



Brilliance Beliefs, Not Mindsets, Explain Inverse Gender Gaps in Psychology and Philosophy

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Abstract

Understanding academic gender gaps is difficult because gender-imbalanced fields differ across many features, limiting researchers' ability to systematically study candidate causes. In the present preregistered research, we isolate two potential explanations—brilliance beliefs and fixed versus growth intelligence mindsets—by comparing two fields that have inverse gender gaps and historic and topical overlap: philosophy and psychology. Many more men than women study philosophy and vice versa in psychology, with disparities emerging during undergraduate studies. No prior work has examined the contributions of both self-perceptions of brilliance and fixed versus growth mindsets on choice of major among undergraduate students. We assessed field-specific brilliance beliefs, brilliance beliefs about self, and mindsets, cross-sectionally in 467 undergraduates enrolled in philosophy and psychology classes at universities in the United States and Canada via both in-person and online questionnaires. We found support for the brilliance beliefs about the self, but not mindset, explanation. Brilliance beliefs about oneself predicted women's but not men's choice of major. Women who believed they were less brilliant were more likely to study psychology (perceived to require low brilliance) over philosophy (perceived to require high brilliance). Findings further indicated that fixed versus growth mindsets did not differ by gender and were not associated with major. Together, these results suggest that internalized essentialist beliefs about the gendered nature of brilliance are uniquely important to understanding why men and women pursue training in different academic fields.

Keywords Brilliance beliefs · Mindsets · Fixed vs. growth · Gender essentialism · Gender gap · Psychology · Philosophy

Although most university undergraduates are women (i.e., based on data from the U.S. and Canada; Jeudy et al., 2021; National Center for Education Statistics, 2019), gender distributions across academic silos vary considerably. Understanding the causes of these gender disparities is important for many reasons. A lack of diversity can lead to a hegemony of perspective, focus, or method, resulting in lower quality work. Further, excluding people from pursuing something in which they are interested and capable is an injustice. Much empirical and theoretical attention has been paid to the

contrasting gender imbalances in STEM (i.e., science, technology, engineering, and math) fields where men outnumber women, versus the humanities and social sciences (e.g., education, sociology, and anthropology), where women typically outnumber men. Yet, despite this considerable interest, explanations for these observed gender gaps have been difficult to confirm because of the myriad differences (e.g., history, subject matter, method, and academic culture) across academic fields.

In the current preregistered study, we focus our comparison on philosophy and psychology, which have inverse gender gaps despite considerable historical and subject matter overlap (e.g., the study of human nature, the mind, ethics, group dynamics, knowledge, perceptions of reality, moral decision making; Haig, 2011; Montgomery, 1993; Suls et al., 2019). Women account for over 70% of psychology graduates at the Bachelor's (79%), Master's (80%), and Doctoral (74%) levels (averaged across the years 2017–18 and 18–19; National Center for Education Statistics, 2019) and 57% of faculty (Zippia Career Data, 2021). In contrast,

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women account for less than 40% of philosophy graduates at the Bachelor's (39%), Master's (35%), and Doctoral (33%) levels (American Academy of Arts and Sciences, 2016; Paxton et al., 2012) and 21% of faculty (Zippia Career Data, 2021). In short, more men than women study philosophy whereas more women than men study psychology. Notably, there are proportionally more women enrolled in introductory philosophy classes and men in introductory psychology classes than obtain an undergraduate degree in these subjects (e.g., Paxton et al., 2012; Yu et al., 2020), suggesting these pipelines leak early. We isolate two potential causes of gender disparities—gendered beliefs about brilliance and fixed versus growth intelligence mindsets—to examine the degree to which they may explain gender disparities in these fields.

Brilliance Beliefs

One popular explanation for academic gender disparities is rooted in gendered beliefs about brilliance (Leslie et al., 2015; Meyer et al., 2015). Brilliance, in this context, is understood as extremely high levels of intelligence that are thought to be innate. People hold brilliance beliefs about different academic fields, i.e., believing that some fields, such as philosophy and math, require more brilliance for success than others, such as psychology and education (e.g., Leslie et al., 2015; Meyer et al., 2015). People also hold brilliance beliefs about others (e.g., Storage et al., 2016, 2020) and themselves (e.g., Bian et al., 2017; Muradoglu et al., 2022), and these beliefs tend to be gendered according to the “men-as-brilliant” stereotype. Specifically, both children and adults tend to believe that boys and men are more brilliant than girls and women (e.g., Bian et al., 2017; Storage et al., 2020). A consequence of these gendered beliefs about brilliance is that girls and women tend to be less comfortable and interested in academic or occupational contexts that are believed to require high levels of brilliance, compared to men (e.g., Bian et al., 2017, 2018a, b; Vial et al., 2022).

To assess whether brilliance beliefs about academic fields correlated with the representation of women in those fields, Leslie et al. (2015) collected data from a large sample of academics (i.e., graduate students, postdoctoral fellows, and professors) from 30 different fields asking about their perceptions of their own fields' requirements for brilliance. Using a measure designed to assess field-specific brilliance beliefs (e.g., “Being a top scholar of [discipline] requires a special aptitude that just can't be taught”) they found that the proportion of women in a given field was negatively related to brilliance beliefs about that field. That is, the more brilliance is believed to be required for success in a field, the fewer women there are represented in that field. Philosophy was rated as one of the highest brilliance-requiring fields (5

out of 6 in brilliance) and also has very few women PhDs, at just over 30% (Leslie et al., 2015). The opposite was true of psychology, which was rated as requiring relatively little brilliance (3.6 out of 6 in brilliance) and which is comprised of 70% women PhDs (Leslie et al., 2015). Similar results emerge when, laypeople were asked to rate the brilliance required for various fields using the same measure: fields that were rated as requiring more brilliance tended to have fewer women in them (Meyer et al., 2015). From these results, the authors argue that women are underrepresented in fields that are believed to require high levels of brilliance because stereotypes suggest men, but not women, possess high levels of brilliance.

Brilliance beliefs not only apply to fields of study, but also to people. When assessing course evaluations on ratemy-professor.com, terms like “brilliant” and “genius” were more often used to describe instructors who were men as opposed to women (Storage et al., 2016). More concerningly, these beliefs may be automatic. Employing the Implicit Association Test (IAT), Storage et al. (2020) found that American children and adults were more likely to associate “male,” as opposed to “female,” with “brilliant” regardless of the comparison trait (with the exception of “strong”). That is, people were faster to pair brilliant- and male-related stimuli than brilliant- and female-related stimuli suggesting a strong unconscious association between brilliance beliefs and gender, a result that held regardless of the race of the target. These results have been replicated across cultural contexts (i.e., with Chinese Singaporean individuals), and development (i.e., children ages 8 to 12 as well as adults) (Zhao et al., 2022). When considered in light of field-specific brilliance beliefs, these automatic, gendered perceptions of who possesses brilliance may serve as a barrier to women's pursuing fields that are thought to require high levels of brilliance.

These gendered brilliance beliefs may exert their effects through feelings of belonging. In a large sample of academics spanning more than 80 fields across the natural and social sciences and humanities, perceptions that one's field requires high levels of brilliance was associated with stronger impostor feelings (e.g., “Sometimes I'm afraid others will discover how much knowledge or ability I really lack”), particularly for women, and most of all, for women with racial/ethnic minoritized identities (Muradoglu et al., 2022). These impostor beliefs in turn predicted weaker feelings of belonging and self-efficacy in brilliance requiring fields. Together, this work suggests that the more a field is believed to require high brilliance, the fewer women are in the field, presumably because of others' and their own internalization of the stereotype that men but not women can be brilliant.

Although the majority of the work demonstrating an association between field-specific brilliance beliefs and women's interest and feelings of belonging across academic fields is correlational, some experimental work suggests the

link is causal. Specifically, across a series of experiments, Bian et al., (2018a, b) manipulated the extent to which brilliance was described as a requirement for an array of educational and professional opportunities and then measured undergraduate students' interest in pursuing those opportunities. When students were asked to rate their interest in an internship program described as seeking people high in brilliance (e.g., “intellectual firecracker,” “at ease with complex, abstract ideas,” “sharp, penetrating mind”) versus dedication (e.g., “great focus and determination,” “passionate about the job,” “someone who never gives up”), women were less interested than men in pursuing the brilliance-requiring (vs. dedication-requiring) internship. Similarly, when non-student adults were asked to report their interest in a new unspecified college major that either required students to be “brilliant,” “smart,” “intelligent,” and “talented” (brilliance condition) or “dedicated,” “motivated,” “hardworking,” and “passionate” (dedication condition), compared to men, women were less interested in educational opportunities framed as requiring brilliance (vs. dedication). Taken together, these studies suggest that gender disparities in academic fields may be due to brilliance beliefs about those fields and women's disinterest in pursuing brilliance-requiring opportunities.

Importantly, these gendered beliefs about brilliance emerge early and have consequences for interests. Across four studies, Bian et al. (2017) examined brilliance beliefs in 5-, 6-, and 7-year-olds and found that by age 6, children associate brilliance with men and boys over women and girls. Despite reporting that girls in their class had higher grades, participants, regardless of own gender, guessed that the really, really smart person was a man or boy rather than a woman or girl. Further, girls were less interested in a game for “really, really smart children” than were boys, highlighting that brilliance beliefs shape interests starting in childhood.

Although assumed to be an integral contributor to gender gaps in majority-men academic fields, brilliance beliefs about the self have not been well operationalized or studied in relation to field of study. It may be that women's internalization of gendered brilliance beliefs contributes to their choice to study psychology over philosophy. If so, we would expect, on average, women's brilliance beliefs about themselves to be lower than men's, brilliance beliefs to be associated with major, and gender and brilliance beliefs to interact. Next, we consider another type of belief about intelligence—fixed versus growth mindsets.

Fixed versus Growth Intelligence Mindsets

An alternative--or complementary--, related explanation for the gender gap has to do with how individuals' conceptualize the malleability of intelligence: fixed versus

growth mindsets. Like brilliance beliefs, fixed versus growth intelligence mindsets are specific beliefs individuals hold about the nature of intellectual abilities. In contrast to brilliance beliefs, which describe intellectual abilities at the highest levels, fixed versus growth mindsets refer to the beliefs individuals hold about the ability to become more intelligent through effort, over time, irrespective of where one's current intellectual level is (Dweck, 2000, 2006, 2008). Importantly, the distinction between brilliance beliefs and fixed versus growth mindsets is both theoretical (i.e., how they are defined) and operational (i.e., how they are measured), but no prior work has compared the associations of brilliance beliefs and fixed mindsets with academic major such that their relative contributions can be empirically distinguished (but see Bian et al., 2018a, b; Thompson et al., 2016).

People who hold more fixed mindsets are more likely to agree with statements that reflect the view that intelligence is innate and cannot be changed, e.g., “Intelligence is something about people that they can't change very much” (Dweck, 2000, 2006). In contrast, people who hold more growth mindsets about intelligence believe it can be changed with effort and are more likely to agree with statements such as, “No matter how much intelligence people have, they can always change it quite a bit” (Dweck, 2000, 2006). Compared to individuals with relatively fixed mindsets, those who hold growth mindsets tend to find challenging tasks invigorating and see them as opportunities for intellectual growth (Dweck & Leggett, 1988). People with highly fixed mindsets tend to avoid challenging tasks because they call into question the adequacy of their intellectual abilities (Dweck & Leggett, 1988). Accordingly, we expect that fixed (vs. growth) mindsets will be associated with majoring in psychology (vs. philosophy) because fixed mindsets are associated with avoidance of particularly challenging activities, likely including philosophy, which is thought to require high brilliance, but not psychology, which is thought to require low brilliance.

It has been theorized (Dweck, 2007) and empirically demonstrated (Nix et al., 2015) that women are more likely than men to hold fixed mindsets, which in turn could explain why women avoid the potential challenges associated with certain fields that are presumed to require high levels of intelligence (e.g., STEM; Nix et al., 2015). Support for this theory comes from the benefits of growth mindset (measured and manipulated) for increasing interest in, motivation, and performance on intellectually demanding pursuits among women (Degol et al., 2018; Good et al., 2003, 2012). For example, in one intervention with 7th graders in a computer class, students learned from their mentor and explored websites explaining

that intelligence can be grown over time, largely because the brain forms new connections and adapts to new problem-solving strategies. Students, especially girls, performed better in math and reading by “changing stereotyped students’ responses to a stereotype threatening situation” (p. 657). In a program of research focused on undergraduate students, those with more growth, less fixed, mindsets about math ability reported a higher sense of belonging in math, and in turn greater interest in and intention to pursue math, compared to women who viewed math as a fixed trait (Good et al., 2012). When women, but not men, perceived that their math class environment featured messages that math ability is fixed and that women have lower abilities in math than men, they felt lower levels of math belonging over time (Good et al., 2012).

Notwithstanding work on the benefits of growth versus fixed mindset, there is a notable lack of empirical evidence to support the “Bright Girl” theory—that women, especially those relatively high in intelligence, are more likely to have fixed (vs. growth) mindsets relative to men, and that these fixed mindsets make these “bright girls” especially likely to opt out of challenging tasks (e.g., Dweck, 2007; Halvorson, 2011). Instead, findings related to gender differences in mindsets are mixed: Some work has found no gender differences in mindsets (e.g., Tucker-Drob et al., 2016; Yan et al., 2014); whereas other work finds that gender differences in mindsets depend on culture (e.g., with women, compared to men, holding more growth mindsets in a Western sample, but more fixed mindsets in an Eastern sample; Yan et al., 2021); and still other work suggests that men have more fixed (vs. growth) mindsets relative to women (e.g., Macnamara & Rupani, 2017). Thus, we might expect that fixed versus growth mindsets will be associated with majoring in psychology over philosophy based on theory and empirical work; however, less clear is whether women will be higher than men in fixed versus growth mindsets and whether fixed versus growth mindsets will be associated with majoring in psychology over philosophy for women more than for men (as theory might assume but for which evidence is mixed).

Current Research

The primary aim of the current work is to examine associations between brilliance beliefs and fixed versus growth mindsets with undergraduate major choice in two fields that have inverse gender gaps. Previous research finds that academics and laypeople alike view philosophy as requiring more brilliance than psychology, and that more men than women study philosophy and more women than men study psychology (e.g., Leslie et al., 2015). We expect to replicate these patterns in undergraduate students studying philosophy and psychology. We also examine

the interaction between beliefs about the fields (specifically, the difference between brilliance beliefs about philosophy and about psychology) and gender. It may be that women, but not men, who believe philosophy requires higher brilliance than psychology are less likely to go into philosophy versus psychology given the ubiquity of the men-as-brilliant stereotype (Leslie et al., 2015; Meyer et al., 2015). That is, women may see a mismatch between stereotypes about their gender (lower brilliance) and the stereotypes about philosophy (higher brilliance) versus psychology (lower brilliance) and therefore choose not to pursue studies in that field, as models of identity theory (Greenwald et al., 2002), role congruency theory (Diekmann et al., 2010), and work in STEM (e.g., Kessels et al., 2014; Master et al., 2016; Starr & Leaper, 2019) would predict. Putting this another way, men may be more likely to decide to study in a field that is believed to require brilliance because of the *match* between brilliance beliefs about the field and the level of brilliance ascribed to men; conversely, women may be dissuaded from studying in such a field because of the *mismatch* between brilliance beliefs about the field and the level of brilliance stereotypically associated with women.

Internalizing the negative gender stereotypes about women’s intellectual ability in general (Leslie et al., 2015; Storage et al., 2020), women may believe themselves to be lower in brilliance than men believe themselves to be. Brilliance beliefs about the self should be particularly important in shaping the individual’s academic paths (e.g., Bian et al., 2018a, b; Muradoglu et al., 2022). The present study considers whether women, compared to men, are more likely to major in psychology over philosophy in part because they believe that they themselves do not possess the brilliance required for success in philosophy. Thus, we anticipate that women will view themselves as lower in brilliance than men view themselves (i.e., the association between perceived brilliance of self and gender); that gender will be associated with major, such that more men than women study philosophy and more women than men study psychology; and that brilliance beliefs about the self and gender will interact to predict major. That is, with respect to the latter, we explore whether women who believe they are low (vs. high) in brilliance are less likely to go into philosophy and more likely to go into psychology compared to men who hold similar beliefs about their own brilliance. This hypothesis is supported by findings that the brilliance beliefs of women (vs. men) more strongly shape decisions about field of study (Bian et al., 2018a, b; Muradoglu et al., 2022), which makes sense in light of the content of the brilliance stereotype—that women are not brilliant, but men are. That is, when educational or professional success is linked to brilliance, women, but not men, show less interest and reduced feelings of belonging (Bian et al., 2018a, b; Muradoglu et al., 2022).

As a conceptually related alternative—or complementary—explanation for the gender gap in philosophy versus psychology, we examine the role of fixed versus growth mindsets. Given that philosophy is thought to require high levels of innate brilliance and psychology is thought to require low levels of innate brilliance, the belief that one cannot grow their intelligence likely dissuades one from studying philosophy but not psychology. Indeed, prior work suggests that fixed versus growth mindsets are associated with disengagement from tasks and contexts perceived to be challenging (e.g., Dweck & Leggett, 1988; Good et al., 2012). We thus expect that stronger fixed versus growth mindsets will be associated with majoring in psychology over philosophy.

Based on theory and some evidence (e.g., Halvorson, 2011; Dweck, 2007), we expect that women will hold more fixed versus growth mindsets than men. Given that other evidence suggests no gender difference (e.g., Tucker-Drob et al., 2016; Yan et al., 2014) or a difference in the opposite direction (e.g., Macnamara & Rupani, 2017), this hypothesis is tentative. We also test to what extent fixed versus growth mindsets interact with gender to predict the focal gender gaps. We anticipate that women, but not men, with more fixed relative to growth mindsets will be more likely to be majoring in psychology than philosophy. Put another way, women with higher growth versus fixed mindsets may be more likely to study philosophy than psychology compared to men. This can be thought about in terms of growth (vs. fixed) mindsets serving as a buffer for women in maintaining interest in philosophy (vs. psychology) insofar as they believe that over time and through effort, they can gain the high level of intelligence (i.e., brilliance) required for success in philosophy. Support for this reasoning comes from work demonstrating that growth versus fixed mindsets and interventions supporting growth mindsets positively predict interest and success in brilliance-related contexts for negatively stereotyped groups (e.g., women in STEM; Degol et al., 2018; Good et al., 2012; Smith et al., 2013; Black students; Aronson et al., 2002; and students from disadvantaged backgrounds; Yeager et al., 2016; Zhao et al., 2021), compared to non-stereotyped groups (e.g., white men and students from high SES backgrounds).

Relatedly, individuals' fixed versus growth mindsets may interact with their beliefs about brilliance required for philosophy and psychology and with perceptions of their own brilliance to predict choice of major. People who have more fixed (vs. growth) mindsets are more likely to view stereotypes as innately determined, meaningful truths (Levy et al., 1998). More broadly, essentialist thinking about social groups leads to more stereotyping (Bastian & Haslam, 2006). Moreover, inculcation of fixed versus growth mindsets (i.e., via professors' communicating a fixed versus growth mindset in their syllabus) is associated with perceptions of stronger gender stereotypes (Canning et al., 2022).

Accordingly, fixed versus growth mindsets may amplify the effect of brilliance beliefs, both about the self and about fields. We thus explore the possibility that people with fixed relative to growth mindsets and who believe they themselves are lower in brilliance are less likely to pursue the field thought to require high brilliance (i.e., philosophy) and instead pursue the field that matches their perceived unimprovable low brilliance (i.e., psychology). Similarly, people who hold fixed versus growth mindsets and who believe philosophy requires much more brilliance than psychology may be deterred from pursuing philosophy because attaining the brilliance necessary for that field is viewed as impossible to gain, regardless of work or effort toward that end.

The interactions between brilliance beliefs about the field and fixed versus growth mindsets as well as between brilliance beliefs about the self and fixed versus growth mindsets may be further modulated by gender. Consider that women more than men respond with reduced interest to the belief that a field requires high brilliance (e.g., Bian et al., 2017, 2018a, b; Vial et al., 2022), are more likely to benefit from a growth mindset intervention in contexts associated with high brilliance (e.g., Degol et al., 2018; Good et al., 2012; Smith et al., 2013), and are negatively affected by exposure to fixed versus growth mindsets when it comes to feelings of belonging, perceived stereotypes, and performance in the context of a high-brilliance field (i.e., STEM, Canning et al., 2022). Accordingly, we expect that for women, but not men, the combination of the belief that philosophy requires more brilliance than psychology and a more fixed versus growth mindset will be associated with majoring in psychology not philosophy. Likewise, fixed versus growth mindsets may amplify the effect of lower brilliance beliefs about the self for women more than for men, such that women, but not men, with more fixed versus growth mindsets who believe that philosophy requires much more brilliance than does psychology are likely to major in psychology over philosophy.

In sum, in this pre-registered investigation (<https://osf.io/5d29e/>), we assess in university undergraduates from diverse North American universities (i.e., in the U.S. and Canada) the relative contributions of gender, brilliance beliefs about philosophy and psychology and the self, as well as fixed versus growth mindsets, in predicting major, in psychology and philosophy.

Hypotheses

H1: Brilliance beliefs about the fields will differ between philosophy and psychology, with philosophy being viewed as requiring more brilliance than psychology.

H2: Gender will be associated with majoring in the two fields such that women will be more likely to

major in psychology, whereas men will be more likely to major in philosophy.

H3: The difference in brilliance beliefs between the two fields will interact with gender to predict major, such that for women, not men, believing that philosophy requires more brilliance than psychology will be associated with majoring in psychology over philosophy.

H4: There will be a gender difference in brilliance beliefs about the self, with women believing themselves to be lower in brilliance than men believe themselves to be.

H5: Brilliance beliefs about the self will be associated with major: people with lower (vs. higher) brilliance beliefs about the self will be more likely to be majoring in psychology over philosophy.

H6: Brilliance beliefs about the self and gender will interact to predict major, such that for women more than men, lower (vs. higher) brilliance beliefs about the self will be associated with majoring in psychology over philosophy.

H7: Mindsets will be associated with major: people with more fixed versus growth mindsets will be more likely to be majoring in psychology over philosophy.

H8: There will be a gender difference in fixed versus growth mindsets, with women holding more fixed versus growth mindsets compared to men.

H9: Fixed versus growth mindsets will interact with gender, such that, relative to men, women with more fixed (vs. growth) mindsets will be more likely to be majoring in psychology over philosophy.

H10: Brilliance beliefs about the fields and fixed versus growth mindsets will interact to predict major: people who believe that more brilliance is required for philosophy than for psychology and have relatively more fixed mindsets will be more likely to major in psychology over philosophy.

H11: Brilliance beliefs about the self and fixed versus growth mindsets will interact to predict major, such that people who believe that they are lower in brilliance (vs. higher) and have more fixed (vs. growth) mindsets will be more likely to major in psychology versus philosophy.

H12: Difference in brilliance beliefs about the fields, fixed versus growth mindsets, and gender will interact to predict major: women, but not men, who believe that more brilliance is required for philosophy than for psychology and hold fixed versus growth mindsets will be more likely to be majoring in psychology over philosophy.

H13: Brilliance beliefs about the self, fixed versus growth mindsets, and gender will interact to predict major: women, more than men, who believe that they are lower (vs. higher) in brilliance and have more fixed versus growth mindsets will be more likely to be majoring in psychology versus philosophy.

Method

Participants and Procedure

We collected data in three waves from undergraduate students, primarily from two large public universities, Concordia University in Quebec, Canada and Florida State University in Florida, United States, as well as from students at different types of institutions across North America to increase our ability to generalize results. In the first (Spring 2019) and part of the second (Fall 2019/Spring 2020) wave of data collection, students in philosophy and psychology classes at Concordia university could volunteer to respond to our survey on paper during class time. Continuation of this method was precluded by the COVID-19 pandemic. We subsequently migrated our survey online for part of wave two and all of wave three (Fall 2020/Spring 2021). Online data collection allowed us to extend our sample to students at other universities across North America. See Table 1 for characteristics of the universities from which we collected data. See Supplements A and B in the online supplement for more information on recruitment and exclusion criteria, respectively.

Our sample included 467 individuals (339 women, 128 men; $M_{\text{age}} = 21.32$, $SD = 4.12$; 59.5% White, 13.7% Hispanic or Latino, 9.4% Asian, 6.8% Black or African, 4.6% Indian, 2.4% Middle Eastern, .5% Native or Indigenous, and 3.1% identified with another race or ethnicity not listed, with 12 people who selected multiple ethnicities). Due to the small sample, we were unable to include and analyze data from 12 participants who identified as non-binary ($n = 7$), post-gender ($n = 2$), genderqueer ($n = 1$), genderfluid ($n = 1$), and demi-female ($n = 1$).

Our a priori and preregistered target sample size was 400 participants based on two primary factors: (1) exploratory pilot data indicated strong factor loadings on each of our a priori scales such that a minimum of 300 participants was needed to establish reliable factor structures (for review, see Kyriazos, 2018), and (2) G*Power analyses indicated that for the most basic analyses (e.g., correlation between gender and brilliance beliefs) 400 participants are needed to reach 85% power to detect an effect size of $r = .15$ (Faul et al., 2007). We also assessed the sample size needed for the more complex hierarchical multiple regression analysis conducted here (i.e., with 14 predictors): G*power indicated that 430 participants are necessary for 90% power to detect a small effect size of $f^2 = .02$.

After providing consent, participants reported their major (or intended major), year in university, high school grade point average, and demographics before completing measures of brilliance beliefs for psychology and philosophy, brilliance beliefs about the self, and fixed versus growth mindsets as part of a larger survey. All participants were presented with the measures in the same order.

Table 1 Characteristics and Number of Participants for Institutions from which Data were Collected

Country	University	City, State/Province	Institution Type, * Undergrads	Collection	<i>N</i>
United States					
	Florida State University	Tallahassee, Florida	Public, 32,795	Online	167
	Auburn University	Auburn, Alabama	Public, 23,379	Online	6
	Emory University	Atlanta, Georgia	Private, 8,000	Online	4
	Stanford University	Stanford, California	Private, 7,761	Online	4
	University of Missouri-St. Louis	St. Louis, Missouri	Public, 5,662	Online	4
	University of Pittsburgh	Pittsburgh, Pennsylvania	Public, 18,274	Online	1
	University of Miami	Miami, Florida	Private, 12,504	Online	1
Canada					
	Concordia University	Montreal, Quebec	Public, 36,555	In-person	139
	Simon Fraser University	Burnaby, British Columbia	Public, 30,380	Online	39
	McGill University	Montreal, Quebec	Public, 27,085	Online	29
	University of Toronto	Toronto, Ontario	Public, 45,370	Online	25
	University of British Columbia	Vancouver, British Columbia	Public, 47,400	Online	15
	University of Montreal	Montreal, Quebec	Public, 38,189	Online	12
	Queen's University	Kingston, Ontario	Public, 27,697	Online	9
	York University	Toronto, Ontario	Public, 49,700	Online	4
	Laurentian University	Sudbury, Ontario	Public, 6,700	Online	1

*Number of undergraduate students enrolled in 2021–2022. University data were not provided for 7 participants

Materials

Major

Participants answered the question *What is your major (or expected major)?* with response options *philosophy*, *psychology*, and *other (please specify)*. Here we focus on psychology and philosophy ($N_{\text{psych}} = 342$, $N_{\text{philo}} = 125$).

Brilliance Beliefs about Philosophy and Psychology

Participants responded to five items that assess the extent to which they believe that success in philosophy requires a raw, innate, high level of intelligence (e.g., *If you want to succeed in philosophy, hard work alone just won't cut it; you need to have an innate gift or talent*). Participants rated the extent to which they agreed with each item on a scale from 1 (*strongly disagree*) to 7 (*strongly agree*; $M = 3.28$, $SD = 1.16$; $\alpha = .82$). These items constitute scales employed by Leslie et al. (2015) and Thompson et al. (2016). Participants responded to the same five items as described above but for psychology using the same 7-point scale. For example, *If you want to succeed in psychology, hard work alone just won't cut it; you need to have an innate gift or talent* ($M = 2.93$, $SD = .94$; $\alpha = .68$). Scores for each field were computed by averaging across items after reverse scoring reversed items. Difference in brilliance beliefs about the fields scores were computed by subtracting brilliance beliefs about psychology from

brilliance beliefs about philosophy. Accordingly, the higher the score, the more brilliance was assumed to be necessary for success in philosophy compared to psychology. Note that participants were only asked to assess the brilliance needed to succeed in philosophy and psychology and no other fields. See Supplement C in the online supplement for more information on measures of brilliance beliefs about the fields, including all items for brilliance beliefs about philosophy (Table S1) and about psychology (Table S2).

Brilliance Beliefs about the Self

Participants responded to a 10-item measure that captures the extent to which they believe they have a raw, innate, high level of intelligence, especially in comparison to others (e.g., *I would say I am more intellectually gifted than average*). Participants rated the extent to which they agreed with each item on a scale from 1 (*strongly disagree*) to 7 (*strongly agree*; $M = 4.52$, $SD = .98$; $\alpha = .85$). Scores were computed by averaging across items after reverse scoring reversed items.

To test whether these items captured a unified construct, we subjected items to an exploratory factor analysis with oblimin rotation and a minimum eigenvalue of 2.5. A single factor emerged and accounted for 44% of the variance with an eigenvalue of 4.38. See Table 2 for all items and their respective factor loadings. Convergent validity was

established by assessing the association between high school grade point average (GPA) and the brilliance of self scale. A positive correlation of $r = .25, p < .001$, indicates that people with a higher GPA—a self-reportable measure of intellect and academic performance—view themselves as higher in brilliance than people with lower grades. For additional details on the scale's development, see the Supplement C in the online supplement.

Fixed versus Growth Mindset

Participants responded to 10 items from Dweck's (2007) mindset scale that assesses beliefs about the fixedness versus malleability with potential for growth of intelligence and talent (e.g., *Your intelligence is something about you that you can't change very much; No matter who you are, you can significantly change your intelligence level* [reversed]). Participants rated the extent to which they agreed with each item on a scale from 1 (*strongly disagree*) to 7 (*strongly agree*; $M = 2.97, SD = 1.09; \alpha = .91$). Scores were computed by averaging across items after reverse scoring reversed items. Higher scores indicate a greater belief that intelligence is fixed and not malleable, or a fixed versus growth mindset. See Supplement C in the online supplement for the full fixed versus growth mindset scale (Table S3).

Covariates

Participants provided their high school grade point averages (GPAs) and current year in university. Participants answered the question *What year of study are you in?* with choices 1st, 2nd, 3rd, 4th, and *Other (please specify)*. Responses were converted to numerical values ($M = 2.81, SD = 1.10$). Participants also responded to the item *What was your grade point average on the CEGEP or in high school?* With choices A+, A, A-, B+, B, B-, C+, C, C-, D, and F. (CEGEP is the pre-university and technical education program in Quebec,

Canada.) The grade point average (GPA) choices were converted to numerical values (i.e., A+ = 9, A = 8, A- = 7, B+ = 6, B = 5, B- = 4, C+ = 3, C = 2, C- = 1; no participants reported a GPA of D or F). The average GPA was a 7.04 out of 9, corresponding to an A- ($SD = 1.61$ letter grades).

Analytic Approach

To test H1, we employed a paired samples t-test comparing mean brilliance of fields for philosophy versus psychology. We test most hypotheses, for which major (a dichotomous variable) is the outcome (i.e., H2, H3, H5, H6, H7, H9, H10, H11, H12, H13), via a hierarchical binomial logistic regression analysis with four steps. In Step 1, predictors include covariates of Year in University, High School GPA; Step 2 adds main effect predictors Difference in Brilliance Beliefs about Fields, Brilliance Beliefs about the Self, Gender, and Mindset; Step 3 adds two-way interactions, including Difference in Brilliance Beliefs about Fields x Gender, Brilliance Beliefs about the Self x Gender, Mindset x Gender, Difference in Brilliance Beliefs about Fields x Brilliance Beliefs about the Self, Brilliance Beliefs about the Self x Mindset, and Difference in Brilliance Beliefs about Fields x Mindset; and Step 4 adds two three-way interactions, Difference in Brilliance Beliefs about Fields x Mindset x Gender and Brilliance Beliefs about the Self x Mindset x Gender. To test H4 and H8, we employed multiple linear regression analyses in which brilliance beliefs about the self and fixed versus growth mindset, respectively, are regressed onto gender, controlling for year in university and high school GPA.

Note that major was coded such that 0 = philosophy, 1 = psychology; and gender was coded such that 0 = man, 1 = woman. To correct for multiple comparisons, hypothesis testing p -values can be compared to $p = .0038$ (i.e., $p = .05 / 13$ comparisons).

Bivariate correlations among variables are provided in Table 3. See Supplement D in the online supplement for interpretation and discussion of bivariate associations. See

Table 2 Brilliance of Self Scale and Item Factor Loadings

	Item	Factor Loading
1.	I would say I am more intellectually gifted than average.	.82
2.	Although I have never been properly tested, it seems likely that I have an higher than average IQ.	.74
3.	I pick up new concepts much faster than many classmates.	.74
4.	People around me suspected from early on that I am intellectually gifted.	.63
5.	I tend to take longer to understand complicated ideas and theories than others. (R)	.61
6.	I need to study much harder than others in order to get good grades. (R)	.55
7.	I noticed early on that my mind seems to work less efficiently than the minds of others. (R)	.54
8.	I am good at coming up with ideas, and perhaps one day I will have an idea that changes the world.	.51
9.	I often have ideas that others didn't think about.	.47

(R) indicates reverse coding

Table 3 Correlations Among Primary Variables

	1	2	3	4	5	6	7	8
1. Major (0 = philosophy, 1 = psychology)	–							
2. Gender (0 = man, 1 = woman)	.38***	–						
3. Brilliance of Self	-.19***	-.15**	–					
4. Brilliance beliefs about Philosophy	.04	.04	.11*	–				
5. Brilliance beliefs about Psychology	.11*	.02	.11*	.59***	–			
6. Dif. in Brilliance Beliefs about the Fields	-.06	.03	.04	.63***	-.26***	–		
7. Fixed Mindsets	.02	-.10*	.05	.55***	.54***	.14**	–	
8. High School GPA	.06	.18***	.25***	-.02	-.02	-.01	-.01	–
9. Year in University	-.09*	-.09	-.02	-.03	-.17***	-.12*	-.12*	-.11*

Dif Difference

* $p < .05$; ** $p < .01$; *** $p < .001$

Supplement E in the online supplement for a comparison of responding on paper versus online via correlation analyses, which are presented in Table S4.

Results

Testing Hypotheses 1 – 3: Brilliance Beliefs about the Fields and Gender

In support of H1, and consistent with past research, philosophy ($M = 3.28$, $SD = 1.16$) is viewed as requiring more brilliance than psychology ($M = 2.92$, $SD = .94$, $t(466) = 7.86$, $p < .001$). Notably, and unexpectedly, neither psychology nor philosophy were rated as requiring *high* brilliance (i.e., above the 3.5 midpoint). One reason for this may be that most respondents were psychology majors who may be motivated to discount the brilliance required for philosophy given they do not study that subject.

Consistent with H2, women were more likely to be majoring in psychology while men were more likely to be majoring in philosophy, as indicated by the positive association between gender and major in Table 3. Indeed, in our sample, psychology is comprised of 83% women and 17% men, whereas philosophy is comprised of 45% women, 55% men.

H3 was not supported: the difference between brilliance beliefs about philosophy and psychology did not interact with gender to predict major (see Table 4).

Testing Hypotheses 4 – 6: Brilliance Beliefs about the Self and Gender

To test whether men and women differed in their average brilliance beliefs about the self, we conducted multiple regression analysis regressing brilliance beliefs about the self onto gender, controlling for year in university and high school GPA. In support of H4, women viewed themselves as

less brilliant than men viewed themselves, as indicated by a negative association between gender and brilliance beliefs about the self, $\beta = -.20$, $B = -.43$, $SE = .10$, 95% CI (-.617, -.234), $p < .001$. This was above and beyond the associations between year in university and gender, $\beta = -.01$, $B = -.01$, $SE = .04$, 95% CI (.039, -.008), $p = .852$ and high school GPA and gender, $\beta = .29$, $B = .17$, $SE = .03$, 95% CI (.121, .227), $p < .001$. This result is striking given that women came into college with a higher average self-reported high school GPA than men (see Table 3). Consistent with H5, brilliance beliefs about the self were negatively associated with major, indicating that people with lower (vs. higher) brilliance beliefs about the self were more likely to be majoring in psychology over philosophy. See Step 2 of Table 4.

Brilliance beliefs about the self interacted with gender to predict major, providing support for H6, as represented in Step 3 of Table 4. To probe this interaction, we tested the effect of brilliance beliefs about the self on major in two binomial logistic regression models—one for men (Table 5) and one for women (Table 6)—controlling for covariates, all other main effects, and all other two-way interactions. For men, the association between brilliance beliefs about the self and major was not significant. However, for women, there was a significant negative association between brilliance beliefs about the self and major. Put another way, for women, but not for men, the belief that one is lower (vs. higher) in brilliance was associated with majoring in psychology over philosophy (Table 7).

Testing Hypotheses 7 – 10: Fixed versus Growth Mindsets and Gender

There was no support for H7: fixed versus growth mindsets were not significantly associated with major, as indicated in Step 2 of Table 4. To test H8, we employed multiple

Table 4 Hierarchical Binomial Logistic Regression Model Regressing Major onto Primary Variables, Controlling for Year in University and High School GPA

Variable	<i>B</i>	<i>SE</i>	Wald	Exp (<i>B</i>)	95% CI for Exp(<i>B</i>)		<i>R</i> ²	χ^2	
					LL	UL			
Step 1								.01	5.039
Year in University	-.17	.10	3.40	.84	.698	1.011			
High School GPA	.07	.07	1.20	1.07	.945	1.218			
Constant	1.03	.56	3.39	2.80					
Step 2								.16	76.921
Year in University	-.12	.11	1.13	.89	.726	1.100			
High School GPA	.05	.08	.43	1.05	.905	1.222			
Dif. In Brilliance of Fields	-.16	.12	1.84	.85	.671	1.075			
Brilliance of Self	-.49***	.13	13.72	.61***	.474	.795			
Gender	1.72**	.25	47.88	5.58***	3.429	9.081			
Mindset	.14	.11	1.56	1.15	.926	1.416			
Constant	-.06	.63	.01	.94					
Step 3								.20	20.23**
Year in University	-.09	.11	.66	.913	.734	1.136			
High School GPA	.05	.08	.37	1.05	.897	1.229			
Dif. In Brilliance of Fields	-.15	.23	.45	.86	.545	1.347			
Brilliance of Self	.09	.22	.19	1.10	.719	1.678			
Gender	1.97***	.27	54.63	7.20***	4.267	12.159			
Mindset	.21	.16	1.73	1.24	.901	1.701			
Dif. In Brilliance of Fields X Gender	.24	.28	.70	1.27	.729	2.202			
Brilliance of Self X Gender	-.94***	.28	10.99	.39***	.223	.680			
Mindset X Gender	-.10	.22	.22	.90	.583	1.393			
Dif. In Brilliance of Fields X Brilliance of Self	-.30	.16	3.41	.74	.544	1.018			
Brilliance of Self X Mindset	-.07	.11	.41	.93	.744	1.162			
Dif. In Brilliance of Fields X Mindset	-.13	.13	.91	.88	.682	1.142			
Constant	-.23	.66	.12	.80					
Step 4								.20	1.30
Year in University	-.09	.11	.58	.92	.737	1.144			
High School GPA	.05	.08	.42	1.05	.900	1.233			
Dif. In Brilliance of Fields	-.14	.24	.37	.87	.546	1.374			
Brilliance of Self	.16	.23	.48	1.17	.749	1.830			
Gender	1.97***	.27	52.88***	7.18	4.221	12.215			
Mindset	.24	.17	1.99	1.27	.911	1.772			
Dif. In Brilliance of Fields X Gender	.24	.28	.69	1.27	.727	2.202			
Brilliance of Self X Gender	-.99***	.29	11.82***	.37	.211	.653			
Mindset X Gender	-1.35	1.14	1.41	.26	.028	2.408			
Dif. In Brilliance of Fields X Brilliance of Self	-.32	.16	3.88	.73	.527	.999			
Brilliance of Self X Mindset	-.20	.17	1.53	.82	.590	1.127			
Dif. In Brilliance of Fields X Mindset	-.15	.21	.51	.86	.578	1.290			
Dif. In Brilliance of Fields X Gender X Mindset	.03	.27	.01	1.03	.609	1.745			
Brilliance of Self X Gender X Mindset	.25	.23	1.25	1.29	.826	2.012			
Constant	-.27	.67	.17	.76					

Effects of interest presented first, *Exp(B)* odds ratio, *CI* confidence interval, *LL* lower limit, *UL* upper limit. *R*² Cox & Snell R-squared, *Dif* Difference, *Brilliance of Brilliance* beliefs about

****p* < .001, Multiple comparison *p* = .0038

Table 5 Multiple Binomial Logistic Regression Analysis Probing the Interaction Between Gender and Brilliance Beliefs of Self for Men, Controlling for All Covariates, Other Main Effects, and Other Interactions

Variable	B	SE	Wald	Exp (B)	95% CI for Exp(B)		R ²	χ ²
					LL	UL		
							.20	102.23***
Gender	1.97***	.27	54.63	7.20***	4.267	12.159		
Brilliance of Self	.09	.22	.19	1.10	.719	1.678		
Brilliance of Self X Gender	-.94***	.28	10.99	.39***	.223	.680		
Year in University	-.09	.11	.66	.91	.734	1.136		
High School GPA	.05	.08	.37	1.05	.897	1.229		
Dif. in Brilliance of Fields	-.15	.23	.45	.86	.545	1.347		
Mindset	.21	.16	1.73	1.24	.901	1.701		
Dif. in Brilliance of Fields X Gender	.24	.28	.70	1.27	.729	2.202		
Mindset X Gender	-.10	.22	.22	.90	.583	1.393		
Dif. in Brilliance of Fields X Brilliance of Self	-.30	.16	3.41	.74	.544	1.018		
Brilliance of Self X Mindset	-.07	.11	.41	.93	.744	1.162		
Dif. in Brilliance of Fields X Mindset	-.13	.13	.91	.88	.682	1.142		
Constant	-.23	.66	.12	.80				

Effects of interest presented first, *Exp(B)* odds ratio, *CI* confidence interval, *LL* lower limit, *UL* upper limit. *R*² Cox & Snell R-squared, *Dif* Difference, *Brilliance of Brilliance* beliefs about

****p* < .001, Multiple comparison *p* = .0038

regression analysis with fixed versus growth mindset as the outcome, gender as predictor, and year in university and high school GPA as covariates. In contrast to H8, the association between gender and fixed versus growth mindsets indicates that men held more fixed versus growth mindsets compared

to women, $\beta = -.10$, $B = -.25$, $SE = .12$, 95% CI (-.473, -.019), $p = .034$, while controlling for year in university, $\beta = -.12$, $B = -.12$, $SE = .05$, 95% CI (-.212, -.031), $p = .009$, and high school GPA, $\beta = -.00$, $B = -.00$, $SE = .03$, 95% CI (-.065, .061), $p = .944$. However, given the multiple comparisons in the

Table 6 Multiple Binomial Logistic Regression Analysis Probing the Interaction Between Gender and Brilliance Beliefs of Self for Women, Controlling for All Covariates, Other Main Effects, and Other Interactions

Variable	B	SE	Wald	Exp (B)	95% CI for Exp(B)		R ²	χ ²
					LL	UL		
							.20	102.23***
Gender	-1.97***	.267	54.628	.139***	.082	.234		
Brilliance of Self	-.85***	.184	21.241	.428***	.298	.614		
Brilliance of Self X Gender	.94***	.284	10.991	2.566***	1.470	4.481		
Year in University	-.09	.11	.66	.91	.734	1.136		
High School GPA	.05	.08	.37	1.05	.897	1.229		
Dif. in Brilliance of Fields	-.15	.23	.45	.86	.545	1.347		
Mindset	.21	.16	1.73	1.24	.901	1.701		
Dif. in Brilliance of Fields X Gender	.24	.28	.70	1.27	.729	2.202		
Mindset X Gender	-.10	.22	.22	.90	.583	1.393		
Dif. in Brilliance of Fields X Brilliance of Self	-.30	.16	3.41	.74	.544	1.018		
Brilliance of Self X Mindset	-.07	.11	.41	.93	.744	1.162		
Dif. in Brilliance of Fields X Mindset	-.13	.13	.91	.88	.682	1.142		
Constant	1.75	.695	6.331	5.749				

Effects of interest presented first, *Exp(B)* odds ratio, *CI* confidence interval, *LL* lower limit, *UL* upper limit. *R*² Cox & Snell R-squared, *Dif* Difference, *Brilliance of Brilliance* beliefs about

****p* < .001, Multiple comparison *p* = .0038

Table 7 Summary of Results by Hypothesis

Hypothesis	Support	Finding / Group Descriptives (<i>SD</i>)
Brilliance Beliefs about the Fields and Gender		
H1: Brilliance Beliefs about the Fields will differ systematically	Yes	Philosophy was viewed as requiring more brilliance than psychology Brilliance Beliefs about the Fields: Psychology: $M = 2.92$ (.94); Philosophy: $M = 3.28$ (1.16)
H2: Gender → Major	Yes	Women were more likely to major in psychology, whereas men were more likely to major in philosophy Percentage of Women and Men in Both Fields: Psychology: 83% Women, 17% Men (.38) Philosophy: 45% Women, 55% Men (.50)
H3: Gender X Difference in Brilliance Beliefs about the Fields → Major	No	There was not a significant interaction between gender and differences in brilliance beliefs about the fields (i.e., brilliance beliefs about philosophy – brilliance beliefs about psychology) in predicting major
Brilliance Beliefs about the Self and Gender		
H4: Gender → Brilliance Beliefs about the Self	Yes	Women rated themselves as lower in brilliance, whereas men rated themselves as higher in brilliance Brilliance Beliefs about the Self Means by Gender: Women: $M = 4.43$ (.92); Men: $M = 4.76$ (.98)
H5: Brilliance Beliefs about the Self → Major	Yes	Lower brilliance beliefs about the self predicted majoring in psychology, whereas higher brilliance beliefs about the self predicted majoring in philosophy Brilliance Beliefs about the Self Means by Major: Psychology: $M = 4.40$ (.93); Philosophy: $M = 4.83$ (1.03)
H6: Brilliance Beliefs about the Self X Gender → Major	Yes	For women, but not men, brilliance beliefs about the self predicted major: women who believed they were more brilliant were more likely to be majoring in philosophy, whereas women who believed they were less brilliant are more likely to be majoring in psychology
Fixed versus Growth Mindsets and Gender		
H7: Fixed versus Growth Mindsets will → Major	No	Fixed versus growth mindsets were not associated with major Mindsets Means by Major: Psychology: $M = 2.99$ (.93); Philosophy: $M = 2.94$ (1.01)
H8: Gender → Fixed versus Growth Mindsets	No	Men and women did not differ in fixed versus growth mindsets at the level of $p = .0038$ Mindsets Means by Gender: Women: $M = 2.91$ (1.04); Men: $M = 3.14$ (1.21)
H9: Gender X Fixed versus Growth Mindsets → Major	No	Fixed versus growth mindsets did not interact with gender to predict major
Brilliance Beliefs and Fixed versus Growth Mindsets		
H10: Difference in Brilliance Beliefs about the Fields X Fixed versus Growth Mindsets → Major	No	Difference in brilliance beliefs about the fields did not interact with fixed versus growth mindsets to predict major
H11: Brilliance Beliefs about the Self X Fixed versus Growth Mindsets → Major	No	Brilliance beliefs about the self did not interact with fixed versus growth mindsets to predict major
Brilliance Beliefs, Fixed versus Growth Mindsets, and Gender		
H11: Difference in Brilliance Beliefs about the Fields X Fixed versus Growth Mindsets X Gender → Major	No	Difference in brilliance beliefs about the fields, fixed versus growth mindsets, and gender did not interact to predict major
H13: Brilliance Beliefs about the Self X Fixed versus Growth Mindsets X Gender → Major	No	Brilliance beliefs about the self, fixed versus growth mindsets, and gender did not interact to predict major

current work and our cutoff of $p = .0038$, we do not interpret this gender difference as significant. The interaction between fixed versus growth mindsets was not significant, as indicated

in Step 3 of Table 4, and thus fails to support H9 that women versus men with fixed versus growth mindsets would be more likely to major in psychology over philosophy.

Testing Hypotheses 10 and 11: Brilliance Beliefs and Fixed versus Growth Mindsets

In contrast to H10, differences in brilliance beliefs about the two fields did not interact with fixed versus growth mindsets. See Step 3 in Table 4. Failing to find support for H11, results of Step 3 in Table 4 also indicate that brilliance beliefs about the self did not interact with fixed versus growth mindsets.

Testing Hypotheses 12 and 13: Brilliance Beliefs, Fixed versus Growth Mindsets, and Gender

In contrast to H12, there was not a significant interaction among differences in brilliance beliefs about the fields, fixed versus growth mindsets, and gender, as represented in Step 4 in Table 4. Likewise, there was not a significant interaction among brilliance beliefs about the self, fixed versus growth mindsets, and gender, such that H13 was not supported. See Step 4 in Table 4.

Discussion

Men are over-represented in philosophy, whereas women are overrepresented in psychology. These inverse gender gaps are striking considering the shared history and non-trivial overlap in subject matter of the two fields (e.g., Haig, 2011; Montgomery, 1993; Suls et al., 2019). We tested how gender, brilliance beliefs about each field, brilliance beliefs about the self, fixed versus growth mindsets about intelligence, and their interactions are associated with majoring in philosophy and psychology. Our research with university students is well-suited for this test given that these academic pipelines leak heaviest at the undergraduate level (e.g., Paxton et al., 2012) and we measured actual major rather than hypothetical choices.

We found that both men and women believe that philosophy requires more brilliance than psychology and that women believe themselves to be less brilliant than men believe themselves to be. Crucially, gender and brilliance beliefs about the self interacted, such that women, but not men, who believe they are relatively low in brilliance are more likely to be majoring in psychology than philosophy. This pattern of results is particularly striking considering the association between individuals' own GPAs and brilliance beliefs about the self and that women enter college with higher GPAs than men. That is, women believe they are relatively low in brilliance despite evidence to the contrary. These findings add to a body of work demonstrating that girls and women believe themselves to be less brilliant than boys and men believe themselves to be, and that such brilliance beliefs affect girls' and women's interests, feelings of belonging, and choices relevant to

career path (e.g., Bian et al., 2017; Correll, 2001, 2004; Muradoglu et al., 2022; Thompson et al., 2016).

Replicating past work (Macnamara & Rupani, 2017) but in contrast to theory (e.g., Dweck, 2007), women believed intelligence to be more malleable than did men (though this finding should be qualified by multiple comparison correction standards). However, fixed versus growth mindsets were not associated with major, nor did mindsets interact with gender to predict major. Put another way, whether women held more fixed relative to growth views about intelligence did not predict whether they were more likely to be majoring in philosophy or psychology. Although mindsets were not the crucial predictor of the philosophy-psychology gender gaps, they did predict difference in brilliance beliefs about the fields: the more fixed (vs. growth) mindsets people held, the more they believed brilliance is necessary to succeed in both philosophy and psychology. This pattern of results suggests that the internalized gendered stereotype of brilliance and brilliance beliefs about the fields are proximately essential to understanding the gender gap, but that mindsets may feed into brilliance beliefs.

Situating this work in broader theoretical frameworks, these findings are consistent with and add nuance to Balanced Identity Theory (Greenwald, 2002) and Role Congruency Theory (Diekmann et al., 2010). These frameworks are often applied to understanding gender gaps in STEM fields and leadership positions (e.g., Kessels et al., 2014; Master et al., 2016; Starr & Leaper, 2019) and center on how women's (i) gender identities, (ii) perceptions of themselves (i.e., the self), and (iii) knowledge of the trait stereotypes of people in particular contexts (e.g., STEM) interact to shape their interests and career pursuits. That is, to the extent that women's stereotype/self-identity association conflicts with the stereotypes of people in STEM, the self/STEM association will be attenuated (or rejected). Mismatched perceptions of one's identity and the context dissuade women from engaging or persevering in that context. Here, we demonstrate that people who identify as women internalize a gender stereotype and perceive themselves as less brilliant, but also share with others (i.e., men) the stereotypes of philosophy as for people who have brilliance and psychology as for people who do not have brilliance. Accordingly, women are more likely to study psychology (a match) over philosophy (a mismatch).

Practical Implications

Scholars have theorized and empirically demonstrated that aspects of the academic environment shape individuals' feelings about themselves and participation in diverse academic fields (e.g., Canning et al., 2022; Cheryan et al., 2011;

Murphy et al., 2007), and our work supports the claim that brilliance beliefs play an important role in understanding why individuals choose to study in one particular field and not another based on how much brilliance is thought to be necessary for success in that field. For example, work in STEM suggests that aspects of physical environment (e.g., paraphernalia, posters, syllabi), source material (e.g., mostly male authors), and historical context (e.g., one that featured overt sexism) may drive women away from those fields (e.g., Canning et al., 2022; Cheryan et al., 2011; Murphy et al., 2007). There may also be classroom factors that shape women's major choices: Buckwalter and Stich (2014) connote that gendered engagement with philosophy teaching methods may leave women believing they themselves are less smart than their male counterparts and therefore less willing to continue taking philosophy classes. Accordingly, making changes to the environment and in the classroom to be less man-centric may remove drivers of women's lower brilliance beliefs. Inversely, we would also expect that a reduction of brilliance beliefs would manifest fewer man-centric cues and practices in the academic environment.

It is also important to zoom in and consider potential mechanisms by which brilliance beliefs deter women from majoring in philosophy and encourage them to major in psychology. Past work suggests that brilliance beliefs reduce women's interests (Bian et al., 2018a, b; Correll, 2001, 2004; Thompson et al., 2016) and feelings of belonging (Bian et al., 2018a, b; Muradoglu et al., 2022) (for review, see Maranges et al., 2023). Because the brilliance-as-man stereotype appears critical in shaping women's interests and career choices, addressing brilliance beliefs becomes vital for attempts to close the gender gap. Although past work indicates that teaching growth mindsets is beneficial for increasing women's interest in and motivation to pursue studies in fields associated with brilliance (e.g., Degol et al., 2018; Good et al., 2003), doing so without targeting the brilliance-as-man stereotype fails to address the problem at its core. In essence, teaching women that intelligence can be developed through hard work without demystifying the belief that brilliance is something only men have implies that women need to work harder to reach men's innate level of brilliance, which only reinforces the status quo (Vial & Cimpian, 2020). Instead, directly targeting both mindsets and brilliance beliefs among individuals of all genders may be more effective for narrowing the gender gaps across fields. Take for example the oft-cited growth mindset intervention that successfully increased students' math achievement motivation over an extended period of time (Blackwell et al., 2007). The researchers not only offered a growth mindset lesson but also provided an anti-stereotyping intervention that directly targeted people's stereotypical beliefs about gender, including those about intelligence.

Our findings also suggest that socialization early in academic training affects some of students' brilliance-relevant perceptions. Specifically, the further along students were in their undergraduate career, the more growth versus fixed mindsets they held, but also, the less brilliance they assumed psychology requires. However, year in university did not predict the extent to which people believed they are brilliant, such that more senior women did not believe they were more or less brilliant than lower classwomen. This makes sense in light of findings that brilliance beliefs exist and operate long before individuals enter college. For example, by first grade, girls view boys as "really, really smart" and are less likely to choose to play a game for "really, really smart" children (Bian et al., 2017).

Here, it is important to acknowledge that past work has found that brilliance beliefs similarly predict underrepresentation of racial and ethnic minoritized groups (e.g., Black students and PhDs) in academic fields such as philosophy (e.g., Meyer et al., 2015). Although people from minoritized groups may face unique challenges, especially insofar as they have intersecting social identities (e.g., women from minoritized racial/ethnic groups; e.g., Muradoglu et al., 2022), our results may have important implications. To the extent that brilliance beliefs, not just fixed versus growth mindsets, shape minoritized students' decisions to major in some fields but not others, intervening on both stereotypes about brilliance and mindsets about the innateness of intelligence is essential. Indeed, preliminary support for this proposal comes from the intervention cited above—minority students did better in math over time after they were exposed to growth mindset *and* anti-race-stereotype interventions (Blackwell et al., 2007).

Limitations and Future Directions

Although we have demonstrated that brilliance beliefs play an important and differential role in women's and men's choices of major in an ecologically appropriate context (i.e., with undergraduate students across diverse educational institutions) with sufficient statistical power, conclusions from the current work are limited in a few ways. First, albeit reflecting to some extent the very issue we are studying, our sample was imbalanced with respect to both the gender and major of participants. Specifically, the majority of our participants were women (72%). Given that psychology programs tend to be bigger than philosophy programs, it is unsurprising that the majority of our participants were psychology majors (73%). Future research on contributors to the gender imbalance across psychology and philosophy (or other fields) should thus aim to prioritize collecting data from a sample more balanced in terms of gender and field.

Second, our findings speak to one way in which the brilliance stereotype could predict the underrepresentation of women in certain fields, but there are other important ways, not addressed here, through which such beliefs could act as a barrier for women. For example, science faculty from universities across the United States rated women applicants for a lab manager position as less competent, and less likely to be hired and mentored than men applicants, based on *identical* applications that only differed on the gender of the names on the applications (Moss-Racusin et al., 2012). Bian et al. (2018a, b) provide another example of the indirect effects of the brilliance stereotype in the context of professional job recruitment. When asked to recommend someone for a company looking to hire a candidate with a high IQ, superior reasoning, and natural intelligence, participants were significantly more likely to refer a man than a woman. Yet another way brilliance beliefs about certain fields could push women out relates to the environment of said fields. That is, the stereotype can create negative workplace cultures (Masculinity-Contest Cultures) which can lead to reduced interest and sense of belonging in women (Vial et al., 2022). In sum, internalization of the brilliance-as-man stereotype is only one possible way by which that cultural belief can affect women's academic and professional outcomes; the brilliance-as-man stereotype also affects women's career trajectories through the behavior of others.

Third, the reliability for our measure of brilliance beliefs about psychology fell below the acceptable cutoff of $\alpha = .7$. Reliability may be low because there are too few questions, poor interrelatedness among them, or heterogeneous constructs captured (Nunnally & Bernstein, 1994; Tavakoll & Dennick, 2011). Regardless of the source of low reliability, relative to a higher reliability, it indicates that the portion of the measure score that is attributable to random error is larger. That the random error may be playing an outsized role in the measure of brilliance beliefs about psychology suggests that conclusions should be interpreted cautiously. Future research may benefit from adapting this measure to include more items or tweaking language to ensure higher conceptual overlap of items and examining the reliability of the measure in populations beyond psychology and philosophy majors.

Finally, although fixed versus growth mindsets were not found to directly predict or moderate gender's association with major choice among university undergraduates in our sample, an interesting follow up question is whether mindsets about brilliance, more specifically, might have an effect. People hold implicit beliefs (i.e., mindsets) about a wide range of abilities (Dweck, 2008). Perhaps the way one views high intellectual abilities (i.e., brilliance) differs from the way they view intelligence across the normal distribution of ability. Relatedly, given

people's mindsets vary by domain, it could also be hypothesized that their mindsets about philosophy and psychology differ. Investigating whether people's brilliance mindsets in particular, as opposed to fixed versus growth intelligence mindsets in general, as well as their field-specific mindsets affect their major choices are possible future directions for this line of work.

Conclusion

In this research we tested simultaneously the associations between beliefs about brilliance required for two fields which are largely matched on subject matter (i.e., field-specific ability beliefs for philosophy and psychology), beliefs about one's own brilliance, and fixed versus growth mindsets with majoring in either psychology or philosophy. Furthermore, we did so in the population that marks the incipience of academic gender gaps in psychology and philosophy—undergraduate students. We found that brilliance beliefs about oneself, rather than beliefs about the extent to which intelligence is fixed or malleable (i.e., mindsets), contribute to low levels of women in philosophy, which is viewed as requiring high brilliance, and high levels of women in psychology, which is viewed as requiring low brilliance. These results underscore that the internalization of cultural stereotypes—here, the stereotype that women tend not to be brilliant—is associated with real academic and occupational trajectories, i.e., college major. Interventions focused on closing gender gaps in fields stereotyped as requiring more brilliance, such as philosophy, should focus on individuals' beliefs about their own brilliance.

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Data Availability Data are available upon request and materials and preregistration are available on the Open Science Framework.

Code Availability Code is available upon request.

Declarations

Ethical Approval Ethics approval was provided by Concordia University (##30010053).

Conflict of Interest The authors have no conflict of interest.

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