunity when exposed to messages emphasizing the importance of brilliance. Men's interest, however, should not suffer.

A 2 (gender: men vs. women)  $\times$  2 (condition: brilliance vs. dedication) analysis of variance (ANOVA) found a significant interaction,  $F(1, 195) = 4.98$ ,  $p = .027$ ,  $\eta_p^2 = 0.025$  (see Fig. 3). Tests of simple effects revealed that women showed lower interest in the brilliance internship compared to the dedication internship,  $F(1, 195) = 6.34$ ,  $p = .013$ ,  $\eta_p^2 = 0.032$ , whereas men's interest did not differ across conditions,  $F(1, 195) = 0.79$ ,  $p = .375$ ,  $\eta_p^2 = 0.004$ . (The full ANOVA tables for this and all subsequent studies are presented in Tables S6–S10 of the SOM.)

In sum, messages that emphasized the importance of brilliance (vs. dedication) to success lowered women's interest in an internship position. These results support a key claim of the FAB model: namely, that women are discouraged from pursuing careers in which success is thought to depend largely on being brilliant.

## 3. Experiment 2: Do anxiety and belonging mediate the negative effect of messages about the importance of brilliance on women's interest?

In Experiment 2, we began to explore the mechanisms through which messages about the value of brilliance might affect women's interest (see Fig. 2). Specifically, we hypothesized that women would anticipate experiencing more anxiety and a weaker sense of belonging in contexts where brilliance is seen as the key to success, which might in turn predict lower interest in the corresponding activities.

Experiment 2 was also designed to assess the generalizability of our initial results by (1) asking participants to evaluate a new major instead of an internship, (2) using a simpler set of words to communicate a focus on brilliance vs. dedication, and (3) sampling from a different participant population.

### 3.1. Method

#### 3.1.1. Participants

Participants ( $N = 195$ ;  $M_{age} = 33.53$ ; 101 women, 94 men) were recruited from Amazon's Mechanical Turk service. They were paid \$0.75 for participation. Thirteen additional participants were excluded because their IP addresses indicated they resided outside of the US ( $n = 5$ ), because they explicitly reported (during debriefing) that they had not paid attention ( $n = 1$ ), because they did not report their gender ( $n = 1$ ), or because they failed an attention check ( $n = 6$ ; see below).

#### 3.1.2. Procedure

The procedure was similar to that of Experiment 1. However, the participants were now asked to consider and evaluate a *major*, whose

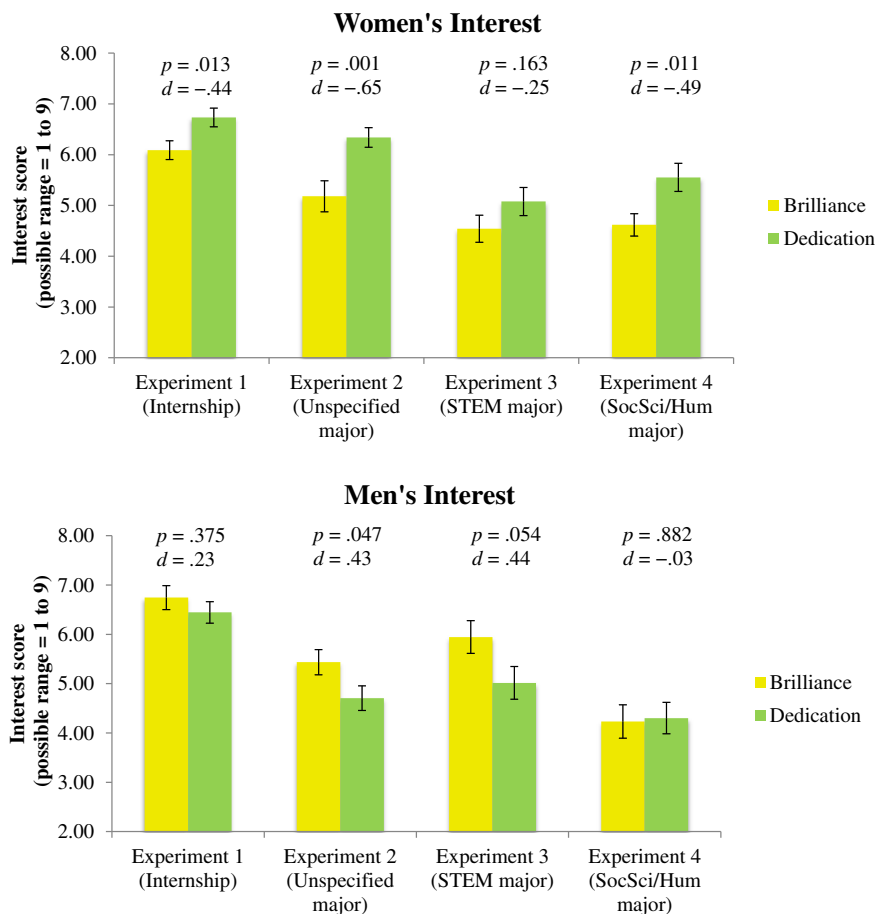


Fig. 3. Women's (top) and men's (bottom) interest, by brilliance vs. dedication condition, across Experiments 1–4. The  $p$  values were derived from tests of the simple effects of condition within women and men. Cohen's  $d$ s are provided as a measure of effect size. Error bars represent  $\pm 1$  SE.

faculty had ostensibly been interviewed about “what type of students would best fit their program.” The task of evaluating a major is familiar to most Mechanical Turk workers; demographic surveys of this population have found that approximately 90% of them have had some exposure to college (e.g., Ipeirotis, 2010; Marshall & Shipman, 2013).

Next, participants were shown “the student characteristics that were most frequently mentioned during their interviews by the professors for the new major,” which varied by condition. We used a new, simpler set of brilliance vs. dedication descriptors: “brilliant,” “smart,” “intelligent,” and “talented” (brilliance condition) vs. “dedicated,” “motivated,” “hardworking,” and “passionate” (dedication condition). In addition, the adjective “respectful” was presented in both conditions and served as a filler. Appendices S1 and S3 in the SOM provide additional information about the perceived malleability of these new characteristics and about participants' guesses regarding the content of the major, respectively.

To ensure that participants in our main study encoded the crucial brilliance vs. dedication information, they were asked to recall these five characteristics immediately after reading them. Participants were retained in the analyses if they (1) mentioned at least one of the traits relevant to their condition, and (2) did not mention any of the traits relevant to the other condition (e.g., “brilliant” in the dedication condition). Six participants did not meet these criteria and were excluded from the analyses.

### 3.1.3. Measures

Participants filled out an interest measure similar to that in Experiment 1 ( $\alpha = 0.81$ ), followed by measures of anticipated anxiety and belonging, in randomized order. (Correlation matrices for this and all subsequent studies are presented in Tables S11–S15 of the SOM.)

**3.1.3.1. Anxiety.** Ten items measured the extent to which participants anticipated feeling anxious and stressed if they were to pursue the major (e.g., “I would feel anxious”; 1 = “not at all” to 9 = “very much so”; see Table S2). The 10 items were averaged into an overall anxiety score ( $\alpha = 0.87$ ).

**3.1.3.2. Belonging.** Belonging is a multifaceted construct that captures a person's sense of membership and acceptance in a field or setting. Four items adapted from Good et al. (2012) and Walton and Cohen (2007) tapped participants' anticipated sense of belonging in the major (e.g., “I would feel like I belong”; 1 = “not at all” to 9 = “very much so”; see Table S2). The four items were averaged into an overall belonging score ( $\alpha = 0.60$ ).

## 3.2. Results and discussion

### 3.2.1. Interest

We predicted that women, but not men, would display less interest in the brilliance than the dedication major. Replicating the results of Experiment 1, a 2 (gender: men vs. women)  $\times$  2 (condition: brilliance vs. dedication) ANOVA revealed the predicted interaction,  $F(1, 191) = 13.86$ ,  $p < .001$ ,  $\eta_p^2 = 0.068$ . Tests of simple effects revealed that women were less interested in the brilliance than the dedication major,  $F(1, 191) = 10.82$ ,  $p = .001$ ,  $\eta_p^2 = 0.054$ , whereas men were more interested in the brilliance (vs. the dedication) major,  $F(1, 191) = 4.00$ ,  $p = .047$ ,  $\eta_p^2 = 0.021$  (see Fig. 3), suggesting a modest “lift” for the positively stereotyped group (Walton & Cohen, 2003).

### 3.2.2. Anxiety

Do women, but not men, anticipate feeling anxious in contexts in which brilliance is thought to be important to success? Indeed, a 2

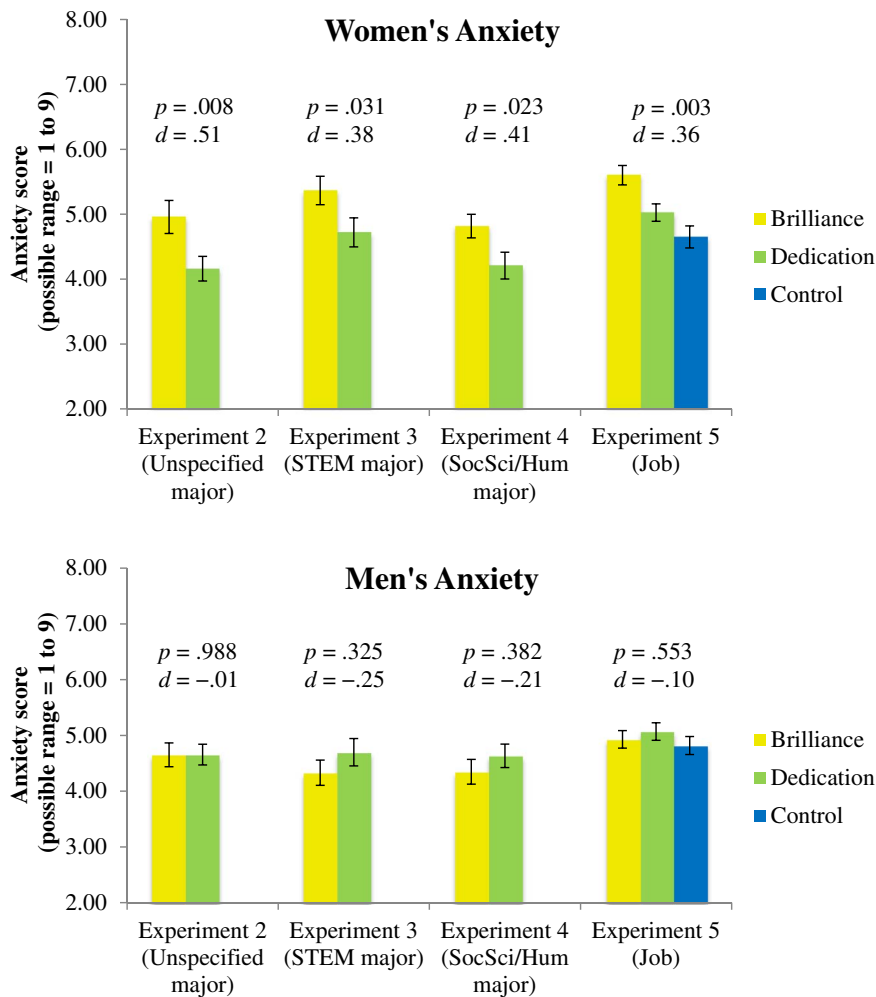


Fig. 4. Women's (top) and men's (bottom) anxiety, by brilliance vs. dedication (vs. control) condition, across Experiments 2–5. The  $p$  values were derived from tests of simple effects (Experiments 2–4) or Fisher's Least Significant Difference (LSD) post-hoc tests (Experiment 5) comparing the brilliance and the dedication conditions within each gender. Cohen's  $d$ s are provided as a measure of effect size for the difference between the brilliance and dedication conditions. Error bars represent  $\pm 1$  SE.

(gender)  $\times$  2 (condition) ANOVA revealed a marginally significant interaction,  $F(1, 191) = 3.51, p = .063, \eta_p^2 = 0.018$ . Tests of simple effects revealed that women reported more anxiety when they imagined pursuing the brilliance vs. the dedication major,  $F(1, 191) = 7.20, p = .008, \eta_p^2 = 0.036$ , but men did not,  $F(1, 191) < 0.01, p = .988, \eta_p^2 < 0.001$  (see Fig. 4).

### 3.2.3. Belonging

The gender  $\times$  condition interaction was also observed with respect to participants' sense of belonging,  $F(1, 191) = 7.63, p = .006, \eta_p^2 = 0.038$ . Women reported lower belonging when considering the brilliance vs. the dedication major,  $F(1, 191) = 9.20, p = .003, \eta_p^2 = 0.046$ ; in contrast, men's sense of belonging did not differ between the two majors,  $F(1, 191) = 0.83, p = .363, \eta_p^2 = 0.004$  (see Fig. 5).

### 3.2.4. Anxiety and belonging as (simultaneous) mediators: testing for gender-moderated mediation

We expected that brilliance-focused messages would undermine women's interest by heightening their anticipated anxiety and lowering their sense of belonging; in contrast, this indirect effect should be weaker or absent for men. To test for moderated mediation, we conducted a conditional process analysis using Model 7 of the PROCESS macro (Hayes, 2013) in SPSS. (The same results were obtained with Model 8 in this experiment and Experiments 3–5.) Anxiety and belonging were entered as mediators in the same model, with condition as the independent variable (brilliance = 0; dedication = 1) and interest as the dependent variable; gender was entered as the moderator (men = 0; women = 1). In line with our prediction, this analysis

showed independent gender-moderated mediation effects for both anxiety, index = 0.30,  $SE = 0.20, 95\% CI = [0.01, 0.80]$ , and belonging, index = 0.65,  $SE = 0.28, 95\% CI = [0.20, 1.34]$  (see Fig. 6). With respect to anxiety, we found a significant indirect effect of condition on interest via anxiety for women,  $ab = 0.30, SE = 0.16, 95\% CI = [0.07, 0.70]$ , but not for men,  $ab = -0.002, SE = 0.11, 95\% CI = [-0.24, 0.22]$ . Similarly, with respect to belonging, there was a significant indirect effect of condition on interest via belonging for women,  $ab = 0.50, SE = 0.20, 95\% CI = [0.17, 0.98]$ , but not for men,  $ab = -0.15, SE = 0.17, 95\% CI = [-0.54, 0.14]$ .

### 3.2.5. Conclusion

Consistent with the FAB model and with the results of Experiment 1, messages about the importance of brilliance to success undermined women's interest in an academic major. These messages also made women feel more anxious and lowered their sense of belonging, which in turn explained their lower interest. These results also speak to the generalizability of our conclusions, insofar as they reveal the predicted negative effect of brilliance cues on women's interest (1) in a different participant population and (2) with a different set of stimuli than in the first study.

## 4. Experiment 3: Novel major in STEM; further evidence for anxiety and belonging as mediators

In Experiment 3, we explored a potential alternative explanation for the results so far. One could argue that messages about brilliance undermined women's interest (relative to messages about dedication)

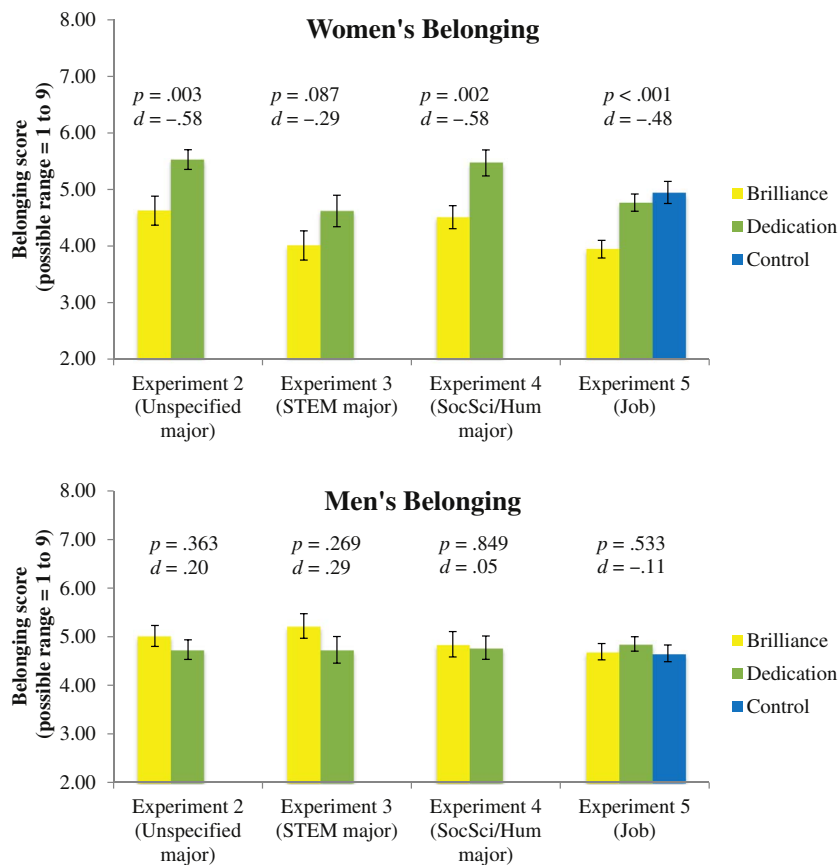


Fig. 5. Women's (top) and men's (bottom) sense of belonging, by brilliance vs. dedication (vs. control) condition, across Experiments 2–5. The  $p$  values were derived from tests of simple effects (Experiments 2–4) or Fisher's LSD post-hoc tests (Experiment 5) comparing the brilliance and the dedication conditions within each gender. Cohen's  $d$ s are provided as a measure of effect size for the difference between the brilliance and dedication conditions. Error bars represent  $\pm 1$  SE.

simply because they called to mind particular sorts of internships (Experiment 1) or majors (Experiment 2)—namely, ones in natural science and engineering, which are widely seen as requiring intellectual talent (Meyer et al., 2015) and in which women are generally underrepresented. Although participants' guesses about specific fields in Experiments 1 and 2 did not moderate the predicted gender  $\times$  condition interactions (which goes against this alternative), in Experiment 3 we addressed this issue more directly by holding fixed the content of the major across conditions. Specifically, participants were asked to evaluate a new interdisciplinary STEM major. (To anticipate, participants in the next experiment were told about a new interdisciplinary major in the social sciences and humanities.) We predicted that messages about the value of brilliance (vs. dedication) would undermine women's interest even in this disambiguated context. In contrast, the alternative explanation predicts no difference between conditions, since they both make explicit reference to a STEM major.

#### 4.1. Method

##### 4.1.1. Participants

Participants ( $N = 204$ ;  $M_{age} = 34.48$ ; 124 women, 80 men) were recruited from Amazon's Mechanical Turk service. They were paid \$0.75 for participation. Six additional participants were excluded because their IP addresses indicated they resided outside of the US.

##### 4.1.2. Procedure and materials

The procedure and materials were similar to those in Experiment 2, including the simpler set of brilliance vs. dedication descriptors. The only difference was that participants were asked to consider and evaluate “a new interdisciplinary major that integrates many natural science and engineering disciplines.” The internal consistency ( $\alpha$ ) of the

measures of interest, anxiety, and belonging was 0.89, 0.90 and 0.78, respectively.

#### 4.2. Results and discussion

##### 4.2.1. Interest

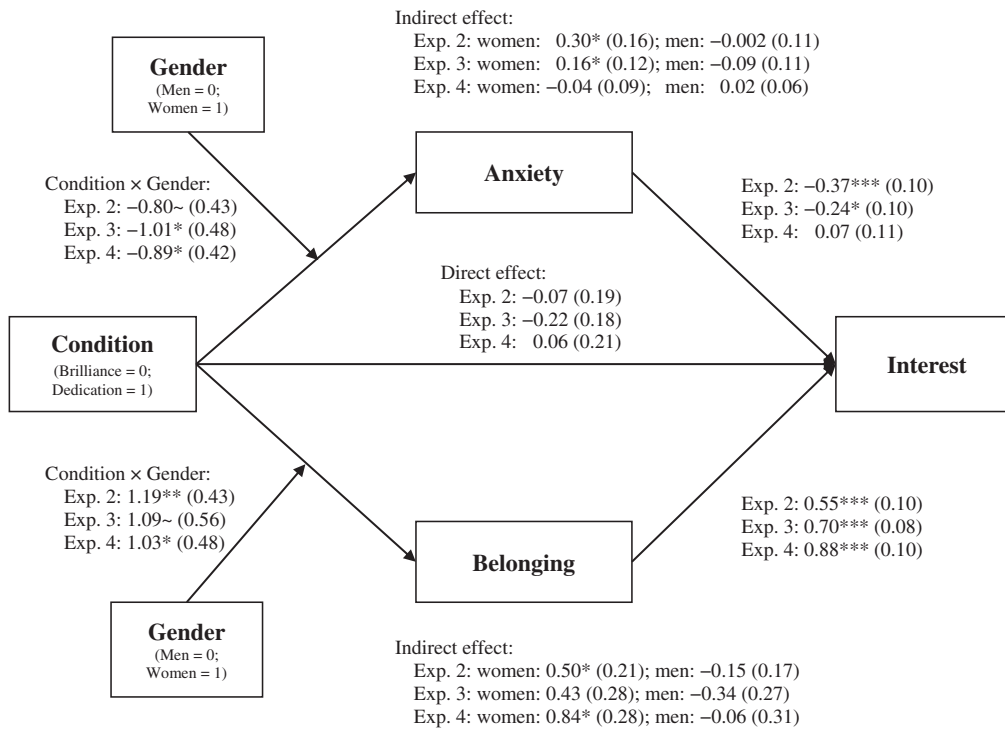
A 2 (gender)  $\times$  2 (condition) ANOVA revealed that women were overall less interested in this STEM major than men were ( $M_s = 4.80$  and 5.43, respectively; both  $SD_s = 2.15$ ),  $F(1, 200) = 4.78$ ,  $p = .030$ ,  $\eta_p^2 = 0.023$ . As predicted, however, this main effect was moderated by the brilliance vs. dedication manipulation,  $F(1, 200) = 5.71$ ,  $p = .018$ ,  $\eta_p^2 = 0.028$ . Tests of simple effects revealed that women reported non-significantly less interest in the brilliance than in the dedication STEM major,  $F(1, 200) = 1.96$ ,  $p = .163$ ,  $\eta_p^2 = 0.010$ , whereas men reported marginally more interest in the brilliance than in the dedication major,  $F(1, 200) = 3.77$ ,  $p = .054$ ,  $\eta_p^2 = 0.018$  (see Fig. 3).

##### 4.2.2. Anxiety

When contemplating what it would be like to pursue the STEM major, women anticipated feeling more anxious than men overall ( $M_s = 5.05$  and 4.53, respectively;  $SD_s = 1.76$  and 1.51),  $F(1, 200) = 4.92$ ,  $p = .028$ ,  $\eta_p^2 = 0.024$ . The predicted gender  $\times$  condition interaction was also significant,  $F(1, 200) = 4.52$ ,  $p = .035$ ,  $\eta_p^2 = 0.022$ . Messages about brilliance (vs. dedication) heightened women's anxious feelings,  $F(1, 200) = 4.71$ ,  $p = .031$ ,  $\eta_p^2 = 0.023$ , but not men's,  $F(1, 200) = 0.97$ ,  $p = .325$ ,  $\eta_p^2 = 0.005$  (see Fig. 4).

##### 4.2.3. Belonging

Women reported a lower sense of belonging in the STEM major than men did ( $M_s = 4.31$  and 4.95, respectively;  $SD_s = 2.12$  and 1.70),  $F(1, 200) = 5.31$ ,  $p = .022$ ,  $\eta_p^2 = 0.026$ , but this main effect was qualified



**Fig. 6.** Gender-moderated multiple mediation of the effect of condition (brilliance vs. dedication) on participants' interest through their anticipated anxiety and belonging. We report unstandardized coefficients (and SEs in parentheses). ~  $p < .10$ . \*  $p < .05$ . \*\*  $p < .01$ . \*\*\*  $p < .001$ .

by a marginally significant interaction with condition,  $F(1, 200) = 3.77$ ,  $p = .054$ ,  $\eta_p^2 = 0.018$ . Women's belonging was marginally lower in the brilliance (vs. dedication) STEM major,  $F(1, 200) = 2.96$ ,  $p = .087$ ,  $\eta_p^2 = 0.015$ , whereas men's belonging was similar across conditions,  $F(1, 200) = 1.23$ ,  $p = .269$ ,  $\eta_p^2 = 0.006$  (see Fig. 5).

#### 4.2.4. Anxiety and belonging as (simultaneous) mediators: testing for gender-moderated mediation

A conditional process analysis analogous to that conducted in Experiment 2 revealed that gender (men = 0; women = 1) independently moderated both the condition → anxiety → interest pathway (index of moderated mediation = 0.24,  $SE = 0.19$ , 95%  $CI = [0.002, 0.78]$ ) and the condition → belonging → interest pathway (index of moderated mediation = 0.77,  $SE = 0.40$ , 95%  $CI = [0.06, 1.62]$ ; see Fig. 6).

With respect to anxiety, the indirect effect of brilliance vs. dedication messages on STEM interest via anxiety was significant for women,  $ab = 0.16$ ,  $SE = 0.12$ , 95%  $CI = [0.001, 0.49]$ , but not for men,  $ab = -0.09$ ,  $SE = 0.11$ , 95%  $CI = [-0.41, 0.04]$ .

The model's results with respect to belonging were somewhat more ambiguous. As predicted, women exposed to the brilliance (vs. dedication) STEM major felt less belonging and in turn less interest, whereas men felt more belonging and in turn more interest. However, despite the significant moderation by gender, neither indirect effect was significant on its own (women:  $ab = 0.42$ ,  $SE = 0.28$ , 95%  $CI = [-0.09, 1.03]$ ; men:  $ab = -0.34$ ,  $SE = 0.27$ , 95%  $CI = [-0.91, 0.16]$ ).

#### 4.2.5. Conclusion

These findings speak against the possibility that messages about the value of brilliance vs. dedication have divergent effects on women's interest simply because they are associated with, and thus call to mind, different types of careers. Every participant in the present experiment was told about a STEM major, yet messages about the importance of brilliance to success still undermined women's interest relative to messages emphasizing dedication. As in the previous study, women also anticipated feeling more anxiety and less belonging in contexts where brilliance is valued, and these differences predicted the gender difference in interest.

### 5. Experiment 4: Novel major in the social sciences and humanities; further evidence for anxiety and belonging as mediators; modesty as an alternative explanation

In Experiment 4, we tested the causal effects of messages about brilliance in another domain—social sciences and humanities (SSH); beliefs about the importance of brilliance track women's representation in this domain as well (Leslie, Cimpian, et al., 2015). This experiment also tested a potential alternative explanation for our findings so far. Because women are subject to stronger modesty norms than men (e.g., Daubman, Heatherington, & Ahn, 1992; Gould & Slone, 1982; Rudman, 1998), perhaps women's lower interest in the activity portrayed as requiring brilliance was driven by a modest reluctance to claim that they are suited for such a career—rather than, as we claimed, by their expectation that they would be anxious and not feel they belong. To assess



this alternative, we measured participants' adherence to modesty norms and tested whether differences between men and women on this dimension can explain the negative effects of messages about the importance of brilliance on women (vs. men). We predicted that we would replicate the crucial gender  $\times$  condition interaction effect on participants' interest even when adjusting for any potential differences in modesty between women and men.

## 5.1. Method

### 5.1.1. Participants

Participants ( $N = 198$ ;  $M_{age} = 34.45$ ; 120 women, 78 men) were recruited from Amazon's Mechanical Turk service. They were paid \$0.75 for participation. Seven additional participants were excluded either because they had non-US IP addresses ( $n = 5$ ) or because they failed an attention check ( $n = 2$ ; same as in Experiment 2).

### 5.1.2. Procedure and materials

The procedure and materials were similar to those in Experiments 2 and 3, except participants were asked to consider and evaluate "a new interdisciplinary major that integrates many disciplines in the social sciences and humanities." Participants also filled out a measure of modesty (e.g., "It's difficult for me to talk about my strengths to others even when I know I possess them"; Whetstone, Okun, & Cialdini, 1992;  $\alpha = 0.93$ ; see Table S3). This measure was administered after the measures of interest ( $\alpha = 0.86$ ), anxiety ( $\alpha = 0.82$ ), and belonging ( $\alpha = 0.58$ ).

## 5.2. Results and discussion

### 5.2.1. Interest

A 2 (gender)  $\times$  2 (condition) ANOVA revealed that women ( $M = 5.00$ ,  $SD = 1.94$ ) were more interested than men ( $M = 4.27$ ,  $SD = 2.03$ ) in the SSH major,  $F(1, 194) = 8.18$ ,  $p = .005$ ,  $\eta_p^2 = 0.040$ . However, the messages that accompanied this major were also influential. Although the gender  $\times$  condition interaction did not reach statistical significance in this analysis,  $F(1, 194) = 2.30$ ,  $p = .131$ ,  $\eta_p^2 = 0.012$ , the tests of simple effects revealed the predicted pattern: Women's interest in the SSH major was lower when brilliance (vs. dedication) was said to be required for success,  $F(1, 194) = 6.67$ ,  $p = .011$ ,  $\eta_p^2 = 0.033$ , whereas men's interest was not affected by these messages,  $F(1, 194) = 0.02$ ,  $p = .882$ ,  $\eta_p^2 < 0.001$  (see Fig. 3).

### 5.2.2. Anxiety

Women and men did not differ in their overall levels of anticipated anxiety,  $F(1, 194) = 0.01$ ,  $p = .920$ ,  $\eta_p^2 < 0.001$ . However, women and men had different reactions to the messages about the importance of brilliance vs. dedication, as revealed by a gender  $\times$  condition interaction,  $F(1, 194) = 4.52$ ,  $p = .035$ ,  $\eta_p^2 = 0.023$ . In line with our previous findings, women felt more anxious in contexts that emphasized brilliance vs. dedication,  $F(1, 194) = 5.24$ ,  $p = .023$ ,  $\eta_p^2 = 0.026$ , whereas ability messages did not affect men,  $F(1, 194) = 0.77$ ,  $p = .382$ ,  $\eta_p^2 = 0.004$  (see Fig. 4).

### 5.2.3. Belonging

A similar pattern of results was observed with respect to belonging. Although there were no overall gender differences in participants' judgments about whether they belonged in the SSH major,  $F(1, 194) = 0.58$ ,  $p = .449$ ,  $\eta_p^2 = 0.003$ , their reactions to the ability belief manipulation were clearly differentiated by gender,  $F(1, 194) = 4.66$ ,  $p = .032$ ,  $\eta_p^2 = 0.023$ . The messages about the importance of brilliance (vs. dedication) lowered women's sense of belonging in the SSH major,  $F(1, 194) = 10.12$ ,  $p = .002$ ,  $\eta_p^2 = 0.050$ , but not men's,  $F(1, 194) = 0.04$ ,  $p = .849$ ,  $\eta_p^2 < 0.001$  (see Fig. 5).

### 5.2.4. Anxiety and belonging as (simultaneous) mediators: testing for gender-moderated mediation

Similar to Experiments 2 and 3, anxiety and belonging were entered simultaneously as mediators in a model with interest as the dependent variable, condition (brilliance = 0; dedication = 1) as the independent variable, and gender (men = 0; women = 1) as the moderator. Unlike in Experiments 2 and 3, however, this model revealed significant gender moderation of just the condition  $\rightarrow$  belonging  $\rightarrow$  interest pathway (index of moderated mediation = 0.90,  $SE = 0.41$ , 95%  $CI = [0.15, 1.76]$ ; see Fig. 6). As before, this result was due to the presence of a significant indirect effect of condition on interest via belonging for women,  $ab = 0.84$ ,  $SE = 0.28$ , 95%  $CI = [0.33, 1.43]$ , and the absence of such an indirect effect for men,  $ab = -0.06$ ,  $SE = 0.31$ , 95%  $CI = [-0.68, 0.53]$ .

In contrast, this model revealed no evidence of moderation by gender of the condition  $\rightarrow$  anxiety  $\rightarrow$  interest pathway (index of moderated mediation =  $-0.06$ ,  $SE = 0.13$ , 95%  $CI = [-0.43, 0.13]$ ). In addition, both indirect effects via anxiety were small and non-significant (for women:  $ab = -0.04$ ,  $SE = 0.09$ , 95%  $CI = [-0.29, 0.09]$ ; for men:  $ab = 0.02$ ,  $SE = 0.06$ , 95%  $CI = [-0.04, 0.24]$ ). The main reason for the absence of these indirect effects, and thus for the non-significant moderation by gender as well, was that participants' anxiety was not predictive of their interest in the SSH major above and beyond their sense of belonging,  $b = 0.07$ ,  $SE = 0.11$ ,  $p = .530$  (see Fig. 6). (Recall that anxiety and belonging were entered simultaneously as mediators in our model.)

What might explain the contrast with the STEM context (Experiment 3), where anxiety was a reliable mediator (and belonging less so)? To speculate, STEM fields may be more emotionally charged than SSH fields are, perhaps in part because success in STEM is often thought to be closely linked with one's intellectual ability (Meyer et al., 2015). As a result, one's anticipated emotional reactions may be seen as a reliable guide to whether one should pursue an opportunity in STEM. The informational value of these reactions may be comparatively smaller in SSH fields.

### 5.2.5. Modesty as an alternative explanation?

The results provided no support for the alternative hypothesis that women's greater modesty prevented them from reporting an interest in the brilliance-oriented major. Contrary to this explanation, an independent-samples  $t$  test revealed that the men ( $M = 5.45$ ,  $SD = 1.66$ ) and the women ( $M = 5.51$ ,  $SD = 1.51$ ) in our sample did not actually differ in their modesty levels,  $t(196) = 0.27$ ,  $p = .785$ ,  $d = 0.04$ . Moreover, including modesty as a covariate in the three ANOVAs reported above (with interest, anxiety, and belonging as dependent variables) did not change the significance of the gender  $\times$  condition interactions or the follow-up tests that compared the brilliance and dedication conditions within gender.

### 5.2.6. Conclusion

When women were told that a new major in the social sciences and humanities was particularly suited for brilliant people, they displayed less interest in this major, anticipated feeling more anxious, and were less confident they would belong than when women heard that this major was suited for people who are dedicated. In contrast, men were not affected by this manipulation. This experiment also suggested that the gender differences in participants' reactions to messages about brilliance vs. dedication were not explained by gender differences in modesty, which were absent in our sample.

## 6. Experiment 5: Distinguishing between prototype matching and stereotype threat as mechanisms; adding a control condition; desire for status as an alternative explanation

This experiment had three main goals. First, we explored two possible mechanisms by which messages about brilliance heighten anxiety

and undermine belonging for women (see Fig. 2). One such mechanism is suggested by *self-to-prototype matching* theory (e.g., Cheryan et al., 2009; Cheryan & Plaut, 2010; Niedenthal et al., 1985; Setterlund & Niedenthal, 1993). When hearing about an organization or field that values brilliance, participants may imagine the typical person who might pursue such a career (e.g., Einstein). They might then compare the features of this prototype (e.g., brilliant, competitive, male) with the features that they believe themselves to possess, using the outcome of this self-to-prototype comparison to guide their attitudes toward the field in question. If—as is likely given the cultural prototypes of intellectual brilliance in American society—women perceive a mismatch between the self and the prototypical person in contexts that value brilliance, they may as a result feel that they do not belong in such contexts and may experience discomfort at the thought of being in them. In addition to this prototype matching mechanism, it is possible that *stereotype threat* (e.g., Emerson & Murphy, 2015; Spencer, Steele, & Quinn, 1999; Steele, 2013) is also involved in the effects of messages about brilliance. Women may anticipate that they will be negatively stereotyped by members of fields that value brilliance, which may in turn diminish their interest in pursuing such fields. Experiment 5 evaluated the contribution of these two mechanisms (prototype matching and stereotype threat) to the effects of messages about the importance of brilliance.

Second, although we have so far found that women feel more anxiety and less belonging in brilliance- than in dedication-oriented contexts, it is unclear if these differences reveal a detrimental effect of messages about brilliance (as suggested by our proposal) or a beneficial effect of messages about dedication. The present experiment teased apart these possibilities by including a third, control condition. Our main prediction was that messages about the importance of brilliance would lower women's belonging and increase their anxiety relative to this neutral control; we did not have strong a priori predictions about the effect of messages about dedication relative to the control.

Third, Experiment 5 explored another alternative explanation for the effects of the brilliance vs. dedication manipulation. Perhaps this manipulation had differential effects on women and men simply because the brilliance activities sounded particularly prestigious, and women are less status-driven than men (e.g., Geary, 2010). In the present experiment, we included measures to assess the perceived prestige and status of the opportunities presented to participants. We predicted that the detrimental effects of messages about the importance of brilliance to success would hold even when adjusting for any condition differences on these measures.

Finally, it is worth noting that Experiment 5 explored the above-mentioned issues in the context of a novel job opportunity. Evaluating a potential job opportunity should be a familiar task for most Mechanical Turk workers, who are on average in their 30s (Paolacci & Chandler, 2014).

## 6.1. Method

### 6.1.1. Participants

Participants ( $N = 598$ ;  $M_{age} = 36.75$ ; 353 women, 245 men) were recruited from Amazon's Mechanical Turk service. The increase in sample size relative to previous experiments was motivated by the addition of a third (control) condition, as well as by the greater number of hypotheses tested in this study. Subjects were paid \$0.50 for participation. An additional 103 participants were excluded from the sample because they had non-US IP addresses ( $n = 17$ ), indicated explicitly that they had not paid attention ( $n = 2$ ), reported a non-binary gender identity ( $n = 2$ ), did not complete the survey ( $n = 1$ ), or failed an attention check ( $n = 81$ ; same as in Experiments 2 and 4).

### 6.1.2. Procedure and materials

The procedure was similar to that of previous experiments, except participants considered a potential job (rather than an internship or a

major). Specifically, participants were asked to imagine that they had been “out of a job for a couple of weeks” and were looking for a new job. They then read and evaluated a job advertisement (ostensibly from a “popular job website”). The brilliance vs. dedication ability messages were embedded in the job advertisement itself (see Table S4 for the full ads). The present experiment also included a neutral control condition, in which the job ad mentioned generic skills and attributes (e.g., “a strong resume”). Appendices S1 and S3 in the SOM provide additional information about the perceived malleability of characteristics in the three job ads and about participants' guesses regarding the types of jobs described in the ads, respectively.

### 6.1.3. Measures

After reading the job ad, participants filled out measures of anticipated anxiety and belonging ( $\alpha = 0.88$  and  $0.71$ , respectively), in randomized order. Next, participants filled out measures of prototype matching (except for an item that asked them to estimate the percentage of men on the job, which was asked at the end; see below) and stereotype threat. Finally, participants estimated the prestige of the job.

**6.1.3.1. Prototype matching.** The anticipated match between participants' own characteristics and those of the prototypical person in the job was measured with five face-valid items (e.g., “How similar do you think you are to the other people who work at this company?”; Cheryan et al., 2009;  $\alpha = 0.86$ ; see Table S3). One of these items was administered at the end of the study and asked participants to estimate the gender diversity of the job (“What percentage of the current employees of this company do you think are men?”). Women's responses to this item were reversed so that higher scores indicate greater similarity to the prototypical employee for both male and female participants. In addition, because this item was on a different scale than the others, we standardized responses to the five items before averaging them into the composite measure of prototype matching.

**6.1.3.2. Stereotype threat.** We measured participants' anticipated stereotype threat using two items adapted from Cohen and Garcia (2005) and Marx, Stapel, and Muller (2005) (e.g., “I worry that people who work at this company will draw conclusions about me based on what they think about my gender”; 1 = “strongly disagree” to 9 = “strongly agree”;  $\alpha = 0.94$ ; see Table S3).

**6.1.3.3. Prestige.** The perceived status or prestige of the job was measured with two questions: “How prestigious do you think the job is?” and “From reading the ad, what is your best estimate of what this job pays?” (see Table S3).

## 6.2. Results and discussion

### 6.2.1. Anxiety

A 2 (gender: men vs. women)  $\times$  3 (condition: brilliance vs. dedication vs. control) ANOVA revealed a significant gender  $\times$  condition interaction,  $F(1, 592) = 4.22, p = .015, \eta_p^2 = 0.014$ . A test of simple effects revealed significant condition differences among women,  $F(2, 592) = 10.70, p < .001, \eta_p^2 = 0.035$ . As predicted, women reported more anxious feelings in the brilliance condition compared to both the dedication ( $p = .003$ ) and the control ( $p < .001$ ) conditions; women's anxiety was also higher in the dedication than in the control condition, but only marginally so ( $p = .073$ ; see Fig. 4). In contrast, a test of simple effects among men revealed no significant condition differences,  $F(2, 592) = 0.51, p = .602, \eta_p^2 = 0.002$ .

### 6.2.2. Belonging

The gender  $\times$  condition interaction was significant for belonging as well,  $F(1, 592) = 4.72, p = .009, \eta_p^2 = 0.016$ . As predicted, a test of simple effects revealed significant condition differences among women,  $F(2, 592) = 12.07, p < .001, \eta_p^2 = 0.039$ . Specifically, women felt less

belonging in the brilliance condition relative to both the dedication ( $p < .001$ ) and the control ( $p < .001$ ) conditions, which were not significantly different from each other ( $p = .421$ ; see Fig. 5). Again, men's belonging did not vary by condition,  $F(2, 592) = 0.31, p = .737, \eta_p^2 = 0.001$ .

### 6.2.3. Prototype Matching

To test for gender differences in perceived match with the three jobs, we conducted a 2 (gender)  $\times$  3 (condition) ANOVA on the prototype matching measure (which was an average of five standardized items;  $M = 0.00, SD = 0.81$ ). This analysis revealed a significant gender  $\times$  condition interaction,  $F(2, 592) = 8.42, p < .001, \eta_p^2 = 0.028$ . A test of simple effects uncovered significant condition differences among women,  $F(2, 592) = 14.67, p < .001, \eta_p^2 = 0.047$ . In particular, women perceived a significantly lower match with the brilliance job ( $M = -0.47, SD = 0.82$ ) than with either the dedication ( $M = -0.06, SD = 0.81$ ) or the control ( $M = 0.03, SD = 0.74$ ) jobs,  $ps < .001$ . There was no significant difference between the dedication and control jobs,  $p = .356$ . In contrast, a test of simple effects revealed no significant condition differences among men (brilliance:  $M = 0.28, SD = 0.70$ ; dedication:  $M = 0.37, SD = 0.68$ ; control:  $M = 0.13, SD = 0.74$ ),  $F(2, 592) = 1.84, p = .159, \eta_p^2 = 0.006$ .

### 6.2.4. Stereotype threat

An analogous ANOVA on the stereotype threat measure revealed a somewhat different pattern of findings. First, the gender  $\times$  condition interaction was weaker,  $F(2, 592) = 2.28, p = .103, \eta_p^2 = 0.008$ . Second, although a test of simple effects revealed significant condition differences among women,  $F(2, 592) = 7.34, p = .001, \eta_p^2 = 0.024$ , the underlying pattern of means was unlike those observed so far. In particular, women experienced a similar level of stereotype threat when considering the brilliance ( $M = 3.80, SD = 2.52$ ) and the dedication ( $M = 3.60, SD = 2.27$ ) jobs,  $p = .458$ , and more threat for these jobs than for the control job ( $M = 2.76, SD = 2.00$ ),  $ps < .003$ . In contrast, men did not experience much stereotype threat in any of the conditions (brilliance:  $M = 2.29, SD = 1.74$ ; dedication:  $M = 2.23, SD = 1.83$ ; control:  $M = 2.13, SD = 1.75$ ),  $F(2, 592) = 0.12, p = .884, \eta_p^2 < 0.001$ .

Given that women did not report more stereotype threat in the brilliance (vs. the dedication) condition but did see themselves as matching this job less well, it seems that the prototype matching mechanism may provide a better explanation for why women show more anxiety and less belonging when considering the brilliance job relative to the others. However, we next used a mediation analysis to investigate the question of mechanism more formally.

### 6.2.5. Prototype matching versus stereotype threat as mechanisms

The prototype matching and stereotype threat variables were entered simultaneously as mediators in a conditional process analysis with condition (brilliance = 0; dedication = 1) as the independent variable and gender (men = 0; women = 1) as the moderator (see Fig. 7). (We found similar results when we contrasted the brilliance and control conditions.) Two such conditional process analyses were conducted: one with anxiety as the dependent variable, and one with belonging. We discuss the results of each in turn.

**6.2.5.1. Anxiety.** We found evidence for prototype matching, but not stereotype threat, as a mediator of the effects of messages about brilliance on women's anticipated anxiety (see Fig. 7). With respect to prototype matching, the conditional process analysis uncovered evidence of gender-moderated mediation, index =  $-0.38, SE = 0.18, 95\% CI = [-0.73, -0.04]$ . Specifically, the indirect effect of condition on anxiety via prototype matching was significant for women,  $ab = -0.49, SE = 0.13, 95\% CI = [-0.75, -0.24]$ , but not for men,  $ab = -0.11, SE = 0.13, 95\% CI = [-0.37, 0.13]$ . In contrast, there was no significant moderation by gender of the

condition  $\rightarrow$  stereotype threat  $\rightarrow$  anxiety pathway, index =  $-0.002, SE = 0.01, 95\% CI = [-0.04, 0.01]$ . The indirect effect of condition on anxiety via stereotype threat was not significant for either women,  $ab = -0.003, SE = 0.01, 95\% CI = [-0.04, 0.01]$ , or men,  $ab = -0.001, SE = 0.01, 95\% CI = [-0.03, 0.01]$ .

**6.2.5.2. Belonging.** The conditional process analysis with belonging as a dependent variable led to similar conclusions (see Fig. 7). Again, we found that gender moderated the condition  $\rightarrow$  prototype matching  $\rightarrow$  belonging pathway, index of moderated mediation =  $0.47, SE = 0.22, 95\% CI = [0.04, 0.91]$ . The indirect effect of condition on belonging via prototype matching was significant for women,  $ab = 0.61, SE = 0.16, 95\% CI = [0.31, 0.92]$ , but not for men,  $ab = 0.14, SE = 0.16, 95\% CI = [-0.17, 0.44]$ . In contrast, gender did not significantly moderate the condition  $\rightarrow$  stereotype threat  $\rightarrow$  belonging pathway, index of moderated mediation =  $-0.002, SE = 0.01, 95\% CI = [-0.05, 0.01]$ . In fact, the indirect effect of condition on belonging via stereotype threat was not significant for either women,  $ab = -0.004, SE = 0.01, 95\% CI = [-0.05, 0.01]$ , or men,  $ab = -0.001, SE = 0.01, 95\% CI = [-0.03, 0.01]$ .

### 6.2.6. Perceived Differences in Job Status as an Alternative Explanation?

Were the three jobs perceived to have different status? We conducted two separate 2 (gender)  $\times$  3 (condition) ANOVAs on participants' responses to the salary and prestige questions. As predicted by this alternative, the main effects of condition were significant in both of these analyses,  $F(2, 592) > 70.34, ps < .001, \eta_p^2 > 0.192$ . The brilliance job was perceived as both higher-paying ( $M = 3.21, SD = 0.87$ ) and more prestigious ( $M = 6.48, SD = 1.58$ ) than the dedication job ( $ps < .001$ ; salary:  $M = 2.26, SD = 0.79$ ; prestige:  $M = 4.59, SD = 2.09$ ) and the control job ( $ps < .001$ ; salary:  $M = 2.19, SD = 0.79$ ; prestige:  $M = 4.46, SD = 2.10$ ). The dedication and control jobs were not judged to be different in either salary or prestige ( $ps > .56$ ). Importantly, however, 2 (gender)  $\times$  3 (condition) analyses of covariance (ANCOVAs) on participants' anxiety and belonging that jointly adjusted for these two covariates (i.e., salary and prestige) found the same pattern of significant gender  $\times$  condition interactions and follow-up comparisons as reported above. Thus, the negative effects of messages about the importance of brilliance are not explained by differences in participants' inferences about the status of these occupations.

### 6.2.7. Conclusion

We draw three main conclusions from the results of this experiment. First, it seems that messages emphasizing the value of brilliance lead women to perceive a mismatch with the contexts described in these terms and the people expected to be within them. This perceived mismatch was better able to account for the effects of messages about brilliance on women's anxiety and belonging than was the threat of being negatively stereotyped. The mere mention of brilliance as a desired characteristic was not sufficient to activate stereotype threat in this context. It is possible, however, that this "brilliance required" cue could actually become threatening with some changes to the situation. For example, adding an evaluative component to the task (e.g., a test, an interview; see Emerson & Murphy, 2015) or more explicitly signaling that women are underrepresented in this context (e.g., Inzlicht & Ben-Zeev, 2000; Murphy et al., 2007) may lead women to become concerned about others' stereotyped judgments. More work is needed to explore these possibilities.

Second, these findings suggest that the results across our experiments were not due simply to women's positivity toward careers portrayed as requiring dedication. In the present experiment, women did not differentiate between a job said to require dedication and one that was described in more generic, neutral terms. In contrast, the job ad that emphasized brilliance led women to anticipate feeling more anxiety and less belonging relative to both the dedication-focused and the

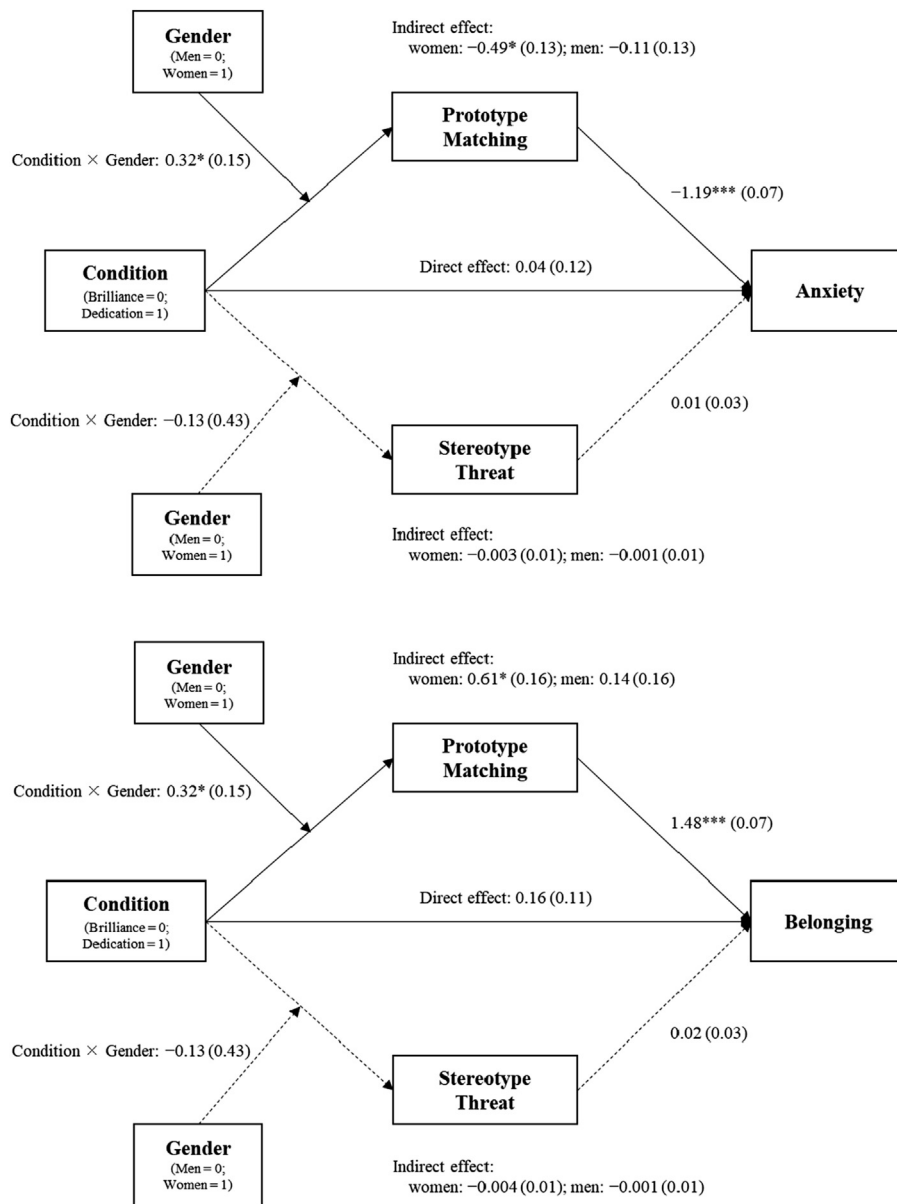


Fig. 7. Gender-moderated mediation of the effect of condition (brilliance vs. dedication) on anxiety (top) and belonging (bottom) through prototype matching but not stereotype threat (Experiment 5). The dashed lines indicate that the effects of condition on anxiety and belonging were not mediated by stereotype threat. We report unstandardized coefficients (and SEs in parentheses). \*  $p < .05$ . \*\*  $p < .01$ . \*\*\*  $p < .001$ .

control ads. Thus, the addition of a neutral control condition disambiguated the interpretation of the differences found so far, indicating that—as hypothesized—messages about the importance of brilliance undermine women's interest in careers described in these terms.

Third, this study speaks against the possibility that the undermining effect of messages about brilliance was due simply to perceived differences in the status of the brilliance and dedication jobs. The predicted pattern of gender differences in anxiety and belonging was found even when statistically adjusting for measures pertaining to this alternative explanation.

### 7. Experiment 6: Self-efficacy and women's perceived mismatch to the prototype in brilliance-focused contexts; fixed vs. growth messages about brilliance

The final experiment had two main goals. First, we tested whether, as hypothesized, women's perception of a mismatch with the prototypical person in brilliance-oriented jobs is related to the “brilliance = men” stereotype. This stereotype may shape women's perceptions of their own abilities (e.g., Bell & Burkley, 2014), as well as prompt concerns about how others will view their abilities (e.g.,

Cheryan et al., 2009). As a result, women may become uncertain about their chances of success in brilliance-oriented jobs (i.e., they may become less self-efficacious), which may be in part why they perceive themselves to be different from the typical successful person in these jobs.

The second goal of Experiment 6 was more practical. Can members of a field talk about brilliance without discouraging members of negatively stereotyped groups? Many fields strongly value this trait and may thus resist suggestions to downplay its role. From an intervention standpoint, then, it may be useful to explore ways of talking about brilliance that avoid the negative effects on women's interest that we have documented so far. Here, we took a first step toward this goal by comparing messages about brilliance that portray it as a fixed, biological trait (which is most likely participants' default construal; see Appendix S1) with messages that portray brilliance as a malleable quantity. Simple growth-oriented messages often buffer stigmatized groups against the demotivating effects of stereotypes (e.g., Aronson, Fried, & Good, 2002; Good et al., 2003; Yeager et al., 2016). Thus, it is possible that a context in which brilliance is emphasized but is also portrayed as an acquirable trait would not undermine women's interest. At the same time, the intuition that only certain people have the

potential to be brilliant (Rattan, Savani, et al., 2012) may be stronger, and thus harder to uproot, than other intuitive beliefs that have been manipulated in prior work (about whether intelligence, personality, etc., are malleable or fixed). Moreover, a job ad describing the exceptional abilities required for success may license inferences about a masculine workplace culture regardless of whatever else it says about the source of these abilities. It is thus an open question whether simply stating to participants that brilliance is malleable will be sufficient to alleviate the gender differences observed so far.

## 7.1. Method

### 7.1.1. Participants

Participants ( $N = 197$ ;  $M_{age} = 35.31$ ; 113 women, 84 men) were recruited from Amazon's Mechanical Turk service. Subjects were paid \$0.60 for participation. An additional 35 participants were excluded from the sample because they had non-US IP addresses ( $n = 4$ ), indicated explicitly that they had not paid attention ( $n = 3$ ), or failed an attention check ( $n = 28$ ; see below).

### 7.1.2. Procedure and manipulation

The procedure was modeled on that of Experiment 5 and required participants to consider and evaluate a job opportunity. However, in the present study *all* participants were told that the job required brilliance. The only difference between the two conditions in this study was whether brilliance was portrayed as a fixed, biological trait (e.g., “brilliant individuals are born, not made”) or malleable quantity (e.g., “no matter who you are, you can become a brilliant individual with the right strategies, the right amount of effort, and the right guidance”; see Table S5 for the text of the job ads and Appendix S3 for participants' inferences about the content of the jobs).

To ensure that participants encoded the fact that brilliance is important for this job, they were asked to recall the job advertisement after reading it. Participants were retained if they made at least one mention of brilliance or related traits. Twenty-eight participants did not meet this criterion and were excluded from our analyses.

### 7.1.3. Measures

After reading the job ad relevant to their condition, participants filled out an interest measure similar to that in Experiment 1 ( $\alpha = 0.94$ ). They then completed a manipulation check (see below), a measure of prototype matching similar to that in Experiment 5 ( $\alpha = 0.87$ ), and a measure of self-efficacy (see below), in randomized order.

Next, participants completed two control measures, in randomized order: One of these measures was the 21-item modesty scale used in Experiment 4 (Whetstone et al., 1992;  $\alpha = 0.92$ ). We included this measure to adjust for any modesty differences between men and women; if women are more modest than men, that could affect their willingness to express interest in a job for brilliant individuals (but see the results of Experiment 4). The other control measure was a scale of chronic self-efficacy, which measured the extent to which participants *generally* perceived themselves to be efficacious (see below). This measure enabled us to test whether participants' self-efficacy with respect to the brilliance-oriented job predicts their interest in it above and beyond their chronic self-efficacy. After these measures, participants were also asked to recall their quantitative SAT or ACT scores. These scores were intended to serve as an approximate means of assessing individual differences in intellectual ability. However, given that our participants were on average 35 years old, many did not remember these scores or were unsure they could remember them accurately. We were thus unable to use this variable in our analyses.

**7.1.3.1. Manipulation check.** Four manipulation-check items were used to assess whether participants understood brilliance—as described in the job advertisement—to be a fixed vs. malleable quantity (e.g., “The

abilities required for this position are ones that are you can't really acquire—you either have them, or you don't”; 1 = “strongly disagree” to 9 = “strongly agree”;  $\alpha = 0.88$ ; see Table S3). These items were coded such that higher scores indicated a more fixed conception of brilliance.

**7.1.3.2. Self-efficacy.** Four face-valid items measured the extent to which participants expected they could succeed on the job (i.e., their self-efficacy; e.g., “The job described in the ad is well within my abilities”; 1 = “strongly disagree” to 9 = “strongly agree”;  $\alpha = 0.67$ ; see Table S3). Two of the items made explicit reference to the job's brilliance requirement (e.g., “I don't consider myself brilliant” [reverse-coded]), which allowed us to capture any differences in self-efficacy that are due specifically to the “brilliance = men” stereotype.

**7.1.3.3. Chronic self-efficacy.** We measured participants' chronic self-efficacy using Chen, Gully, and Eden's (2001) eight-item New General Self-Efficacy Scale (e.g., “I am confident that I can perform effectively on many different tasks”; 1 = “strongly disagree” to 9 = “strongly agree”;  $\alpha = 0.95$ ; see Table S3).

## 7.2. Results and discussion

### 7.2.1. Manipulation check

We performed a 2 (gender: men vs. women)  $\times$  2 (condition: fixed-brilliance vs. malleable-brilliance) ANOVA to verify that participants in the two conditions had different views about the malleability of the intellectual abilities required by the job. Indeed, participants who read the fixed-brilliance ad ( $M = 6.20$  on a 1 [malleable] to 9 [fixed] scale,  $SD = 2.07$ ) were more likely to report that the abilities required were fixed than those who read the malleable-brilliance ad ( $M = 3.85$ ,  $SD = 1.61$ ),  $F(1, 193) = 74.06$ ,  $p < .001$ ,  $\eta_p^2 = 0.277$ .

### 7.2.2. Interest

An analogous ANOVA on the measure of participants' interest revealed only a main effect of gender,  $F(1, 193) = 16.14$ ,  $p < .001$ ,  $\eta_p^2 = 0.077$ . Women ( $M = 4.31$ ,  $SD = 2.52$ ) were less interested in the job than men were ( $M = 5.74$ ,  $SD = 2.38$ ; see Fig. 8). This gender difference was not moderated by whether brilliance was said to be fixed or malleable,  $F(1, 193) = 0.38$ ,  $p = .538$ ,  $\eta_p^2 = 0.002$ . Thus, simply talking about brilliance as malleable was not sufficient to balance men and women's interest in a job that prizes brilliance.

We now go on to investigate what might explain the observed gender difference in interest. Specifically, we test the hypothesis that this difference is mediated by women's perceived dissimilarity to the prototypical successful person in this job, which in turn is predicted by women's lower expectations of success in this job.

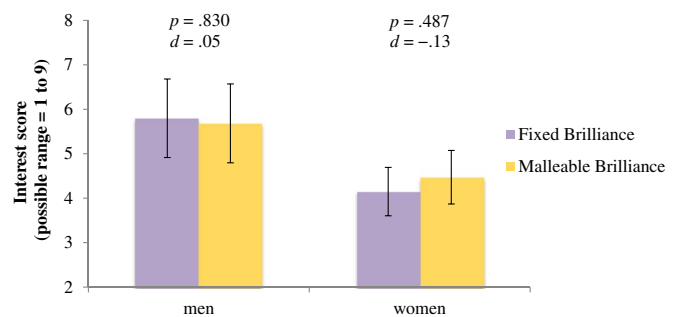


Fig. 8. Men's and women's interest in Experiment 6, by fixed-brilliance vs. malleable-brilliance condition. The  $p$  values were derived from tests of the simple effects of condition within gender. Cohen's  $d$ s are provided as a measure of effect size. Error bars represent  $\pm 1$  SE.

7.2.3. *Prototype matching*

Indeed, women ( $M = -0.32, SD = 0.78$ ) perceived themselves to be less similar to current employees of the company than men did ( $M = 0.38, SD = 0.66$ ),  $F(1, 193) = 44.18, p < .001, \eta_p^2 = 0.186$ . Again, this effect was not significantly moderated by whether the job ad portrayed brilliance as a fixed or malleable quantity,  $F(1, 193) = 2.57, p = .111, \eta_p^2 = 0.013$ .

7.2.4. *(Job) self-efficacy*

Did women report lower self-efficacy than men with respect to the brilliance-requiring jobs in this study? A 2 (gender)  $\times$  2 (condition) ANOVA revealed that, indeed, women's expectations of success ( $M = 5.35, SD = 1.67$ ) were lower than men's ( $M = 6.11, SD = 1.52$ ),  $F(1, 193) = 10.71, p = .001, \eta_p^2 = 0.053$ . This gender difference was not significantly moderated by the fixed- vs. malleable-brilliance condition,  $F(1, 193) = 1.88, p = .172, \eta_p^2 = 0.010$ .

It is also noteworthy that the two items on this scale that made specific reference to the job's brilliance requirement ("I'm one of the smartest people I know" and "I don't consider myself brilliant" [reverse-coded]) showed as large a gender difference,  $M_{men} = 5.89, SD_{men} = 1.84$  vs.  $M_{women} = 5.19, SD_{women} = 1.78, t(195) = 2.72, p = .007, d = 0.39$ , as the items that referred to success on the job more broadly ("The job described in the ad is well within my abilities" and "I don't think I have what it takes to succeed in the job described in the ad" [reverse-coded]),  $M_{men} = 6.33, SD_{men} = 1.91$  vs.  $M_{women} = 5.51, SD_{women} = 2.22, t(195) = 2.72, p = .007, d = 0.39$ . These results suggest that women's lower self-efficacy judgments may have been informed by the cultural stereotypes that associate brilliance with men.

We now proceed to formally test whether, as hypothesized, the gender differences in interest toward the brilliance-requiring jobs in this study were mediated by differences in self-efficacy and perceived match with the prototypical employee.

7.2.5. *Sequential mediation: gender  $\rightarrow$  self-efficacy  $\rightarrow$  prototype matching  $\rightarrow$  interest*

The self-efficacy and prototype match measures were entered (in this order) as sequential mediators in Model 6 of the PROCESS macro for SPSS (Hayes, 2013). Gender (men = 0; women = 1) was the independent variable in this analysis, and interest was the dependent variable. This analysis revealed evidence for the predicted indirect path from gender to interest via self-efficacy and prototype matching, indirect effect =  $-0.55, SE = 0.18, 95\% CI = [-0.93, -0.23]$  (see Fig. 9).

We also tested whether the gender differences in self-efficacy might instead occur *downstream* of the perceived mismatch with the company's current employees. That is, we tested an indirect path in which the order of the two mediators was reversed: gender  $\rightarrow$  prototype matching  $\rightarrow$  self-efficacy  $\rightarrow$  interest. This indirect effect was not significant,

indirect effect =  $0.12, SE = 0.09, 95\% CI = [-0.04, 0.32]$ . Thus, the hypothesis that women's perceived prototype-mismatch is mediated (in part) by their lower self-efficacy fits the data better than the alternative hypothesis that women's lower self-efficacy is itself mediated by a perceived mismatch with the prototypical employee.

We should note, however, that self-efficacy is likely not the only reason why women might perceive a lack of fit with the people in brilliance-oriented jobs. Job ads that emphasize exceptional ability might also conjure up an image of a workplace with a masculine culture centered around competition and rigid hierarchies (Gaucher, Friesen, & Kay, 2011). These elements are also likely to lower women's judgments of fit, beyond the self-efficacy pathway. To test this possibility, we asked whether the prototype matching variable would mediate the relationship between gender and interest (in a one-step mediation model: gender  $\rightarrow$  prototype matching  $\rightarrow$  interest) even when adjusting for self-efficacy on both the *a* and the *b* paths. Indeed, this indirect effect was significant,  $ab = -1.24, SE = 0.25, 95\% CI = [-1.75, -0.77]$ .

7.2.6. *Alternative explanations: modesty and chronic self-efficacy*

The men ( $M = 5.64, SD = 1.08$ ) and the women ( $M = 5.77, SD = 1.36$ ) in our sample did not actually differ in their modesty levels,  $t(195) = 0.77, p = .441, d = 0.10$ . Similarly, there was no gender difference in participants' chronic self-efficacy levels (men:  $M = 6.78, SD = 1.29$ ; women:  $M = 6.89, SD = 1.39$ ),  $t(195) = 0.54, p = .593, d = 0.08$ . Moreover, including these variables as covariates in the ANOVAs above (with interest, prototype matching, and self-efficacy as dependent variables) did not change any of the significant results described.

7.2.7. *Conclusion*

Women were less interested in brilliance-oriented jobs than men were; they also perceived themselves to be less similar to the people in these jobs and were less sure they could succeed in them. A sequential mediation analysis suggested that a pathway from women's lower self-efficacy to their perceived mismatch to their diminished interest fit the data better than a pathway in which women's lower self-efficacy followed from their perceptions of mismatching a prototype. However, self-efficacy is likely not the only input into women's judgments of similarity with others, as evidenced by the fact that the prototype matching variable mediated the relationship between gender and interest even when statistically controlling for self-efficacy.

In addition, these results suggest that portraying brilliance as malleable may not always be effective in counteracting the negative effects of messages about brilliance. To speculate, it is possible that the current manipulation was ineffective because participants came in with a strong assumption that the potential to be brilliant is genetic (e.g., Rattan, Savani, et al., 2012). (Although participants did report more growth-oriented beliefs on the manipulation-check items in the malleable-brilliance condition, these items mapped so closely onto the job

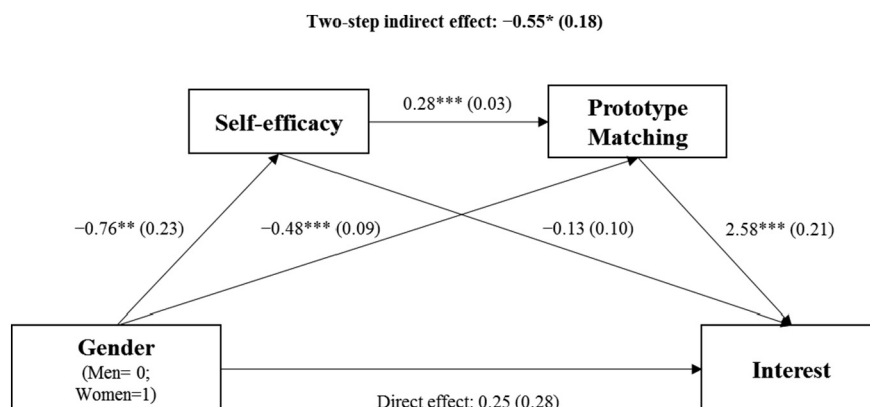


Fig. 9. The indirect pathway between gender and interest via self-efficacy and prototype matching (Experiment 6). We report unstandardized coefficients (and SEs in parentheses). \*  $p < .05$ . \*\*  $p < .01$ . \*\*\*  $p < .001$ .

ads that participants probably construed them as memory or attention checks—that is, these items probably did not actually tap participants' more-general beliefs about the origins of brilliance.) In addition, perhaps both the malleable- and the fixed-brilliance advertisements evoked a masculine work environment (e.g., Gaucher et al., 2011; Mundy, 2017). Such masculine cultures, oriented to competition and hierarchy, are often assumed to be present in fields that value brilliance (e.g., Meyer et al., 2015); changing these entrenched practices may thus be key to any effort to make brilliance-oriented fields more hospitable to women.

## 8. General discussion

Six experiments suggested that messages about the importance of brilliance to success undermine women's interest. This causal effect emerged across a variety of contexts (internships, degree programs in STEM and in the social sciences and humanities, and jobs), in two participant populations (college students and Mechanical Turk workers), in participants' responses to rating scales and open-ended prompts (see Appendix S2), and regardless of the specific wording used to convey the emphasis on brilliance. Moreover, the results provided clues about the psychological processes that may explain the effect of these messages: Women were less sure of success in brilliance-oriented settings and believed they were dissimilar to the type of person who commonly works in these settings. In turn, these judgments predicted feelings of stress and anxiety, as well as a diminished sense of belonging.

### 8.1. Theoretical contributions

The present results support a key claim of the Field-specific Ability Beliefs model: namely, that beliefs and messages about the importance of brilliance to success have a causal influence on the diversity of a field. Here, we found that brilliance-focused messages lowered women's anticipated involvement in a range of educational and professional opportunities. In combination with the evidence that beliefs about brilliance predict women's actual involvement across fields (e.g., Leslie, Cimpian, et al., 2015), this work demonstrates the value of the FAB model as a tool for understanding the gender and race/ethnicity imbalances that are still so common in academia and industry.

These studies also advance theorizing on the link between environmental beliefs about ability and women's career outcomes. First, although previous work has investigated the consequences of environmental beliefs about intelligence (e.g., Emerson & Murphy, 2015) and mathematical ability (Good et al., 2012), this research is the first to document the toll that environmental messages about *brilliance* take on women's aspirations. Second, and related to the first point, this research is the first to investigate environmental beliefs about *exceptional* ability, which members of many fields believe is necessary for success. Third, this research reveals that the effects of environmental beliefs about ability extend beyond STEM and business settings, which is where they were previously investigated (Emerson & Murphy, 2015; Good et al., 2012; Smith et al., 2013). Thus, our studies speak to issues of general importance for fostering gender equity. Fourth, the present research advances current understanding of the mechanisms by which environmental beliefs have their effects. Specifically, mediation analyses suggested that messages about brilliance undermined women's interest by lowering their self-efficacy and their perceived similarity to others, which in turn exacerbated feelings of anxiety and not belonging (see Figs. 6, 7, and 9).

### 8.2. Limitations and directions for future research

Several limitations should be taken into account when evaluating this research. First, the conclusions drawn from our mediation analyses are necessarily limited by their correlational nature (e.g., Preacher,

2015). That is, although we can be confident that messages about brilliance had a causal influence on the proposed mechanisms (e.g., anxiety, belonging, self-efficacy), as well as the main outcome (i.e., interest), the additional claim that the mechanism variables had a causal influence on participants' interest is more tentative. The fact that the mediators were often strongly correlated with one another and with participants' interest (see Tables S11–S15) also suggests caution in this respect. Further research in which the proposed mediating variables are independently manipulated would provide more definitive evidence regarding mechanism.

Another limitation of the present studies is that they relied on self-report measures in the context of hypothetical scenarios. Although the observed effects of messages about brilliance are consistent with the real-world data on women's representation (e.g., Cimpian & Leslie, 2015; Leslie, Cimpian, et al., 2015), measuring women's interest in actual opportunities would bolster the external validity of our conclusions. A more ecologically valid test of our hypothesis would also minimize demand characteristics (i.e., inferences about the goal of the study and about which responses are “appropriate”).

Further, the variability in the magnitude of the effects across studies (see Fig. 3) suggests that more research on moderators would be informative. Under what circumstances are the negative effects of messages about brilliance strongest and, importantly, what circumstances dampen them? Investigating such moderators is critical for understanding how to translate this work into real-world settings, which vary along a number of important dimensions that might interact with the effects identified in the present studies. For instance, do individuals' personal growth vs. fixed mindsets (Dweck, 1999, 2006) moderate the effect of messages about the importance of brilliance and genius? Are women who personally endorse growth mindsets able to develop an interest in fields whose members emphasize that brilliance is essential for high-level performance?

Although the present work focused on women's interest as an explanation for their underrepresentation in fields that cherish brilliance, these fields probably discourage women's participation in other ways as well. For instance, in light of the cultural belief that brilliance is more common among men, women may be seen as less suited for the fields where brilliance is valued, which may in turn give rise to biased selection and promotion practices (e.g., Heilman, 2012; Milkman, Akinola, & Chugh, 2012; Moss-Racusin, Dovidio, Brescoll, Graham, & Handelsman, 2012; Wenerås & Wold, 1997). It will be important for future studies to investigate which other aspects of brilliance-valuing fields make women feel unwelcome.

### 8.3. Implications

This research suggests that deemphasizing the role of brilliance in achieving success may reduce the impact of the cultural prototype of the “brilliant person” on women's interest and involvement. When the same opportunities (majors, internships, and jobs) were described as requiring dedication and effort instead of brilliance, women's interest no longer lagged behind men's. A shift away from messages about brilliance would be advisable even if certain professions did require a higher level of intelligence than others. Explicitly linking success to raw intellectual aptitude is likely to discourage participation by women because, despite being as intellectually capable as men, women will nevertheless interpret such messages through the lens of the current stereotypes against their intellects. In fact, in our studies messages about the importance of brilliance were detrimental to women's participation even when brilliance was explicitly framed as an acquirable trait (Experiment 6), which underscores just how toxic these messages are. It will be important, however, to continue exploring how to talk about intellectual talent and its role in success without inadvertently turning away capable women. Brilliance and talent are integral to the culture of many academic fields (e.g., Cimpian & Leslie, 2017; Leslie, Cimpian, et al., 2015); members of these fields may think it is

misleading to tell students and mentees that hard work is the only thing that matters. However, until we discover how to talk about individual differences in innate potential for brilliance without also triggering thoughts about *group* differences in this respect, such talk is likely to be counterproductive to any efforts to improve the gender balance of these fields.

Importantly, strategies such as those described above may boost participation not just by women but also by other social groups that are similarly stigmatized for their intellectual abilities (LaCosse, Driskell, Garcia, Zirkel, & Murphy, 2016). Consistent with this idea, Leslie, Cimpian, et al.'s (2015) data revealed that field-level beliefs about ability are strongly predictive of African American representation: The greater a field's emphasis on brilliance, the fewer the African American PhDs. Thus, the suggestion to deemphasize brilliance may also inform efforts to narrow the race gaps present in many educational and professional settings.

#### 8.4. Conclusion

The present research suggests that portraying a profession as requiring brilliance undermines women's interest in it. This work provides a new perspective on the problem of women's underrepresentation across a broad range of disciplines, thereby paving the way for potential solutions to this problem.

#### Open practices

The data for all studies are available on Open Science Framework: [https://osf.io/ca3yx/?view\\_only=ee796e20211e42269f4d9abb294c070e](https://osf.io/ca3yx/?view_only=ee796e20211e42269f4d9abb294c070e).

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#### Appendix A. Supplementary online materials

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jesp.2017.11.006>.

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