

EXPRESS YOURSELF OR SECURE YOUR FUTURE?  
CONSTRUCTIONS OF CHOICE AND GENDER GAPS IN STEM FIELDS

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## Abstract

In many developed societies, women have greater freedom than ever before to engage in academic and professional pursuits of their own choosing. However, gender gaps in representation in Science, Technology, Engineering and Mathematics (STEM) fields persist. In these settings, which commonly construct academic choice as a means of self-expression, men and women may diverge in their motivation to pursue STEM, because the personal preferences they express through academic choice would bear the imprint of gender stereotypes. In settings that construct academic choice as a means to reach material security, however, men and women alike may be likely to prefer lucrative fields, including STEM. Three studies examined the implications of self-expression and security goals for STEM interest and motivation across genders. Study 1 documented that experimental activation of self-expression goals steered women away from STEM, but led to greater STEM interest among men. However, activation of security goals only affected men's STEM interest positively. Study 2 partially replicated this pattern for STEM and Business fields using a regulatory focus manipulation. In light of the findings, Study 3 examined whether security goals may be gendered in certain cultural settings, such that they play a larger role in men's choices than women's. Indeed, perceived lucrateness of STEM played a positive role in STEM interest and motivation only among men, and particularly among those who did not find STEM enjoyable. The studies provide initial evidence for the role of constructions of academic choice—as a means of self-expression or material security—in academic interest and motivation, highlighting the sociocultural shaping of academic choices among both women and men.

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## Express Yourself or Secure Your Future?

### Constructions of Choice and Gender Gaps in STEM Fields

In August 2017, a manifesto written by a Google employee appeared all over the news. He was arguing that genetic gender differences are the reason why women are underrepresented in the technology sector, which led him to receive harsh criticism and eventually lose his job. However, he also received praise from some for openly expressing this opinion. This incident presents one example of several cases in which people resort to innate sex differences to explain gender gaps in participation in STEM (Science, Technology, Engineering, and Mathematics) fields. It also illustrates the very beliefs that constitute one of the social barriers that women face in these fields: that women lack the ability or interest in STEM, which men inherently possess. However, social psychological research has repeatedly documented that it is indeed social barriers such as these stereotypical beliefs that steer women away from entering STEM fields.

Based on a social barriers approach, women's underrepresentation in STEM fields reflects a form of social inequality. In other words, in many cases, social barriers push women away from these fields in which they might otherwise excel. This approach suggests that gender gaps in STEM fields would be minimized in settings where women are free of social constraints to pursue any academic or professional field of their choice. However, in many high development nations where women are relatively liberated in their choices in general—including the US—gender gaps in STEM fields persist; indeed, they even appear to be larger than the gender gaps in several developing nations where women presumably face more barriers that constrain their choices in life. This pattern of variation in gender gaps in STEM across nations is puzzling.

A cultural psychological perspective can provide an insight into such a puzzling pattern. First, a cultural psychological perspective affords an analysis of different understandings of the meaning and purpose of choice in general, and *academic choice* in particular, across cultural ecologies. Specifically, it allows one to examine how constructions of academic choice as a means of self-expression or a means of achieving material security, which tend to be prevalent in high development and developing contexts, respectively, inform students' motivation to pursue particular academic fields. Second, a cultural psychological perspective challenges the implicit androcentric tendency of research that strives to explain why women's STEM attitudes, participation, or performance fall short of men's. Instead, it shifts the epistemic standpoint to examine the sociocultural processes that guide men's tendency to choose STEM fields, as well as women's tendency to steer away from them, to explain the reproduction of gender gaps.

In the present paper, I empirically test how the major goals that characterize different constructions of academic choice—specifically, self-expression and material security—shape students' interest in and motivation to pursue STEM fields as a function of their gender. Instead of comparing the effects of self-expression and material security goals on academic interest and motivation across cultural settings, I experimentally activated these sets of goals among American participants to examine their implications. In order to present the rationale behind the hypotheses tested in the studies, I first provide a brief overview of conventional social psychological perspectives on gender gaps in STEM and the common hypothesis that societal development attenuates gender inequality in STEM, and review studies that use multi-national data to test this hypothesis. Then, I provide a cultural psychological analysis of constructions of

(academic) choice across settings as a basis to understand the implications of self-expression and security goals for academic interest and motivation. Finally, I describe three studies that test these implications.

### **Gender Gaps in STEM: Conventional Social Psychological Perspectives**

Conventional perspectives in social psychology consider gender gaps in STEM to be a result of systemic disadvantage or social barriers that women experience in these domains. These barriers are unjust, not only because they artificially constrain women's identification and performance, but also because they block their participation in fields that are high in status, command prestige, provide lucrative career paths and the fastest growing occupations (Charles, 2011; Cheryan et al., 2009; Freeman, 2004; Hill, Corbett & Rose, 2010). In turn, persistence of unequal gender representation across high-status STEM and low-status, non-STEM domains contributes to the reproduction of gender stratification in the society at large through pay and status gaps (Charles, 2011; Correll, 2004; Croft, Schmader, & Block, 2015; Riegle-Crumb, 2005; Wood & Eagly, 2012).

### **Effects of Gender Socialization on STEM Attitudes**

One way in which social barriers contribute to the emergence of gender gaps in STEM is through the influence of gender stereotypes on academic attitudes, interests, and goals. Common stereotypes about STEM portray them as masculine domains, which require stereotypically masculine traits and innate forms of "brilliance" for success (Carli, Alawa, Lee, Zhao, & Kim, 2016; Leslie, Cimpian, Myer, & Freeland, 2015; Nosek et al., 2009). Parents, teachers, and counselors often show differential expectations and treatment of boys and girls that reflect stereotypical associations of STEM with males; these stereotypes, in turn, shape children's self-beliefs and interest in STEM (e.g.

Bandura, Barbaranelli, Caprara, & Pastorelli, 2001; Catsambis, 2005; Frome & Eccles, 1998; Jacobs, Davis-Kean, Bleeker, Eccles, & Malanchuk, 2005; Saucerman & Vasquez, 2014; Zeldin & Pajares, 2000). For instance, girls and women report lower efficacy beliefs, self-assessed competence, and expectations of success in STEM domains than do boys and men, regardless of their actual performance (e.g., Else-Quest, Mineo, & Higgins, 2013; Herbert & Stipek, 2005; MacPhee, Farro, & Canetto, 2013; Pajares, 2005; Sikora & Pokropek, 2012). These beliefs can steer female students' academic aspirations and interests away from STEM fields (Correll, 2001, 2004).

Socialization processes also lead men and women to develop different types of career goals, which they aim to fulfill by choosing careers that are conducive to these goals (Diekman et al., 2010). Women tend to endorse communal, interpersonal, and caregiving career goals, whereas men value agency, power, and status goals (Evans & Diekman, 2009; Gino, Wilmoth, & Brooks, 2015; Konrad et al., 2000; Morgan et al., 2001; Weisgram & Bigler, 2006). The stereotypical portrayal of STEM fields as incompatible with communal goals can signal to women that they would not enjoy careers in these fields, and steer them away (Diekman et al., 2011).

These studies document how girls grow up to believe that they would not like the subject matter of STEM domains or enjoy STEM careers (even in the absence of much experience with these domains), or could not succeed in them (even despite actual performance). Thus, many women may end up avoiding STEM pursuit due to such beliefs that forces of socialization have shaped over the years.

### **Situational Threats in STEM Contexts**

Even women who manage to develop interests in and positive attitudes toward STEM domains, despite said stereotypes, can repeatedly face situational threats that deter them from entering these fields. These are not necessarily overt forms of discrimination (Steele et al., 2002); instead, situations where gender stereotypes are salient can trigger a “threat in the air” that impairs women’s performance in and identification with STEM domains (“stereotype threat”; Steele, 1997). For example, minor reminders of stereotypes about gender differences in math ability interfere with the performance of women on a relevant task due to heightened concerns about confirming such negative stereotypes (Spencer et al., 1999). Meta-analyses on stereotype threat based on gender in math domains document small to moderate effects on test performance (Flore & Wicherts, 2015; Nguyen & Ryan, 2008; Stoet & Geary, 2012; Walton & Spencer, 2009). These effects may underlie gender gaps in standardized test scores (Spencer, Logel, & Davies, 2016). Moreover, repeated experience of stereotype threat in math domains can lead initially interested women to disidentify with math-intensive fields in the long run (Steele, 1997; Spencer et al., 1999).

Beyond stereotype salience, minor situational cues can act as reminders of systemic oppression and trigger the experience of threat among women in STEM-related contexts (Adams et al., 2006). For instance, women perform worse on a math-related test after interacting with a male engineering student who shows subtly sexist behaviors compared to those who have had no such interaction (Logel et al., 2009) or after hearing about an instructor who seems sexist compared to having no such information (Adams et al., 2006).

Another barrier that negatively impacts women's outcomes in STEM is social identity threat: a broader concern about facing hostility, prejudice, or negative treatment in a context (i.e., STEM setting) due to identification with a devalued social identity (i.e., as a woman; Branscombe et al., 1999; Steele et al., 2002). Social identity threat not only affects performance, but can also harm attitudes and interest by shaping women's experience in STEM settings. For instance, viewing a conference room with a low women-to-men ratio (compared to a gender-balanced one) can lead women to report lower sense of belonging and motivation to participate in that setting (Murphy, Steele & Gross, 2007). Beyond gender composition, the material ecologies of STEM departments can pose a threat to belonging by signaling to women that they would not fit into that environment (Cheryan, 2012; Cheryan et al., 2011; Cheryan & Plaut, 2010; Cheryan, Plaut, Davies, & Steele, 2009). For instance, women's sense of ambient belonging (i.e. feeling of fitting into and being similar to others in an environment), interest, and anticipated success in computer science was lower after exposure to a classroom decorated with stereotypically masculine objects (e.g., a Star Trek poster and video games) compared to exposure to a neutral classroom setting without such physical cues (Cheryan et al., 2011).

These findings document the important role of stereotypical beliefs and their manifestations in STEM settings in steering women away from STEM fields. Even—or indeed, particularly—women who may be interested in or care about succeeding in STEM domains may end up changing their minds and avoiding or exiting these fields as a result of their experience in relevant settings.

### **Contextual Variation in Gender Gaps across Nations**

As the preceding section demonstrates, conventional social psychological perspectives locate the source of gender gaps in STEM in the systemic disadvantage that women experience in their educational paths. From these perspectives, gender gaps in STEM domains reflect and reproduce a form of social inequality that constrains women from pursuing career options in which they might otherwise excel.

One implication of these perspectives is that gender inequality in STEM may vary with the degree of overall gender inequality in a setting. That is, one can expect gender gaps in STEM to be smaller in more gender egalitarian settings, where the loosening of gendered constraints allows women greater freedom to pursue any academic or professional field of their own choosing. Conversely, one can expect gender gaps in STEM to be larger in less gender egalitarian settings, where tighter gendered constraints may limit women's academic options to gender-appropriate fields.

These expectations constitute the “gender stratification hypothesis”, which posits that perceptions of opportunities for future success—especially concerning societal affordances and constraints—are an important determinant of student achievement and aspirations (Baker & Jones, 1993; Eccles, 1987; Guiso, Monte, Sapienza, & Zingales, 2008; Riegle-Crumb, 2005; Else-Quest, Hyde & Linn, 2010). In settings with low gender equality, girls and women may perceive little opportunity for (or many barriers against) the pursuit of male-dominated or stereotypically masculine careers such as those in STEM fields. To the extent that girls and women in such settings find it counter-productive to invest in STEM, they might report lower interest and achieve worse outcomes in STEM domains. In settings with greater gender equality, however, girls and



women may believe that they are free to pursue any career they want, including male-dominated or stereotypically masculine careers such as STEM. This belief would encourage them to show greater interest and participation in STEM domains.

Scholars in the modernization theoretical tradition propose that gender equality, or improvements in the status of women in a society, is a defining feature of overall societal development (Inglehart, Norris & Welzel, 2002; Welzel, Inglehart & Kligeman, 2003). To the extent that societal development and modernization are associated with relatively low gender stratification, this would suggest a “modernization hypothesis”, such that gender gaps in STEM will be smaller in more modern or developed settings than in less modern or developed settings (Charles, 2011a, 2011b). Together, I refer to the gender stratification and modernization hypotheses as the *development hypothesis*. In the following sections, I review studies that use multi-national data to test the development hypothesis by examining societal development or gender equality as macro-level predictors of gender gaps in STEM attitudes and participation.

### **Contextual Variation in Gender Gaps in STEM Attitudes**

Studies that examine gender gaps in STEM attitudes focus on a variety of variables, including math self-concept and self-efficacy (Else-Quest et al., 2010; Sikora & Pokropek, 2012), liking and enjoyment of math and science domains, and STEM-related aspirations (Charles, Harr, Cech, & Hendley, 2014; Riegle-Crumb, 2005). An overview of studies on gender gaps in STEM attitudes across nations appears in Table 1.

Riegle-Crumb (2005) examined the link between various indices of gender equality and STEM attitudes, using items from the multi-national TIMSS (Trends in International Mathematics and Science Study) dataset that tapped liking and enjoyment

of, perceived level of achievement, and aspiration to get a job in STEM domains. Consistent with the development hypothesis, gender equality in the home and labor force domains predicted smaller gender gaps in STEM attitudes (Riegle-Crumb, 2005). However, gender equality in the government domain was unrelated to the gender gap in STEM attitudes (Riegle-Crumb, 2005). Furthermore, whereas economic development predicted smaller gender gaps in science attitudes, it showed no relationship with gender gaps in math attitudes (Riegle-Crumb, 2005).

Else-Quest and colleagues (Else-Quest et al., 2010) likewise examined math attitudes (valuing math, extrinsic and intrinsic motivation, self-concept, self-efficacy, and math anxiety) using items from the TIMSS and PISA (Programme for International Student Assessment) datasets. Contrary to the development hypothesis, results revealed that gender gaps in math attitudes were *larger* in countries that scored higher on overall gender equality. Results for domain-specific indices of gender equality were mixed. Consistent with the development hypothesis, greater proportions of women in secondary and tertiary enrollment, research positions, and higher labor market positions predicted smaller gender gaps in math attitudes (Else-Quest et al., 2010). However, unexpectedly, greater political representation of women predicted larger gender gaps in math attitudes (except for math anxiety; Else-Quest et al., 2010).

Further evidence contrary to the development hypothesis comes from a study on gender differences in the proportion of high school students who expect to gain employment in computing, engineering, and mathematics (CEM) fields, based on open-ended responses to items from the PISA 2006 (Sikora & Pokropek, 2012). Gender gaps in aspiration to pursue CEM were smallest in Bulgaria, Montenegro, Thailand, and

Indonesia, all of which were classified as developing countries (Sikora & Pokropek, 2012). Furthermore, the percentage of girls who expected to have a CEM job in the future was highest in two developing countries, Jordan and Thailand (around 20 percent; Sikora & Pokropek, 2012). Also contrary to the development hypothesis, gender differences in science self-concept—favoring boys—were larger in advanced industrial countries than in developing countries (Sikora & Pokropek, 2012).

Based on a recent analysis of data from 53 countries, greater socioeconomic development—measured by the Human Development Index (HDI)—predicted larger gender differences in liking of math and aspirations for math-related careers, contradicting the development hypothesis (Charles et al., 2014). Gender gaps in aspirations were largest in such high HDI countries as the Netherlands, New Zealand, Belgium, Italy, and England, whereas it was very small in Ghana and South Africa, disappeared in Indonesia and Malaysia, and reversed in favor of girls in Botswana, all of which rank lower in terms of HDI (Charles et al., 2014).

To summarize, research documents patterns that often contradict the development hypothesis. Although results are mixed, several studies show that gender gaps in STEM attitudes are often *larger* in more gender egalitarian and economically developed countries than in less egalitarian and less developed countries.

### **Contextual Variation in STEM Participation**

Research on variation in gender gaps in *participation* in STEM fields is limited. Most existing research examines gender differences in enrollment in STEM programs in higher education (e.g., Bradley 2000; Charles & Bradley, 2006). An overview of studies on gender gaps in STEM participation across nations appears in Table 2.

To test the development hypothesis, Ramirez and Wotipka (2001) examined economic development (measured by GDP per capita) and societal development (measured by high school enrollment ratios) as predictors of women's participation in STEM across nations, which they operationalized as the ratio of women enrolled in STEM programs in higher education compared to all women in the 20-24 age cohort. Inconsistent with the development hypothesis, women's presence in STEM fields was unrelated with either measure of development (Ramirez & Wotipka, 2001).

Bradley (2000) compared gender ratios among engineering students across nations between the years 1965 and 1990. She concluded that women constituted a greater proportion of engineering students in less economically developed countries than in more developed ones. In a later study, Charles and Bradley (2006) examined the relationship between domain-specific indices of gender equality, such as women's representation in higher education and the labor force, and women's participation in computer science across 21 countries. Contrary to the development hypothesis, participation of women in computer science was highest in countries with the lowest gender egalitarianism scores (Turkey and South Korea). Furthermore, level of economic development was unrelated to women's participation in this STEM field (Charles & Bradley, 2006). Another analysis of data from 44 countries by Charles and Bradley (2009) showed that economic development (measured by GDP) was positively related to gender gaps in STEM participation among a set of developing countries, again contradicting the development hypothesis.

In a more recent analysis, Charles (2011a) reported that the most male-dominated engineering programs in the world between 2005 and 2008 were in the highly

industrialized countries of Japan, Switzerland, Germany, and the US. The least male-dominated engineering programs were in Mongolia, Greece, Serbia, and Panama (Charles, 2011a). Furthermore, contrary to the development hypothesis, representation of women in science fields was lowest in the Netherlands and highest in the majority-Muslim countries of Iran, Uzbekistan, Azerbaijan, Saudi Arabia and Oman, which do not rank high in terms of gender equality indices (Charles, 2011a).

Using most recent data available, I examined the relationships of levels of human development and gender equality with gender gaps in STEM participation. Figure 1 illustrates the share of degrees earned by women in math/computer science fields (National Science Board, 2016) across a selected set of countries ranked by the Human Development Index (HDI), which is a composite indicator based on health (i.e., life expectancy), education (i.e., mean years of schooling), and standard of living (i.e., gross national income per capita; United Nations Development Programme, 2015). Interestingly, women's participation in these fields is lowest in the countries that rank among the highest in terms of human development. As Figure 2 illustrates, a similar pattern emerges among a selected set of countries ranked by Gender Gap Index (GGI), which is a composite indicator of gender equality based on health (e.g., healthy life expectancy), education (e.g., literacy rate), economy (e.g., labor force participation), and politics (e.g., women in parliament; World Economic Forum, 2016).

Using the complete set of countries for which data are available ( $N = 64$ ), I computed bivariate correlations between level of human development and gender gaps in STEM participation (Table 3). Although HDI score (ranging from .42 for Mozambique to .94 for Norway) was positively associated with women's representation in higher

education overall ( $r = .36, p = .003$ ), and in social sciences ( $r = .34, p = .006$ ), it was marginally related to women's participation in physics/biology ( $r = .23, p = .06$ ), and *negatively* (although not significantly) with their participation in math/computer science ( $r = -.11, p = .3$ ) and engineering fields ( $r = -.07, p = .5$ ). These patterns suggest that while a greater percentage of women are attending higher education in high development nations, they may be choosing to pursue social sciences (and possibly less stereotypically masculine science fields such as Biology) more so than they do STEM fields.

Overall, research has consistently failed to support the development hypothesis with regards to gender gaps in STEM participation, and in some cases has documented patterns contrary to it; that is, gender gaps in STEM participation tend to be *larger* in more economically developed and gender egalitarian nations compared to less developed or less gender egalitarian nations.

### **A Cultural-Psychological Analysis of Academic Choice**

Studies that examine variation in gender gaps in STEM attitudes and participation across nations suggest that gender gaps do not shrink with increased societal development or gender equality. This intriguing pattern of larger gender gaps in high development settings is in line with previous research that has found larger gender differences in personality traits, attitudes, values, and emotions in more gender egalitarian contexts (e.g., Schwartz & Rubel, 2005). Guimond and colleagues (Guimond, Chatard, & Lorenzi-Cioldi, 2013) have focused on processes of social comparison to shed light on such patterns of larger gender differences in higher development settings. One important argument these researchers make is that social comparison processes inform the extent to which stereotypes inform self-evaluations. Specifically, including the other sex in the set

of people against which one compares the self may lead to greater self-stereotyping and amplify gender differences (Guimond et al., 2006; Guimond et al., 2007). Comparing oneself against members of the other gender may be more appropriate in gender egalitarian settings. For instance, in high power distance settings, where the society is more hierarchically organized on the basis of power differences along gender, women may be less likely to include men in the set of people that they compare themselves against (Guimond et al., 2007). Girls in high power distance settings may compare their STEM attitudes with that of other girls, but not boys, and would be less likely to characterize their attitudes in contrast to boys (i.e., as less positive; Else-Quest et al., 2010). However, in low power distance settings, gender differences in self-construal may be magnified: it is more appropriate or relevant for people to compare themselves with members of the other sex, as a result of which they tend to self-stereotype more (Guimond et al., 2007). In keeping with this process, gender gaps in math performance are smaller in high power distance contexts, controlling for strength of implicit stereotyping (Hamamura, 2012).

Social comparison focus effects are in keeping with the shifting standards model, which posits that the standard against which people make judgments of a target in a stereotyped domain can shift based on the point of comparison, given a subjective response scale (Biernat, 2012; Biernat & Manis, 1994; Biernat, Manis, & Nelson, 1991). As a result of shifting standards, judgments of targets based on common-rule scales remain in line with stereotypes, whereas subjective judgments attenuate or reverse this effect (Biernat, 2012). For instance, women may evaluate their own attitudes toward math and science domains to be more positive in contexts that encourage them to

compare themselves to the average woman. This comparison point sets a low standard to judge oneself against, as the average woman is stereotyped to have negative attitudes toward math and science. To the contrary, the standard is higher if the comparison point is the average man, leading to lower ratings of the self.

Shifts in comparison points provide a compelling explanation for why gender differences in general, as well as those in STEM attitudes in particular, may amplify in high development settings with greater gender equality. It is possible for girls and boys to develop diverging STEM attitudes as a result of habitually comparing themselves to members of the other sex in settings that allow or encourage comparisons across genders. This analysis is contingent upon the assumption that stereotypes associating STEM with masculinity exist across national settings (e.g., that STEM fields are stereotyped as masculine domains everywhere). Although individuals implicitly associate STEM fields with masculinity in many national settings, the strength of such associations vary as a function of the size of gender gaps in these fields (Nosek et al., 2009). Importantly, representation of women in STEM fields in a nation negatively predicts individuals' tendency to implicitly associate these fields with masculinity or report considering them as masculine domains (Miller, Eagly, & Linn, 2015). For instance, in settings where participation in computer science is gender-equal, such as India, Malaysia, and Armenia, this field is not stereotyped as masculine but considered gender-neutral (Gharibyan & Gunsaulus, 2012; Lagesen, 2008; Varma, 2009). These studies suggest that not only the extent to which people tend to engage in self-stereotyping due to social comparison processes, but also the strength of the relevant stereotype itself may vary across settings, and inform people's self-evaluations. Thus, it is important to consider the underpinnings



of gender gaps in *participation* in STEM across settings. Although social comparison processes may inform the development of gendered attitudes, STEM participation may not be a direct reflection of STEM in every cultural setting; choice of academic field may be shaped by other considerations than preferences or liking. Therefore, it is necessary to take a closer look into the cultural ecologies of high development and developing settings that shape academic choice in order to provide an insight into contextual variation in gender gaps in STEM *participation*.

I draw upon the literature on the cultural psychology of choice making and apply this knowledge base to examine the meaning and purpose of academic choice in these settings, which shapes students' tendencies to enter STEM fields and lead to gender gaps of different sizes in STEM participation. Based on cultural psychological perspectives (e.g., Adams & Markus, 2004; Markus & Hamedani, 2007; Markus & Kitayama, 2010), characteristics of cultural ecologies such as values and beliefs, and their instantiation in everyday life in the form of cultural products, practices, and institutions, afford different understandings of the self and individual action. Although one might assume that the process of choosing an academic pursuit would be similar for students across settings, cultural psychological perspectives suggest that the act of making a choice may acquire very different meanings in different cultural ecologies (e.g., Markus & Schwartz, 2010; Savani, Markus, & Conner, 2008). Specifically, cultural settings can afford a construction of *choice* as an act of unconstrained, individual self-expression or as a means to fulfill certain normative expectations and responsibilities arising from social roles. Individuals may thus understand the act of making an *academic choice*, in particular, as a means to assert their individuality by expressing the preferences of the authentic self (i.e., achieve

self-expression goals), or as a means to fulfill obligations and responsibilities regarding future material security (i.e., achieve security goals). These cultural understandings, in turn, inform the choice of academic pursuit among students.

### **Self-Expression and Material Security Goals in Academic Choice**

Cultural psychological perspectives suggest that independent construals of the self are more common in Western cultures (Markus & Kitayama, 1991), or the WEIRD (i.e., Western, Educated, Industrial, Rich and Democratic; see Henrich, Heine, & Norenzayan, 2010) cultural ecologies that generally inform mainstream psychological science. Based on a cultural understanding of the self as an independent entity, the internal attributes of an individual such as preferences, attitudes, beliefs, and goals are fixed and stable, and make up the core aspects of the self (Markus & Kitayama, 1991). Because these internal attributes and qualities are the most meaningful aspects of the self, individuals are motivated to express these attributes and qualities to make them explicit for others to observe; one way in which individuals can accomplish such self-expression is through making choices (Kim & Sherman, 2007).

WEIRD settings that are commonly characterized by economic prosperity and increased life opportunities encourage individuals to act on such “emancipative” values as self-expression through freedom of choice (e.g. Inglehart 1997, Inglehart & Baker 2000; Inglehart & Welzel, 2005; Welzel & Inglehart, 2010). Everyday realities of WEIRD settings afford ample opportunities for individuals to engage in self-expression by exercising free choice (e.g., abundance of options; Inglehart & Welzel, 2005; Welzel & Inglehart, 2010). In these settings, choice making thus becomes a valued opportunity to express the authentic, unique self; choice is thus understood as a direct reflection of core

attributes, preferences, desires, and goals, unconstrained by external factors such as norms and obligations (Iyengar & Lepper, 1999; Kim & Drolet, 2003; Markus & Schwartz, 2010; Snibbe & Markus, 2005; Stephens, Markus, & Townsend, 2007; Stephens, Fryberg & Markus, 2011). Furthermore, in cultural settings that emphasize self-expression through free choice, individuals become particularly invested in the choices that they make (e.g., devalue options they have not chosen), given that their choices are informative of who they truly are (Kim & Sherman, 2007).

Based on these cultural patterns, personal preferences are assumed to guide choices, whereas norms and obligations are considered as external constraints on what is supposed to be an internally driven action (Riemer, Shavitt, Koo, & Markus, 2014). For instance, middle-class American participants based their choices of consumer products directly on their personal preferences (i.e. liking), and were motivated to express their preferences by making their own choices (Savani et al., 2008). These participants evaluated pens more positively when they chose them, compared to when the pens were chosen for them by an experimenter (Savani et al., 2008). Similarly, White American children showed more motivation to engage in an activity when they were given the opportunity to freely choose it, as opposed to when it was chosen for them by their mothers or peers, reflecting a cultural emphasis on internally driven, unconstrained choice, whereas Korean American children showed the opposite pattern (Iyengar & Lepper, 1999).

Such cultural ecologies that construct choice (in general) as an opportunity for the expression of personal preferences are likely to promote a construction of *academic* choice (in particular) as an opportunity to follow one's heart, and chase dreams, passions,

enjoyment, and interests. Based on cultural psychological perspectives, these core attributes that make up the “authentic” self are not free of cultural influence, but shaped through engagement with cultural institutions and practices; what appear to be personal attributes are indeed a reflection of context in person (Adams, 2012). For instance, academic interests and preferences are not just natural or innate after all, but bear the influence of gender socialization (Charles, 2011a). Therefore, what one experiences as their authentic, unique interests and preferences is essentially *gendered*, or shaped in accordance with cultural stereotypes about gender and academic fields. Cech (2013) argues that individuals’ sense of self reflects the gender structure of the society at large; their self-conceptions generally tend to align with gender stereotypes. However, individuals are unlikely to be consciously aware of the extent to which their self-conceptions are gendered, and instead experience them as a part of their unique individuality (Cech, 2013). Thus, it becomes very difficult to connect gendered self-conceptions to larger social structures, as they get “encoded” as self-expression (Cech, 2013). As a result, when a cultural setting encourages individuals to choose academic fields that best express their authentic attributes, ironically, they may end up making more gender-stereotypical choices, or self-segregate, given that gender stereotypes about academic fields are in place (e.g., Sikora & Pokropek, 2012).

In many societies outside WEIRD settings construe the self as interdependent (Markus & Kitayama, 1991). Based on an interdependent construal of the self, internal attributes such as attitudes, beliefs, and goals are not necessarily fixed and stable; instead, individuals’ social roles and relationships primarily define the self (Markus & Kitayama, 1991). Given that internal attributes and qualities do not make up the most meaningful

aspects of the self, individuals may not consider expression of such attributes and qualities as particularly important in these settings; choice making is also not understood as a means to express the inner self (Kim & Sherman, 2007). Such post-materialist values as individual self-expression through free choice are not prevalent in developing societies outside of WEIRD settings; materialist values regarding physical and material security are more prominent (Inglehart, 2008).

Based on these cultural patterns, personal preferences are considered virtually indistinguishable from normative expectations and obligations arising from social roles and relationships (Riemer et al., 2014). Relatedly, individuals in these settings do not consider choice as a direct expression of personal preferences or liking (Savani et al., 2008). For instance, middle-class Indian participants showed less motivation than American participants to express their preferences through their choices, and evaluated pens of their own choice and pens chosen for them by the experimenter equally favorably (Savani et al., 2008). Instead, choices bear the influence of norms, social roles and related obligations, concerns about managing relationships, and goals regarding material security. This does not mean that choices are constrained or less agentic in these settings; instead, these settings construct agency in a way that does not locate the source of action strictly within the person (Savani et al., 2008).

Such cultural ecologies that construct choice (in general) as an occasion to fulfill normative expectations and obligations are likely to promote a construction of *academic* choice (in particular) as a means to achieve material security for oneself or one's current or future family, by acquiring lucrative employment opportunities and securing a decent standard of living. For instance, in Armenia, local ways of being encourage students to be

realistic in choosing a career path; choice of fields in which one can succeed and reach material security is emphasized, whereas there is no cultural emphasis on chasing a “dream” career or having a job one loves (Gharibyan & Gunsaulus, 2006). In this setting, computer science is a popular field among both women and men, because it provides job security and a comfortable life in the future (Gharibyan & Gunsaulus, 2006). In such settings that emphasize future security, both male and female students may show a tendency to base their academic choices on prospects of opportunities to fulfill goals regarding security, more so than liking or enjoyment of the subject matter of a field of study, leaning toward fields that offer lucrative career options.

### **Examining Women’s and Men’s Choices**

A cultural psychology perspective affords an understanding that constructions of academic choice would shape men’s, as well as women’s, academic choices. Instead of setting men’s academic experience as the standard and women’s experience (e.g., less positive STEM attitudes and lower STEM participation) as the deviant phenomenon that requires explanation and fixing (e.g., Bruckmüller & Abele, 2010; Bruckmüller et al., 2012; Hegarty & Pratto, 2001), one can investigate the implications of constructions of academic choice for both men and women.

**Self-expression goals across genders.** A construction of academic choice as self-expression is likely to influence choice of STEM among women and men in opposite directions. For women, expression of the self (e.g., personal preferences, dreams, and passions) may be incompatible with showing an interest in STEM. Socialization processes and identity threat can lead girls and women to believe that they would enjoy and succeed in female-stereotyped fields more so than male-stereotyped ones. Therefore,

settings that afford opportunities and freedom to “follow one’s heart” may steer women away from masculine STEM fields and toward stereotypically feminine fields instead (Charles, 2011; Charles & Bradley, 2009; Cech, 2013; Charles et al., 2014; Stout et al., 2011).

Furthermore, because the field of study one chooses is understood as an expression of who they truly are, this choice acquires a special meaning in the pursuit of romantic relationships. That is, individuals may believe that the field they choose influences their attractiveness in the eyes of potential mates. For instance, when romantic relationship goals were experimentally activated, female participants from the US expressed more negative attitudes toward and less intention to choose a STEM field, but greater interest in the traditionally feminine fields of English and foreign languages (Park, Young, Troisi, & Pinkus, 2011). More broadly, endorsement of romantic ideologies fosters a tendency among women to avoid choosing careers that yield power and status (Rudman & Heppen, 2003). For instance, women who prioritized romantic relationship goals during college in US settings tended to be in lower status, female-stereotyped occupations after graduation (Holland & Eisenhart, 1990). Thus, self-expression goals can push women away from STEM and toward stereotypically feminine fields due to concerns about romantic relationships, as well.

For men, expression of the self is compatible with showing an interest in STEM. Socialization processes can lead boys and men to believe that they would enjoy and succeed in male-stereotyped fields such as STEM more so than female-stereotyped ones. Indeed, pursuit of these fields can be particularly attractive for men as it serves to affirm their masculinity (Croft et al., 2015), which people tend to understand as a precarious

attribute that needs to be protected and affirmed (Vandello et al., 2008). For instance, entering stereotypically feminine fields, or even working for gender-atypical supervisors, can threaten masculine identity, and is encountered with severe backlash (Brescoll, Uhlman, Moss-Racusin, & Sarnell, 2012; Croft et al., 2015; Henson & Rogers, 2011). Therefore, settings that encourage and afford opportunities for self-expression can motivate men to enter stereotypically masculine STEM fields.

**Security goals across genders.** Security goals are likely to influence STEM choice among men and women in the same way. Specifically, these goals are likely to motivate both men and women toward lucrative or profitable fields. For instance, in Malaysia and India, female participants reported primarily financial reasons (e.g., helping out their families, securing future jobs and prestigious positions) for choosing to study computer science (Lagesen, 2008; Varma, 2009). Similarly, the majority of female engineering students in India (68%) cited job opportunities as a reason for choosing engineering, whereas only 27% mentioned liking of the subject matter (Gupta, 2012). These findings suggest that the tendency to consider security goals have the potential to lead women toward practical and lucrative fields such as STEM.

For men, achieving security goals is likely to be particularly important, given societal gender role expectations regarding men's financial success and ability to provide for their families (Croft et al., 2015; Morgan et al., 2001). Furthermore, earning potential and status are attractive characteristics that increase men's mating value in heterosexual relationships (Eastwick, Luchies, Finkel, & Hunt, 2014; Michniewicz, Vandello, & Bosson, 2014). To the extent that STEM careers yield more opportunities for financial success and prestige than most female-dominated fields (Carnevale, Cheah, & Hanson,



2015; Croft et al., 2015) security goals are likely to lead men to show greater interest in these and potentially other stereotypically masculine and lucrative fields.

### **The Present Research**

The present cultural psychological analysis suggests the counterintuitive proposition that men and women may diverge in their tendency to choose STEM fields to a larger extent in high development settings due to a construction of academic choice as self-expression. Conversely, men and women alike may lean toward potentially lucrative academic options, including STEM, in developing societies due to a construction of academic choice as a means to reach material security. One implication of this analysis is that, at the individual level, prioritization of self-expression or material security goals can influence students' interest in stereotypically masculine and highly lucrative fields such as STEM. For instance, although individuals in US settings, where self-expression through free choice is a prominent cultural value (e.g., Kim & Markus, 1999; Kim & Sherman, 2007), are likely to prioritize expression of personal attributes such as passions, dreams, and desires in choice of academic pursuit, they are unlikely to completely ignore other concerns regarding future financial security and responsibilities in this process. This suggests that both sets of goals—self-expression and security—can potentially be activated at a given moment to guide academic choices of these individuals.

Using college student samples from the US, I conducted three studies to empirically investigate the role of constructions of academic choice (i.e., self-expression or security goals) in female and male students' interest in and motivation to pursue STEM fields. The present cultural psychological analysis of constructions of academic choice suggests an interaction hypothesis (H1), such that constructions of academic

choice will influence STEM interest and motivation as a function of gender. That is, self-expression goals will negatively affect STEM interest and motivation among women but positively among men (H1a). Specifically, self-expression goals will lead women to report lower STEM interest and motivation compared to a control condition, given that pursuit of these fields is incompatible with expression of the female self. Conversely, self-expression goals will lead men to report higher STEM interest and motivation compared to a control condition, given that pursuit of these fields is compatible with the expression of the male self. However, security goals will have a positive effect on STEM interest and motivation among men and women alike (H1b). When security goals are active, both men and women will report higher STEM interest and motivation compared to a control condition, given that these fields have the potential to fulfill such goals by yielding lucrative careers.

To test these hypotheses, in Study 1, I experimentally induced self-expression or security goals before assessing participants' STEM interest and motivation. In Study 2, I used a regulatory focus manipulation to activate self-expression and security goals in an alternative way. I also extended Study 1 by investigating whether the manipulation also influences choice of other male-dominated and lucrative fields such as Business, and female-dominated and less lucrative Social Science fields. Finally, in Study 3, I used a correlational design to provide some insight into the patterns that Studies 1 and 2 documented. First, I explored the extent to which men and women consider various academic fields to be conducive to the fulfillment of self-expression and security goals. Then, I examined whether each set of goals predicts academic interest and motivation to differing extents as a function of gender.

## Study 1: Self-Expression and Security Goals

In Study 1, I conducted an experiment to test the effect of activation of self-expression or security goals on STEM interest and motivation as a function of participant gender. I manipulated construction of academic choice (as a means of fulfilling self-expression or security goals) by asking participants to focus on personal fulfillment or financial security in the process of choosing a field of study.

### Method

**Participants.** I recruited 330 participants (154 men, 169 women, 7 missing;  $M_{age} = 19.31$ ,  $SD_{age} = 1.78$ ) through the participant pool of our university to participate in an online survey. Participants received partial course credit for completing the survey. Data collection continued throughout one academic semester, and data were analyzed at the end of that time frame. Three hundred and twenty-five participants indicated pursuing a field other than STEM, whereas 42 were STEM majors; 5 did not indicate their majors. Most participants identified as White/Caucasian (75.5%), 8.2% identified as mixed race or with other racial/ethnic categories, 6.7% as Asian, 4.8% as Hispanic/Latino, and 3.9% as African American/Black. Mean subjective social standing was above the mid-point of the (10-point) scale ( $M = 6.58$ ,  $SD = 1.59$ ).

**Manipulation of construction of academic choice.** At the beginning of the study, participants were randomly assigned to a self-expression, security, or control condition. In the self-expression condition, participants read a brief passage emphasizing personal fulfillment as the primary goal of academic pursuit to activate a construction of academic choice as self-expression. The passage stated the importance of following one's heart when choosing an academic field, and pursuing a career that would allow one to

express and fulfill oneself. In the security condition, participants read a brief passage emphasizing economic security as the primary goal of academic pursuit to activate a construction of academic choice as a means to achieve material security. The passage stated the importance of choosing an academic field that would provide economic security and financial stability in the future. In the control condition, participants read a shorter prompt, which only highlighted the need to take into consideration various factors when choosing an academic pursuit, without discussing what these factors are. Full texts of the manipulation passages appear in Appendix A.

**Measures.** After the manipulation, all participants completed a questionnaire. All items were measured using 7-point Likert-type scales, except subjective social standing, which was measured on a 10-point scale.<sup>1</sup>

***STEM interest and motivation.*** Two items measured STEM interest and motivation. The items were, “How interested are you in pursuing Math- and Science-related careers after college”, and “How motivated are you to pursue Math- and Science-related careers after college”. I computed the mean of both items to create a composite variable ( $r = .95$ ).

***Demographics.*** Participants reported their age and gender, and indicated identification with racial category and their current major in college in an open-ended format. They also indicated their subjective social standing by choosing where they perceive themselves to be standing on a ten-rung ladder (1: worst off – 10: best off) that

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<sup>1</sup> I included measures of authenticity, locus of control, gender essentialism, and implicit theories of intelligence in this study for exploratory purposes as potential control variables. However, these variables were not included in the analyses since they did not show any relationship with the outcome measure.

<sup>2</sup> Following Park et al. (2011) I included current major as a control variable by categorizing participants’

represents everyone in the society ranked based on education, income, and occupation (Adler, Epel, Castellazzo, & Ickovicks, 2000).

## Results

To test H1, I conducted a 3 (Manipulation: Self-expression, Security, Control)  $\times$  2 (Gender: Male, Female) Analysis of Covariance (ANCOVA) on STEM interest and motivation, with current major (STEM: 1, Other: 0) as a control variable.<sup>2</sup> The main effect of current major on STEM interest and motivation was significant,  $F(1, 312) = 68.00, p < .001, \eta^2_p = .18$ . The main effect of gender was significant,  $F(1, 312) = 4.05, p = .04, \eta^2_p = .01$ , such that men ( $M_{adj} = 4.00, SE = .15$ ) reported higher STEM interest and motivation than did women ( $M_{adj} = 3.58, SE = .14$ ). The effect of the manipulation was not significant,  $F(2, 312) = 1.42, p = .2, \eta^2_p = .01$ . The hypothesized (H1) interaction between the manipulation and gender was significant,  $F(2, 312) = 3.83, p = .02, \eta^2_p = .02$  (Figure 3).

I conducted simple effects tests to decompose the interaction by examining the effects of the manipulation for each gender. The manipulation had marginal effects on both women and men,  $F_s(2, 312) = 2.78$  and  $2.45, p_s = .06$  and  $.08, \eta^2_{ps} = .02$  and  $.015$ , respectively. Based on simple contrasts, in line with H1a, women reported marginally lower STEM interest and motivation in the self-expression condition ( $M_{adj} = 3.11, SE = .25$ ) compared to the control condition ( $M_{adj} = 3.93, SE = .26, p = .068, d = -.44$ ).<sup>3</sup>

Conversely, self-expression goals led men to report slightly higher STEM interest and

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<sup>2</sup> Following Park et al. (2011) I included current major as a control variable by categorizing participants' open-ended responses as "STEM" and "Other". Analyses in the following studies also use the same procedure.

<sup>3</sup> Significance ( $p$ ) values for the pairwise comparisons reported in all studies have been adjusted using Sidak correction, which is available when probing ANCOVAs on SPSS, to account for the inflation of Type I error rates due to multiple tests.

motivation ( $M_{adj} = 4.11$ ,  $SE = .26$ ) compared to the control condition ( $M_{adj} = 3.54$ ,  $SE = .27$ ,  $p = .348$ ,  $d = .31$ ), although this pattern was not significant.

Contrary to H1b, security goals did not affect women's STEM interest and motivation ( $M_{adj} = 3.70$ ,  $SE = .24$ ) compared to the control condition ( $p = .88$ ,  $d = -.12$ ). However, security goals did lead men to report marginally higher STEM interest and motivation ( $M_{adj} = 4.34$ ,  $SE = .25$ ) compared to the control condition ( $p = .088$ ,  $d = .43$ ).

I also examined the simple effects of gender within each condition as an alternative way of probing the interaction. The gender difference in STEM interest and motivation was not significant in the control condition,  $F(1, 312) = 1.05$ ,  $p = .3$ ,  $\eta^2_p = .003$ , marginal in the security condition,  $F(1, 312) = 3.55$ ,  $p = .06$ ,  $\eta^2_p = .18$ , and significant in the self-expression condition,  $F(1, 312) = 7.53$ ,  $p = .006$ ,  $\eta^2_p = .024$ .

## Discussion

Study 1 tested the effects of activation of self-expression or security goals on STEM interest and motivation, and provided evidence for the hypothesized interaction between the manipulation of construction of academic choice and gender. Data collection was contingent on the participant pool in this study; therefore, I conducted post hoc power analyses for the hypothesized effects using G\*Power 3.1 (Faul, Erdfelder, Lang, & Buchner, 2007). Power to detect an interaction effect in an ANCOVA with an effect size of  $\eta^2_p = .02$  and a sample size of  $N = 330$  was .73. The analysis suggests that a sample size of 387 would be necessary to detect this rather small effect with a power of at least .80, which is the minimum sample size that replications of this study should aim for.

When female participants focused on personal fulfillment and following their hearts, they reported (marginally) lower STEM interest and motivation; however, when

male participants focused on self-expression goals, they reported slightly (non-significantly) higher STEM interest and motivation. The pattern of results is in line with the hypothesis that self-expression goals have opposite effects on STEM interest and motivation across genders. This is in keeping with the idea that for women, expressing the (female) self may be incompatible with showing an interest in STEM, but for men, expressing the (male) self seems to be compatible with it.

Furthermore, when male participants focused on concerns about economic security and financial stability, they reported (marginally) higher STEM interest and motivation, as STEM pursuit has the potential to fulfill these security goals. However, activation of security goals did not affect women's STEM interest and motivation. A speculative explanation for why security goals only had an effect on men but not women has to do with the differential gendering of these goals in relatively privileged (White, upper- or upper middle-class American) settings that most participants in the present study came from. In these relatively privileged settings, where students might not have to worry about future material security too much, they may base their academic choices primarily on self-expression goals instead. This tendency may be particularly pronounced among women. Researchers have argued that in the US, choice of academic and career pursuit is portrayed as a self-expressive act for women in particular (Charles et al., 2014). For instance, in a qualitative study on the factors that played a role in the academic choices of students in an elite, liberal arts college in the US, female participants did not list any security-related concerns (e.g., job availability); instead, they reported choosing their academic pursuits solely on the basis of liking and enjoyment (Mullen, 2014).

As noted earlier, expression of gender-appropriate interests, dreams, and passions through academic choice can serve romantic relationship goals, as well. This is relevant for the current discussion, as numerous observers have noted a “culture of romance” in hegemonic (White, middle-class) American spaces that represents romantic relationships as an integral part of the college experience (Abowitz & Knox, 2003; Gilmartin, 2015; Holland & Eisenhart, 1990). Therefore, in these settings, women may prioritize affirming their feminine attractiveness over other concerns—by showing an aversion to STEM and an interest in stereotypically feminine fields instead (Park et al., 2011)—in the process of choosing an academic pursuit. Hence, self-expression goals in academic choice would habitually guide the actions of these women, which may make it difficult for them to respond to a simple manipulation of economic security as the one used in the present study.

On the other hand, security goals may resonate with and guide the actions of men more so than women in these relatively privileged settings. This is because societal gender role expectations, which dictate that men, in particular, reach financial success and status, and provide for their families, remain relevant in these settings; fulfillment of these material security goals through pursuit of lucrative or high-status activities is an important and self-defining goal for men (e.g., Croft et al., 2015; Diekman et al., 2011; Morgan et al., 2001; Mullen, 2014). For instance, men from upper-class backgrounds reported considering the lucrateness of future career options extensively when choosing their majors, although women in the same setting did not (Mullen, 2014). Men from upper-class families may also face greater familial expectations than women to pursue prestigious careers that would allow them to maintain their social status (Ma, 2009).



Furthermore, achievement of security goals through pursuit of stereotypically masculine and lucrative STEM fields can increase men's mating value in these settings, as it signals bright prospects for maintaining a privileged social status in the future (Eastwick et al., 2014).

The discussion on the gendering of self-expression and security goals suggests that in relatively privileged US settings, security goals may guide academic choices of men more strongly than women. Although results of the current study are consistent with this speculative explanation, replication of these results is necessary for further interpretation.

### **Study 2: Promotion and Prevention Focus**

The aim of Study 2 was to provide a conceptual replication of Study 1 by testing Hypothesis 1 again, using a regulatory focus (i.e., promotion and prevention focus) manipulation. In addition, this study extended Study 1 by examining the effect of self-expression and security goals on interest in other lucrative fields such as Business. Women are underrepresented particularly in leadership roles in Business fields, as negative stereotypes about women's leadership abilities persist (Eagly & Karau, 2002; Emerson & Murphy, 2015; Schein, 1973, 1975). Nevertheless, participation of women in Business and related fields has steadily increased in the US in recent decades, to a larger extent than participation of women in most STEM fields has (Diekmann et al., 2010). Researchers have proposed that these patterns differ because stereotypes about STEM fields uniquely portray these fields as unfavorable to communal career goals that women tend to value (e.g., working with and helping people, serving the society, Diekmann et al., 2010). Business and STEM are similar, however, in that both have the potential to lead to

lucrative and high-status careers. In other words, Business fields, like STEM fields, have the potential to fulfill security goals. In light of these characteristics, I tested whether Hypothesis 1 would be supported in the case of Business interest and motivation also.

Finally, I explored whether the manipulation might affect interest in and motivation to pursue stereotypically feminine fields that are not commonly very lucrative, such as Social Sciences and Humanities (Carnevale et al., 2015). Stereotypes portray these fields as affording the fulfillment of communal goals (Diekmann et al., 2010). Most of these fields show gender parity in participation, and some are relatively female-dominated, in the US (NSB, 2016). Given these characteristics, I explored whether the manipulation might affect Social Science interest and motivation in a different way than it might affect STEM (and Business) interest and motivation.

### **Regulatory Focus: Prevention and Promotion**

Regulatory focus refers to the strategies that individuals use to progress toward a desired end-state, or goal, and away from an undesired reference point (Higgins et al., 1994). One possible strategy that an individual can use is to approach states that match her/his desired end-state; another possible strategy is to avoid states that do not match the desired end-state (Crowe & Higgins, 1997). Researchers refer to regulatory focus (i.e., promotion and prevention focus) to differentiate between these two types of self-regulation that people commonly engage in. Promotion focus is an approach strategy, which orients individuals toward advancement, growth, and accomplishment, whereas prevention focus is an avoidance strategy, which orients individuals toward security, safety, and responsibilities (Crowe & Higgins, 1997). Individuals may habitually engage in one type of self-regulation strategy more so than the other; for instance, security-

oriented parenting is likely to instill prevention focus in children (Higgins, 1997).

However, prevention or promotion focus can also be induced temporarily in a given situation when it serves the accomplishment of a desired end-state (Crowe & Higgins, 1997).

Based on the literature on regulatory focus, promotion focus and prevention focus are conceptually similar to an orientation toward self-expression or security goals. Self-expression goals that concern self-fulfillment and growth through expression of the inner self are likely to be associated with the activation of promotion focus. Security goals that concern fulfilling obligations and expectations arising from one's social roles and relationships, particularly regarding material security, are likely to be associated with the activation of prevention focus. Therefore, in Study 2, I used regulatory focus as an alternative way of activating self-expression and security goals.

## **Method**

**Participants.** I recruited 284 participants (107 men, 175 women, and 12 missing,  $M_{age} = 19.24$ ,  $SD_{age} = 2.96$ ) through the participant pool of our university. Participants received partial course credit for completing the survey. Data collection continued throughout one academic semester, and data were accessed and analyzed at the end of that time frame. Most participants identified as White/Caucasian (71.1%), 13.3% identified as Asian, 4.8% as Latino, 4.4% as African American/Black, and 3% as mixed race or with other racial/ethnic categories.<sup>4</sup> Fifty-four participants indicated pursuing a STEM major, 35 were Social Science or Humanities majors, and 81 indicated majoring in Business or related fields (Finance, Marketing, or Economics).

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<sup>4</sup> Subjective social standing was not measured in this study due to an error.

**Manipulation of regulatory focus.** At the beginning of the study, participants were randomly assigned to a promotion focus, prevention focus, or control condition. To manipulate regulatory focus, I adopted an existing method (e.g., Kirmani & Zhu, 2007; Pham & Avnet 2004). In the promotion focus condition, participants read a prompt asking them to think about the hopes, dreams, and aspirations they had in the past and those that they currently have, and list two examples of each. In the prevention focus condition, participants read a prompt asking them to think about the duties, obligations, and responsibilities they had in the past and those that they currently have, and list two examples of each. In the control condition, participants briefly wrote about their typical day and their ideal day.

**Measures.** After the manipulation, all participants completed a questionnaire. All items were measured using 7-point Likert-type scales.

***STEM interest and motivation.*** I used six items to measure STEM interest and motivation. The items were, “I am interested in Technology-related [Math and Science / Engineering] fields” and “If I could choose any career to pursue in the future, I would choose a Technology-related [Math and Science / Engineering] career.” I computed the mean of all six items to create a composite variable ( $\alpha = .80$ ).

***Business interest and motivation.*** I measured interest in and motivation to pursue Business-related fields using two items. The items were “I am interested in Economics / Marketing / Business Administration” and “If I could choose any career to pursue in the future, I would choose a career in Economics / Marketing / Business Administration.” I computed the mean of both items to create a composite variable ( $r = .89$ ).

**Social Science interest and motivation.** I assessed interest in and motivation to pursue Social Sciences and Humanities using four items. The items were “I am interested in Social Sciences [Humanities]” and “If I could choose any career to pursue in the future, I would choose a Social Sciences [Humanities] career.” I computed the mean of all four items to create a composite variable ( $\alpha = .84$ ).

**Demographic variables.** Participants indicated their age and gender, and identification with racial category and current major in an open-ended format.

## Results

To test Hypothesis 1, I conducted 3 (Manipulation: Promotion Focus, Prevention Focus, Control)  $\times$  2 (Gender: Male, Female) ANCOVAs on each set of interest and motivation variables (STEM, Business, and Social Science), with current major (STEM: 1, Other: 0 / Business-related: 1, Other: 0 / Social Science: 1, Other: 0, in the respective analyses) as a control variable.

**STEM interest and motivation.** The main effect of current major on STEM interest and motivation was significant,  $F(1, 273) = 72.14, p < .001, \eta^2_p = .21$ . The main effect of gender was significant,  $F(1, 273) = 12.88, p < .001, \eta^2_p = .04$ , such that men reported higher STEM interest and motivation ( $M_{adj} = 3.42, SE = .11$ ) than did women ( $M_{adj} = 2.90, SE = .09$ ). The main effect of the regulatory focus manipulation was significant,  $F(2, 273) = 5.27, p = .006, \eta^2_p = .04$ . In line with H1b, prevention focus led participants to report higher STEM interest and motivation ( $M_{adj} = 3.48, SE = .12$ ) compared to the control condition ( $M_{adj} = 3.07, SE = .12, p = .05, d = .35$ ). Promotion focus did not affect participants’ responses ( $M_{adj} = 2.92, SE = .12$ ) compared to the control condition ( $p = .7, d = -.13$ ). Contrary to H1, the interaction between gender and

the manipulation was not significant,  $F(2, 273) = 1.53, p = .2, \eta^2_p = .01$ . Nevertheless, I conducted simple effects tests to examine whether the effects of the regulatory focus manipulation across genders were consistent with the patterns observed in Study 1 (Figure 4). The effect of the manipulation was marginal among women and significant among men,  $F_s(2, 273) = 2.75$  and  $3.78, p_s = .06$  and  $.02, \eta^2_{ps} = .02$  and  $.03$ . In keeping with Study 1, promotion focus led women to report slightly lower STEM interest and motivation ( $M_{adj} = 2.62, SE = .15$ ) compared to the control condition ( $M_{adj} = 2.98, SE = .15, p = .27, d = -.23$ ), although this effect was not significant. Unlike Study 1, promotion focus did not affect men's STEM interest and motivation ( $M_{adj} = 3.23, SE = .19$ ) compared to the control condition ( $M_{adj} = 3.17, SE = .18, p = .99, d = .05$ ).

In keeping with Study 1, prevention focus did not affect women's responses ( $M_{adj} = 3.10, SE = .14$ ) compared to the control condition ( $p = .92, d = .10$ ). However, prevention focus did lead men to report higher STEM interest and motivation ( $M_{adj} = 3.86, SE = .21$ ) compared to the control condition ( $p = .03, d = .60$ ).

I also examined the simple effects of gender within each condition. The gender difference in STEM interest and motivation was not significant in the control condition,  $F(1, 273) = .61, p = .44, \eta^2_p = .002$ , but significant in both the prevention and promotion conditions,  $F_s(1, 273) = 9.04$  and  $5.93, p_s = .003$  and  $.016, \eta^2_{ps} = .03$  and  $.02$ .

These patterns seem to be partially consistent with Study 1. However, since the interaction between gender and the manipulation was not significant, these patterns should be interpreted with caution.

**Business interest and motivation.** The main effect of current major on Business interest and motivation was significant,  $F(1, 273) = 131.20, p < .001, \eta^2_p = .32$ . The main

effect of gender was significant,  $F(1, 273) = 7.64, p = .006, \eta^2_p = .03$ , such that men reported higher Business interest and motivation ( $M_{adj} = 4.71, SE = .16$ ) than did women ( $M_{adj} = 4.14, SE = .12$ ). The main effect of the manipulation was not significant,  $F(2, 273) = 1.97, p = .14, \eta^2_p = .01$ . The analysis revealed the hypothesized (H1) interaction between gender and the manipulation,  $F(2, 273) = 3.85, p = .02, \eta^2_p = .03$  (Figure 5).

I conducted simple effects tests to decompose the interaction. The effect of the manipulation was not significant among women, but it was significant among men,  $F_s(2, 273) = 1.49$  and  $3.94, p_s = .22$  and  $.02, \eta^2_{ps} = .01$  and  $.03$ . Still, I conducted simple contrasts among women, as well as men, to examine whether the pattern of effects were consistent with the previous findings. Women reported slightly lower Business interest and motivation in the promotion focus condition ( $M_{adj} = 3.86, SE = .21$ ) compared to the control condition ( $M_{adj} = 4.27, SE = .21, p = .4, d = -.27$ ), although this pattern was not significant. Conversely, promotion focus led men to report marginally higher Business interest and motivation ( $M_{adj} = 4.97, SE = .27$ ) compared to the control condition ( $M_{adj} = 4.13, SE = .25, p = .063, d = .53$ ).

Prevention focus did not affect women's responses ( $M_{adj} = 4.30, SE = .20$ ) compared to the control condition ( $p = .99, d = .02$ ). However, prevention focus led men to report higher Business interest and motivation ( $M_{adj} = 5.04, SE = .28$ ) compared to the control condition ( $p = .046, d = .58$ ).

I examined the simple effects of gender within each condition as an alternative way of probing the interaction. The gender difference in STEM interest and motivation was not significant in the control condition,  $F(1, 273) = .18, p = .67, \eta^2_p = .001$ , but

significant in both the prevention and promotion conditions,  $F_s(1, 273) = 4.59$  and  $9.93$ ,  $p_s = .033$  and  $.002$ ,  $\eta^2_{ps} = .017$  and  $.035$ .

**Social Science interest and motivation.** The effect of current major on Social Science interest and motivation was significant,  $F(1, 271) = 28.35$ ,  $p < .001$ ,  $\eta^2_p = .09$ . The effect of gender was significant,  $F(1, 271) = 18.15$ ,  $p < .001$ ,  $\eta^2_p = .06$ , such that men reported lower Social Science interest and motivation ( $M_{adj} = 3.38$ ,  $SE = .16$ ) than did women ( $M_{adj} = 4.25$ ,  $SE = .12$ ). Neither the manipulation nor the interaction between gender and the manipulation had an effect on Social Science interest and motivation,  $F_s(2, 271) = .008$  and  $.082$ ,  $p_s = .9$ ,  $\eta^2_{ps} = .00$ .

## Discussion

Study 2 aimed to replicate and extend Study 1 by testing the effect of experimental activation of an orientation toward growth and accomplishment (i.e., promotion focus), or obligations and responsibilities (i.e., prevention focus) on interest in and motivation to pursue STEM, as well as Business and Social Science fields. The pattern of findings for STEM and Business interest and motivation generally did not contradict H1a, but did not show strong support, either. Responses to the promotion focus were consistent with H1a in the case of Business fields, although the positive effect on men was the only significant pattern. The findings partially supported H1b. Prevention focus led participants to show greater STEM interest and motivation; however, this effect seemed to be driven primarily by men's responses to the manipulation. Prevention focus did also have the hypothesized positive effect on Business interest and motivation among men, but not among women. One important caveat is that the sample size in this study was smaller than Study 1 due to constraints of the participant pool, which yielded even



lower power (.67) to detect the hypothesized interaction effects between gender and the manipulation for an anticipated small effect size. This analysis suggests that the chance of detecting an effect in this study that actually exists in the population (i.e., correctly rejecting the null hypothesis) was lower than what is commonly considered acceptable in social science research (Faul et al., 2007). Alternatively stated, it is possible for the hypothesized interaction effect to exist in the larger population but not be captured in this particular study due to low sample size. A replication of the study with adequate power (i.e., with a sample size of at least  $N = 387$ ) would yield results that one can interpret with greater certainty.

The effects of the manipulation on STEM interest and motivation were generally small in this study, which may be a function of the manipulation itself. The regulatory focus manipulation was not specifically targeting activation of personal fulfillment or economic security goals, but focusing more broadly on hopes and aspirations (promotion focus) or general responsibilities and obligations (prevention focus). Participants may have interpreted these in various ways. For instance, in their open-ended responses to the promotion focus prompts, many participants cited aspirations regarding financial or academic/career pursuits in addition to aspirations regarding family/relationships and hobbies/traveling, among others. Thus, it is possible for the manipulation to have activated a broad range of goals for the participants, some of which are related to security concerns rather than self-expression. This might explain why the promotion focus condition in particular did not yield the same effects that the self-expression condition did in the previous study.

Based on the exploratory analyses, the manipulation had no effect on Social Science interest and motivation. One might expect women in particular to show greater interest in these relatively female-dominated fields when promotion goals are active. It is unclear why no such pattern emerged in this sample. However, the results do show that prevention focus did not lead men to report higher interest in just any field (e.g., Social Sciences), but only in lucrative, male-dominated fields.

One pattern that consistently emerged across the two studies is that activation of security goals (or prevention focus) had the hypothesized positive effect on men's, but not women's, STEM and Business interest and motivation. These findings likely reflect the characteristics of the present samples, as opposed to revealing a universal experience of women. Participants in both studies were majority-White, middle- or upper middle-class, American, university students. These participants come from relatively privileged settings within the US society based on racial and social class background. In these settings, self-expression and security goals may be gendered, such that the tendency to prioritize self-expression resonates with women, whereas security goals also habitually figure in academic choices of men. This could explain why a simple manipulation of security goals (or prevention focus) did not have the intended effect on women's academic interests and motivation in Studies 1 and 2. The replication of this pattern across Studies 1 and 2 suggests that it warrants further attention.

### **Study 3: Gendering of Security Goals**

The pattern of results documented in Studies 1 and 2 suggest that self-expression and security goals may resonate with and guide the academic interests and motivation of men and women to differing extents. Specifically, security goals may play a role in the

academic choices of men more so than women in relatively privileged settings. In Study 3, I examined the role of self-expression and security goals in academic choice across genders using a correlational design. I assessed perceived enjoyableness and perceived lucrateness of various academic fields to test the hypothesis (H2) that gender will interact with perceptions of lucrateness and enjoyableness of each field, such that women and men will differ in their ratings of enjoyableness of STEM, Business, and Social Science fields, but not in their ratings of lucrateness. More specifically, women will consider stereotypically masculine STEM and Business fields as less enjoyable than do men, but Social Sciences as more enjoyable than do men. However, both women and men will consider STEM and Business fields to be more lucrative than Social Sciences. I then tested the role of these perceptions in STEM and Business interest and motivation as a function of participant gender. Based on the results of Studies 1 and 2, as well as the previous literature, the extent to which an academic pursuit is interesting and enjoyable (i.e., fulfills self-expression goals) is likely to play a role in both women's and men's academic choices; however, the extent to which an academic pursuit is lucrative and profitable (i.e., fulfills security goals) is likely to matter particularly for men's choices. Specifically, (H3) perceived enjoyableness will positively predict STEM (and Business) interest and motivation among all participants; however, (H4) perceived lucrateness will interact with gender, such that it will positively predict STEM (and Business) interest and motivation among men but not women. I also conducted exploratory analyses to predict Social Science interest and motivation.

## Method

**Participants.** Power analyses indicated that 256 participants would yield a power of .80 to test the significance of single regression coefficients in a regression with 8 predictors. I targeted university students on Mechanical Turk using a survey ad and was able to recruit 250 participants. After the elimination of those who indicated that they were not university students at the beginning of the survey and were thus excused from the study, the sample consisted of 241 university students (122 male, 114 female, 5 missing,  $M_{age} = 26.11$ ,  $SD_{age} = 7.01$ ) through by targeting. Most participants identified as White/Caucasian (70.1%), 9.1% identified as Hispanic/Latino, 9.1% as African American/Black, 5.4% as Asian, and 4.6% as mixed race or with other racial/ethnic categories. Mean subjective social standing was  $M = 5.09$ ,  $SD = 1.85$ .

**Measures.** After the manipulation, all participants completed a questionnaire. All items were measured using 7-point Likert-type scales, except subjective social standing.

**Perceived enjoyableness.** In order to assess how much participants perceived various academic fields to provide opportunities to fulfill self-expression goals, I asked them to rate the extent to which they considered each of a set of 12 fields to be enjoyable. They responded to the item, “Please rate whether you think each of the fields are enjoyable (i.e., have the potential to lead to enjoyable jobs and interesting careers) or not”. I created composite perceived enjoyableness and perceived lucrateness scores for the STEM ( $\alpha = .87$ ), Social Sciences/Humanities ( $\alpha = .81$ ), and Business ( $r = .60$ ) categories by computing the mean ratings of each field in the respective category.<sup>5</sup>

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<sup>5</sup> The composite variables for perceived enjoyableness and lucrateness of Social Science/Humanities included an education field. The analyses did not change when the education field was removed from the analyses, so it was kept in.

***Perceived lucrateness.*** In order to assess how much participants perceived various academic fields to provide opportunities to fulfill material security goals, I asked them to rate the extent to which they considered each of the same 12 fields to be practical or lucrative. They responded to the item, “Please rate whether you think each of the majors below are practical/lucrative (i.e., have the potential to lead to well-paid jobs and good careers) or not”. I created composite perceived enjoyableness and perceived lucrateness scores for the STEM ( $\alpha = .81$ ), Social Sciences/Humanities ( $\alpha = .84$ ), and Business ( $r = .49$ ) categories by averaging the ratings of each field in the respective category.<sup>6</sup>

***STEM interest and motivation.*** I used two items to measure STEM interest and motivation. The items were, “I am interested in Science and Technology-related fields” and “If I could choose any career to pursue in the future, I would choose a Science and Technology-related career.” I computed the mean of both items to create a composite measure ( $r = .86$ ).

***Business interest and motivation.*** I used two items to measure Business interest and motivation. The items were, “I am interested in Business Administration/Economics /Finance” and “If I could choose any career to pursue in the future, I would choose a Business Administration/Economics/Finance career.” I computed the mean of both items to create a composite measure ( $r = .88$ ).

***Social Science interest and motivation.*** I used two items to measure STEM interest and motivation. The items were, “I am interested in Social Sciences and

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<sup>6</sup> Although the bivariate correlations between the perceived lucrateness (and similarly, perceived enjoyableness) ratings of Business and Economics fields were low, I used the composite variable(s) in the analyses that follow. Interpretations of analyses using these variables should be mindful of this shortcoming.

Humanities” and “If I could choose any career to pursue in the future, I would choose a Social Sciences and Humanities career.” I computed the mean of both items to create a composite measure ( $r = .68$ ).

**Demographic variables.** As in the previous studies, participants indicated their gender, age, racial category identification, current major, and subjective social standing.

## Results

To test H2, I conducted a 2 (Gender: Male, Female)  $\times$  2 (Perception: Perceived Enjoyableness, Perceived Lucrativeness)  $\times$  3 (Field: STEM, Business, Social Science) mixed model ANOVA with Perception and Field as within-subjects variables. To test H3 and H4, I conducted separate linear multiple regression analyses on each academic interest and motivation variable (STEM, Business, and Social Science) with current major of participants (STEM: 1, Other: 0 / Business: 1, Other: 0 / Social Science: 1, Other: 0, for the respective analyses), gender (Male: 0, Female: 1), perceived enjoyableness, perceived lucrativeness, all possible two-way interaction terms and the three-way interaction term between the perception variables and gender as predictors.<sup>7</sup>

**Perceived enjoyableness and lucrativeness.** Ratings of perceived enjoyableness and lucrativeness of each field as a function of gender appear in Tables 3 and 4. As hypothesized (H2), the repeated-measures ANOVA revealed a three-way interaction between gender, perception, and field,  $F(1, 234) = 8.63, p = .004, \eta^2_p = .04$ . Men and women differed in their perceptions of enjoyableness of each field, such that men rated STEM and Business fields as more enjoyable ( $M_s = 4.48$  and  $3.97, SD_s = 1.32$  and  $1.47$ ) than did women ( $M_s = 3.72$  and  $3.56, SD_s = 1.50$  and  $1.60, F_s(234) = 17.09$  and  $4.39, p_s$

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<sup>7</sup> All continuous variables were mean-centered in regression analyses.

= .00 and .037,  $\eta^2_{ps} = .07$  and .02), and Social Science fields as less enjoyable ( $M = 4.18$ ,  $SD = 1.42$ ) than did women ( $M = 4.52$ ,  $SD = 1.33$ ,  $F(234) = 3.58$ ,  $p = .06$ ,  $\eta^2_p = .015$ ). However, men and women did not differ in their perceptions of lucrateness of STEM, Business, or Social Science fields,  $F_s \leq .47$ ,  $p_s \geq .5$ . Participants considered STEM fields as more lucrative ( $M = 5.55$ ,  $SD = 1.02$ ) than both Business ( $M = 5.14$ ,  $SD = 1.19$ ,  $p = .00$ ,  $d = .37$ ) and Social Science fields ( $M = 3.08$ ,  $SD = 1.23$ ,  $p = .00$ ,  $d = 2.2$ ), and Business fields as more lucrative than Social Science fields ( $d = 1.7$ ).

**STEM interest and motivation.** The linear regression model predicting STEM interest and motivation was significant,  $F(8, 227) = 20.85$ ,  $p < .001$ ,  $R^2_{adj} = .40$ . The analysis revealed current major ( $\beta = .38$ ,  $t(227) = 7.03$ ,  $p < .001$ , CI [1.077, 1.916]) and gender ( $\beta = -.16$ ,  $t(227) = -2.96$ ,  $p = .003$ , CI [-.974, -.195]) as significant predictors of STEM interest and motivation. As hypothesized (H3), perceived enjoyableness emerged as a positive predictor ( $\beta = .34$ ,  $t(227) = 5.65$ ,  $p < .001$ , CI [.284, .589]). The hypothesized (H4) interaction between perceived lucrateness and gender was not significant, ( $\beta = -.09$ ,  $t(227) = -1.57$ ,  $p = .12$ , CI [-.370, .042]); however, the analysis revealed a significant three-way interaction between perceived lucrateness, gender, and perceived enjoyableness ( $\beta = .30$ ,  $t(227) = 2.82$ ,  $p = .005$ , CI [.180, 1.02]).

To probe the three-way interaction, I conducted linear multiple regression analyses among men and women separately with current major, perceived enjoyableness, perceived lucrateness, and the interaction between the perception variables as predictors of STEM interest and motivation. Among men, the model was significant,  $F(4, 117) = 24.71$ ,  $p < .001$ ,  $R^2_{adj} = .44$ . The analysis revealed current major ( $\beta = .44$ ,  $t(117) = 6.24$ ,  $p < .001$ , CI [.455, 1.842]) and perceived enjoyableness ( $\beta = .45$ ,  $t(117) = 5.43$ ,  $p <$

.001, CI [.343, .738]) as significant predictors of STEM interest and motivation. As hypothesized (H4), perceived lucrateness emerged as a significant positive predictor ( $\beta = .20$ ,  $t(117) = 2.83$ ,  $p = .005$ , CI [.098, .553]). However, the analysis also revealed a significant interaction between perceived lucrateness and perceived enjoyableness, (Figure 6;  $\beta = -.19$ ,  $t(117) = -2.36$ ,  $p = .02$ , CI [-.636, -.056]).

To decompose the interaction between perceived lucrateness and perceived enjoyableness, I conducted simple slope tests.<sup>8</sup> Simple slope tests revealed that among male participants who reported high enjoyableness of STEM fields (1 SD above the mean), perceived lucrateness did not relate to STEM interest and motivation ( $b = -.02$ ,  $SE = 0.17$ ,  $t(117) = -.1$ ,  $p = .9$ ). However, among male participants who reported low enjoyableness (1 SD below the mean), STEM interest and motivation increased as a function of perceived lucrateness ( $b = .67$ ,  $SE = .20$ ,  $t(117) = 3.35$ ,  $p = .001$ ). Regions of significance tests revealed that the difference in STEM interest and motivation between low and high levels of perceived enjoyableness disappeared at .88 SD above the mean of perceived lucrateness.

Among women, the model was significant,  $F(4, 109) = 12.12$ ,  $p < .001$ ,  $R^2_{adj} = .28$ . The analysis revealed current major ( $\beta = .36$ ,  $t(109) = 4.13$ ,  $p < .001$ , CI [.863, 2.456]) and perceived enjoyableness ( $\beta = .25$ ,  $t(109) = 2.93$ ,  $p = .004$ , CI [.107, .553]) as significant positive predictors of STEM interest and motivation. However, in line with H4, perceived lucrateness was not a significant predictor, ( $\beta = -.003$ ,  $t(109) = -.03$ ,  $p = .9$ , CI [-.353, .341]). The interaction between perceived enjoyableness and perceived

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<sup>8</sup> For all the simple slope tests I report, I used an online tool developed by Preacher and colleagues (Preacher, Curran, & Bauer, 2006).



lucrative-ness did not reach conventional levels of statistical significance ( $\beta = .17$ ,  $t(109) = 1.75$ ,  $p = .08$ , CI [-.032, .523]).

As hypothesized (H3), perceived enjoyableness emerged as a significant positive predictor of STEM interest and motivation among men and women alike; however, again as hypothesized (H4), perceived lucrative-ness was a significant predictor among men only. The latter finding was qualified by an interaction with perceived enjoyableness, such that perceptions of lucrative-ness played a positive role in STEM interest and motivation particularly among men who reported not finding STEM very enjoyable.

**Business interest and motivation.** The linear regression model predicting Business interest and motivation was significant,  $F(8, 227) = 17.63$ ,  $p < .001$ ,  $R^2_{adj} = .36$ . The analysis revealed current major ( $\beta = .28$ ,  $t(227) = 5.15$ ,  $p < .001$ , CI [.764, 1.710]), gender ( $\beta = -.13$ ,  $t(227) = -2.44$ ,  $p = .02$ , CI [-.930, -.098]), and perceived enjoyableness ( $\beta = .38$ ,  $t(227) = 4.57$ ,  $p < .001$ , CI [.274, .690]) as significant predictors of Business interest and motivation, whereas perceived lucrative-ness was not a significant predictor, ( $\beta = .06$ ,  $t(227) = .87$ ,  $p = .4$ , CI [-.129, .332]). The hypothesized (H4) interaction between gender and perceived lucrative-ness was not significant, ( $\beta = .05$ ,  $t(227) = .74$ ,  $p = .45$ , CI [-.274, .608]). None of the other predictors reached statistical significance,  $t_s \leq .97$ ,  $p_s \geq .3$ .

As hypothesized (H3), the analysis showed that perceived enjoyableness was a significant positive predictor of Business interest and motivation among men and women alike; however, contrary to H4, perceived lucrative-ness did not emerge as a significant predictor among men.

**Social Science interest and motivation.** The linear regression model predicting Social Science interest and motivation was significant,  $F(8, 227) = 21.31, p < .001, R^2_{adj} = .41$ . The analysis revealed current major ( $\beta = .43, t(227) = 8.25, p < .001, CI [1.382, 2.248]$ ), gender ( $\beta = .11, t(227) = 2.06, p = .04, CI [.017, .734]$ ), perceived enjoyableness, ( $\beta = .24, t(227) = 4.04, p < .001, CI [.149, .432]$ ), and perceived lucrateness ( $\beta = .18, t(227) = 3.24, p = .001, CI [.100, .411]$ ) as significant predictors of Social Science interest and motivation. The interaction between perceived enjoyableness and lucrateness was significant (Figure 7;  $\beta = -.19, t(227) = -2.64, p = .009, CI [-.531, -.077]$ ). None of the other predictors reached statistical significance,  $ts \leq 1.68, ps \geq .095$ .

To decompose the interaction between perceived enjoyableness and perceived lucrateness, I conducted simple slope tests. Simple slope tests revealed that among participants who reported high enjoyableness of Social Science fields (1 SD above the mean), perceived lucrateness did not relate to Social Science interest and motivation ( $b = -.21, SE = .16, t(227) = -1.35, p = .2$ ). However, among participants who reported low enjoyableness (1 SD below the mean), Social Science interest and motivation increased as a function of perceived lucrateness ( $b = .73, SE = .19, t(227) = 3.81, p < .001$ ). Regions of significance tests revealed that the difference in Social Science interest and motivation between low and high levels of perceived enjoyableness disappeared .3 SD above the mean of perceived lucrateness.

## Discussion

The extent to which individuals believe various fields are enjoyable and lucrative are likely to figure in their decision of what to study in college. Whereas perceived enjoyableness of careers in a field relates to self-expression goals, perceived lucrateness

relates to security goals. Study 3 provided evidence that these goals may be gendered; they figure in men's and women's academic interest and motivation in different ways in this particular sample, which shows similar characteristics with the samples in the previous studies in terms of racial and social class background.<sup>9</sup>

As hypothesized, men and women differed in the extent to which they considered STEM, Business, and Social Science as enjoyable, but agreed that STEM are the most lucrative and Social Sciences are the least lucrative of these fields. Among women and men alike, perceived enjoyableness positively predicted interest and motivation in all three fields. Not surprisingly, in general, individuals showed interest in academic fields that they find enjoyable.

The role of perceived lucrateness in academic interest and motivation seems to be more complex. In the case of STEM interest and motivation, perceived lucrateness was a significant predictor among men, but not among women. The analyses further revealed that the positive relationship between perceived potential of STEM fields to fulfill security goals (i.e., lucrateness) and STEM interest and motivation only emerged among men who did not report enjoying STEM much. This suggests that dislike for the subject matter of STEM may not turn men away from these fields, given that STEM pursuit has the potential to satisfy security goals. However, among women, perceptions of lucrateness did not predict STEM interest and motivation. Instead, liking or enjoyment seemed to matter for women's academic interests.

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<sup>9</sup> The samples are similar in terms of racial composition across all three studies; however, participants in Study 3 reported slightly lower subjective social standing ( $M = 5.09$ ,  $SD = 1.85$ ) than those in Study 1 ( $M = 6.58$ ,  $SD = 1.59$ ). The sample in Study 2 is likely to be similar to Study 1 in this sense, given they were collected from the same university participant pool.

Exploratory analyses on Social Science interest and motivation showed that perceptions of lucrateness positively predicted interest in these fields among participants who did not find the subject matter particularly enjoyable. Unlike the case of STEM fields, perceived lucrateness may be playing a role in women's interest and motivation when it comes to a female-dominated field. Female participants may be interpreting the implications of lucrateness of STEM and Social Science differently, such that high lucrateness of a relatively female-dominated field that they generally enjoy may figure in women's interest as a positive factor, whereas it may not matter for a male-dominated field that they tend to enjoy less. Since the analyses with Social Sciences were exploratory, this pattern should be interpreted with caution.

Finally, for Business interest and motivation, perceived lucrateness did not emerge as a significant predictor for either gender. One shortcoming of this analysis to keep in mind is the low reliability of the perceived lucrateness and perceived enjoyableness measures. Furthermore, it is difficult to label Business fields as strictly masculine, given their changing gender composition. Therefore, it is unclear how women and men might interpret the implications of lucrateness in the case of Business fields.

Overall, Study 3 provides some insight into the varying role of self-expression and security goals in academic interest and motivation across genders in this particular sample. The pattern of findings for STEM interest and motivation, whereby lucrateness does not seem to figure in women's interest, is in keeping with the findings of Studies 1 and 2, where women did not show higher STEM interest and motivation in response to security goals (or prevention focus).

## General Discussion

As the present paper documents, gender inequality in STEM persists in high development settings with relatively high levels of overall gender equality, where women are generally liberated in their choices and enjoy freedom in academic and professional life. Interestingly, smaller gender discrepancies in STEM attitudes and participation emerge in several national settings that rank lower in terms of societal development and fare worse in terms of overall gender equality. A cultural psychological perspective suggests that different constructions of academic choice that are prevalent in these settings may explain these patterns of variation in gender gaps. Specifically, self-expression values (and opportunities to express the self through free choice) are generally more prevalent in high development settings, which afford an understanding of academic choice as a means to express the unique self. On the other hand, material security values are more prevalent in developing settings, which afford an understanding of academic choice as a means to achieve security goals. This analysis suggests the general hypotheses that cultural construction of academic choice as self-expression can lead women away from, and men toward pursuit of stereotypically masculine STEM fields, whereas cultural construction of academic choice as a means to achieve material security can lead both men and women toward these lucrative fields.

Although these hypotheses are derived from an analysis of gender gaps in STEM fields across nations that vary in levels of societal development and gender equality, the present research does not provide a direct test of the relationship between these macro-level variables and gender gaps in STEM. Instead, the present research examines the role of different constructions of academic choice in academic interest and motivation among

individuals within the US. More specifically, in a given situation, if individuals prioritize expressing their interests, dreams, and passions (i.e., self-expression goals), which typically reflect the imprint of gender socialization, they are likely to diverge in their motivation to pursue gender stereotypical fields such as STEM, as a function of their gender. In contrast, if individuals prioritize concerns about material security such as financial or relational obligations and responsibilities (i.e., security goals), they are likely to lean toward lucrative or practical academic choices regardless of their gender. In this paper, I provided an empirical test of these hypotheses.

In Study 1, self-expression goals led women to report less interest in STEM, whereas they led men to report greater interest in these fields. Study 2 partially replicated these patterns for STEM, and showed that they extend to Business fields, as well. When considered jointly, the findings of both studies provide some initial support for the hypothesis that academic interests and motivation of women and men tend to diverge in response to a construction of academic choice as self-expression. A more consistent pattern emerged with regards to security goals (or prevention focus). Security goals led men to show greater interest in STEM and Business fields, whereas they did not affect women's responses. This pattern suggests that security goals can motivate men to choose lucrative and masculine fields; however, boosting women's interest in these fields through activation of security concerns may not be a straightforward undertaking.

To explain these findings, Study 3 tested whether material security goals may be gendered in a particular way in relatively privileged, hegemonic (White, middle-class) American spaces that most participants in Studies 1 and 2 came from. Not surprisingly, perceived enjoyableness played a positive role in academic interest and motivation

among men and women alike. However, whereas perceived lucrateness figured in men's STEM interest and motivation, particularly when they did not find the subject matter inherently appealing, it did not seem to figure in women's responses. These findings suggest that material security concerns may simply not be relevant to the academic interests of women in these relatively privileged samples, since they can potentially forgo concerns about security and focus on enacting self-expression goals instead. Alternatively, even though women might care about security and acknowledge certain fields as lucrative, they might assume that pursuing STEM or Business is unlikely to be a good way for them to fulfill security goals. For instance, women may believe that they could not succeed in reaching a high-status and well-paid position within STEM fields anyways.

To summarize, the present studies provided initial evidence that self-expression and security goals may influence academic interest and motivation differently among men and women. Importantly, findings of all three studies highlight that sociocultural factors (e.g., different understandings of the meaning and purpose of academic choice) underlie both women's and men's interest in STEM (and potentially other fields).

### **Limitations and Future Directions**

Replication of the present studies is necessary to yield more confident interpretations than the current data allow. One caveat to keep in mind when interpreting the current findings is that the manipulations used in Studies 1 and 2 were different. The manipulation in Study 1 activated self-expression or security goals by focusing on the considerations students need to take into account when choosing their major. Although this manipulation gets directly at different constructions of choice, the wording of the

texts (e.g., use of need/should phrases) may have led to perceived experimenter demand. The regulatory focus manipulation in Study 2 was intended as a conceptual replication of Study 1 that is less directly relevant to academic choice. However, what participants focused on in the promotion condition in Study 2 (hopes, aspirations, dreams) may not exactly map onto personal fulfillment (self-expression condition in Study 1); what participants focused on in the prevention condition in Study 2 (duties, obligations, and responsibilities) may not exactly map onto economic security and financial stability (security condition in Study 1). The regulatory focus manipulation can lead to a wider variety of responses, and activate multiple goals at once. This might explain some of the non-significant effects observed in Study 2. Future research could use varieties of the constructions of academic choice manipulation that specifically target self-expression and security goals, which make up the core of the present hypotheses. Furthermore, interestingly, in both Studies 1 and 2, the gender gap in STEM (and Business) interest and motivation was not significant in the control condition, unlike Study 3. It is unclear why this might have been the case; however, it is important to keep in mind that this pattern may partly underlie the observed interaction between gender and the manipulation on STEM interest and motivation in Study 1 and on Business interest and motivation in Study 2.

One limitation of the present research is that important potential moderators such as gender identification and self-stereotyping were not included. It is possible for people who are more strongly identified with their gender category or who show a greater tendency to self-stereotype as a member of their gender category to report more gender-stereotypical responses when self-expression goals are active. It is also possible for



gender identification to interact with security goals among men, in particular, as those who are highly identified with their gender category may show a stronger respond to the activation of security goals by indicating higher levels of STEM interest and motivation. Relatedly, the manipulation is likely to be less effective on people who do not strongly identify with their gender category, or those who do not identify with either gender category. Future research could examine these potential moderators.

Another limitation of the present research is that the measures of interest and motivation vary slightly between the studies. It is unclear whether participants' responses to STEM (as well as Business and Social Science) interest and motivation items might change based on whether items refer to a single category (Math- and Science-related or Science- and Technology-related fields), multiple sub-categories (Math and Science, Technology, and Engineering fields) or each field individually. Study 3 assessed perceptions of enjoyableness and lucrateness of a subset of the wide range of fields of study that make up STEM, Social Sciences/Humanities, and Business-related fields, but did not cover all or even most of them. Thus, in some cases, the items did not have high reliability when used as a composite measure (e.g., Business items). Future research could use more comprehensive measures of perceptions of and interest in academic fields.

The main focus of the current research was on gender gaps in STEM; particularly the analyses on Social Science outcomes were exploratory. Further research is necessary to unpack the role of self-expression and security goals in interest in fields that are not as strongly gender-stereotyped as STEM tends to be, and those that vary in level of lucrateness.

Finally, the patterns that these studies documented are unlikely to reflect a universal experience of women. The participants in these studies were majority-White, middle- or upper middle-class, American, university students. These participants represent a relatively privileged portion of the US society based on racial and social class background. An important direction for future work is to examine the role of self-expression and security goals in academic interest and motivation in different cultural settings, both across and within nations.

### **Theoretical Implications**

**Considering self-expression and security goals across settings.** As discussed earlier, the present research suggests that self-expression and security goals may be gendered in particular ways within hegemonic, American spaces. In these settings, women may have the liberty to act primarily based on self-expression when making academic choices (e.g., Mullen, 2014). For men in these settings, however, fulfilling security goals is also quite important; these goals figure in their academic choices to a larger extent than women's (Croft et al., 2015; Mullen, 2014).

The relevance of self-expression and security goals for students may vary across cultural settings. For instance, pursuit of dreams and passions in career choice may be a foreign idea to people in various parts of the world (e.g., Gharibyan & Gunsaulus, 2006), and may not be effective in guiding their academic interests and motivation. Furthermore, these sets of goals may not be gendered in the same way in different national settings. For instance, research from India and Malaysia with female participants shows that these women did carefully consider availability of jobs and lucrative careers when making their academic decisions (Gupta, 2012; Lagesen, 2008; Varma, 2009). Therefore, security

goals may indeed play a role in the academic choices of women in these settings.

Furthermore, even within the US, self-expression and security goals may have different implications outside of predominantly White, middle-class settings. For instance, these goals may affect individuals in predominantly African American settings in different ways. One reason why that might be the case is that African American communities construct femininity differently than do hegemonic, White understandings. Whereas hegemonic constructions of masculinity and femininity regard traits such as strength, resilience, assertiveness, and self-reliance as masculine, African American constructions regard these traits as compatible with femininity (Cole & Zucker, 2007; Hanson, 2004; Harris, 1996; Settles, 2006). African American women rate such traits as more self-descriptive than White women do, and as equally self-descriptive as African American men do (Harris, 1996). This is relevant for the current discussion, as stereotypes commonly associate these same characteristics with STEM pursuit (Carli et al., 2016). Therefore, in predominantly African American spaces, STEM pursuit may be understood as compatible with femininity, as opposed to its portrayal as a strictly masculine domain common in hegemonic understandings. In keeping with this argument, gender gaps in STEM outcomes are smaller within African American than White spaces. For instance, African American women report more positive attitudes toward science and higher confidence in STEM domains, show lower implicit stereotypical associations between STEM and males, and are more likely to choose a STEM major than White women do (Hanson, 2004; Litzler, Samuelson, & Lorah, 2014; O'Brien et al., 2014; Riegle-Crumb & King, 2010). These data suggest that for African American women, showing an interest in STEM may well be compatible with expressing the (female) self.

Therefore, experimental activation of self-expression goals may not steer African American women away from STEM pursuit, as it did White women in the current samples.

Furthermore, given that African American settings are generally less privileged within the society, it is possible for security goals to habitually figure in both men's and women's academic choices more so than concerns about chasing dreams and passions, which people in these settings may not afford to prioritize. Thus, African American women may be more likely than White women to take security goals into consideration when making academic choices; their choices may not diverge much from men's. Therefore, female (as well as male) participants in an African American sample may respond to security goals by showing greater interest in STEM like men (but not women) did in the present studies.

This discussion suggests that a cultural psychological perspective is useful to uncover the affordances that shape the meaning and purpose of academic choice across various cultural ecologies. Such analyses would pave the way for a more comprehensive understanding of the sociocultural underpinnings of gender gaps in academic participation.

**Challenging androcentric standards.** An important contribution of this paper is to illustrate that men's STEM interest and motivation is not "just natural", but cultural, just like women's are. Social psychological research has successfully challenged the idea that women are innately incompetent at or averse to STEM fields by highlighting the impact of sociocultural factors such as stereotypes on women's academic experience. However, research has not focused on the factors that play a role in men's academic

experience to the same extent (see Croft et al., 2015, for a recent exception). The uneven research attention on women and men is understandable, given the severe underrepresentation of women in most STEM fields. However, the almost exclusive focus on explaining women's outcomes may inadvertently elevate men's experience in STEM domains to an unquestioned standard, or the norm (Bruckmüller & Abele, 2010; Bruckmüller, Hegarty, & Abele, 2012; Hegarty & Pratto, 2001). Investigating why women's STEM outcomes "fall short" of men in terms of STEM attitudes, participation, or performance thus implicitly sets women's experience as a deviation that requires explanation and fixing (Bruckmüller & Abele, 2010; Bruckmüller et al., 2012; Hegarty & Pratto, 2001).

One useful strategy in challenging androcentric standards is to turn the analytic lens (Adams & Salter, 2007; Salter & Adams, 2013) and take men's academic interests, performance, and choices as a phenomenon of investigation. Such an investigation allows one to challenge the assumption that men have an innate interest in or ability for STEM pursuit that women may lack, and argue instead that certain cultural forces lead men to succeed, show interest, and participate in STEM fields. For instance, men's higher performance on standardized tests might be an artifact of "stereotype lift", or a performance boost due to the awareness of gender stereotypes about ability in the relevant performance domain (Walton & Cohen, 2003). Likewise, the present research provides initial evidence for the idea that men's STEM interest has sociocultural foundations, as opposed to stemming from inherent qualities of their sex: social goals such as expressing the masculine self and fulfilling socially sanctioned goals regarding financial security can motivate men to pursue STEM fields.

**Defining liberation.** Another theoretical contribution of the present paper is questioning the assumption that societal development would automatically lead to gender equality in participation across academic/professional domains. Of course, elevation of women's overall status in the society plays a crucial role in increasing women's access to education and professional careers (Charles, 2011). However, liberation of women defined in terms of expression of the self through (presumably unconstrained) choice does not guarantee societal equality in representation in academic domains.

An understanding of liberation at the individual level defines it as the liberty to enact individual goals, passions, and desires, free of any societal constraints. This definition resonates with cultural settings that construct free choice as an expression of the authentic self (Markus & Schwartz, 2010; Savani et al., 2008; Stout et al., 2011), where the majority of psychological research takes place (Henrich et al., 2010). The present research provides initial evidence that, ironically, the constraining effects of gender stereotypes may be greater in these settings that promise the liberty to follow one's heart freely and provide the resources for individuals to do so: gender gaps in STEM interest and motivation enlarge when individuals prioritize self-expression goals. One implication of the present analysis is that, contrary to common assumptions, encouraging students to prioritize the pursuit of dream careers is unlikely to challenge the status-quo of gender inequality in participation in academic fields. Similarly, increasing the opportunities for students to exercise free choice in course selection (as opposed to limiting choice by implementing required courses) may not be a helpful strategy, particularly at earlier points in the education path, as this may give girls and women the opportunity to minimize their engagement with STEM solely based on stereotypical

beliefs expectations.

### **Conclusion**

Some readers may interpret the results of the present research as evidence that gender gaps in STEM participation reflect natural or innate sex differences in personal preferences. More specifically, one can assume that larger gender differences emerge in the self-expression condition (or more generally, in cultural settings that encourage self-expression) because men are naturally inclined toward STEM, and women have a natural dislike for STEM, which simply comes out when they are encouraged to express their authentic selves. In this case, pressuring women to enter STEM fields, which they simply are not interested in by nature, may not be a justified undertaking.

Although the present studies do not provide direct evidence refuting this account, from a cultural psychological perspective, the “authentic” self that people express cannot be free of cultural influence. What people experience and express as their genuine, authentic, or true selves has inevitably been gendered throughout a lifetime of engagement with cultural forces such as gender stereotypes. In that sense, innate tendencies and societal influence are indistinguishably merged. Thus, expression of the authentic self in academic choice can, ironically, be akin to expression of gender-stereotypical academic preferences. This argument is counter-intuitive, as choosing an academic pursuit that is gender-stereotypical does not seem to be the best way of expressing one’s unique self. However, individuals can *experience* their choices as authentic, despite the fact that they have actually been culturally shaped to a large extent (Cech, 2013).

To conclude, the present research provides an insight into the patterns of variation

in gender gaps in STEM across nations through an analysis of cultural constructions of academic choice. Furthermore, the present studies provide initial evidence for the implications of constructions of academic choice as a means of self-expression or material security for the academic interest and motivation of women as well as men. The current work thus paves the way for further research on the varying meaning and purpose of choice across cultural ecologies, which has the potential to broaden our understanding of the sociocultural underpinnings of gender inequality in the academic sphere.



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Table 1

Overview of studies on cross-national variation in gender gaps in math and science attitudes

Authors	Sample (countries included)	Findings that support the development hypothesis	Findings that challenge the development hypothesis
Riegle-Crumb (2005)	$N = 47$ ; TIMSS 1995	Domestic freedom and higher representation of women in the labor force negatively predicted gender gaps in math and science attitudes (liking and enjoyment, perceived level of achievement, and aspiration to get a job in math and science).	-
Eise-Quest et al. (2010)	$N = 46$ ; $N = 41$ ; PISA 2003 and TIMSS 2003	Proportion of women in secondary and tertiary enrollment, research positions, and higher labor market positions negatively predicted gender gaps in math attitudes (valuing math, extrinsic motivation, intrinsic motivation, self-concept, self-efficacy, and math anxiety).	GEM positively predicted gender gaps in all attitude measures. Political representation of women positively predicted gender gaps in math attitudes, except math anxiety.
Charles & Bradley (2009)	$N = 44$ , UNESCO	-	Gender gaps in affinity toward math, science, and math-related careers were larger in advanced industrial countries than developing countries based on GDP.
Sikora & Pokropek (2012)	$N = 50$ ; PISA 2006	-	The size of the gender discrepancy in expecting to have a job in biology, agriculture, and health fields was larger in advanced industrial countries compared to transforming countries. Gender gap in science self-concept was larger in advanced industrial countries.
Charles et al. (2014)	$N = 53$ ; TIMSS 2003, 2007, 2011	-	The Human Development Index (a composite indicator based on life expectancy, education, and national income) and self-expressive values (e.g., interpersonal trust) positively predicted gender gaps in affinity for math and aspirations for math-related careers.

Table 2

Overview of studies on cross-national variation in gender gaps in STEM participation

Authors	Sample (countries included)	Findings that support the development hypothesis	Findings that challenge the development hypothesis
Ramirez & Wotipka (2001)	N = 67; 1972, 1982, and 1992	-	Economic development (GDP per capita) and societal development (high school enrollment ratios) did not predict women's STEM participation (ratio of women enrolled in science and engineering programs in higher education to all women in the 20-24 age cohort).
Charles & Bradley (2006)	N = 21; OECD data	-	Economic development did not relate to women's participation in computer science programs in higher education. Women's share of the labor force, women's share of professional occupations, and women's share of tertiary students were not related with to women's participation in computer science.
Charles & Bradley (2009)	N = 44; UNESCO data	Women's share of professional jobs negatively predicted gender gaps in participation in engineering.	Among developing countries, GDP was the strongest (positive) predictor of gender gaps in participation in engineering and math/natural sciences in higher education. Women's share of professional jobs did not predict gender gaps in participation in math/natural sciences.
Charles (2011a)	N = 84; UNESCO data		Most male-dominated engineering programs in Japan, Switzerland, Germany, and the US; least male-dominated ones in Mongolia, Greece, Serbia, and Panama. Representation of women in science lowest in the Netherlands and highest in Iran, Uzbekistan, Azerbaijan, Saudi Arabia and Oman.

Table 3

*Bivariate correlations between HDI, GGI and degrees conferred to women out of all degrees in science fields in higher education*

	1	2	3	4	5	6	7
1 - HDI	1	.35**	.36**	.23	-.11	-.07	.34**
2 - GGI		1	.15	-.29*	-.44**	-.05	.001
3 - Women in higher education			1	.35**	-.01	.19	.44**
4 - Women in Physics and Biology				1	.42**	.31*	.45**
5 - Women in Math and CS					1	.34**	.07
6 - Women in Engineering						1	.07
7 - Women in Social Sciences							1

\*  $p < .05$

\*\*  $p < .01$

Table 4  
*Means (and standard deviations) for STEM interest and motivation among men and women in Study 1*

STEM Interest & Motivation	Men	Women
Control	3.65 (2.04)	3.68 (2.07)
Self-expression	4.46 (1.65)	2.98 (2.14)
Security	4.29 (2.04)	3.66 (2.25)

Table 5  
*Means (and standard deviations) for STEM, Business, and Social Science interest and motivation among men and women in Study 2*

		Men	Women
STEM Interest & Motivation	Control	3.35 (1.38)	2.87 (1.55)
	Promotion	3.24 (1.15)	2.49 (1.19)
	Prevention	4.15 (1.49)	3.05 (1.27)
Business Interest & Motivation	Control	4.83 (1.87)	4.07 (2.08)
	Promotion	5.74 (1.28)	3.43 (2.03)
	Prevention	5.13 (1.75)	3.93 (1.95)
Social Science Interest & Motivation	Control	3.33 (1.36)	4.39 (1.77)
	Promotion	3.12 (1.56)	4.32 (1.82)
	Prevention	3.34 (1.75)	4.26 (1.77)

Table 6  
*Means (and standard deviations) for STEM, Business, and Social Science interest and motivation among men and women in Study 3*

	Men	Women
STEM Interest & Motivation	5.36 (1.58)	4.27 (1.95)
Business Interest & Motivation	4.29 (1.84)	3.58 (2.02)
Social Science Interest & Motivation	3.96 (1.65)	4.83 (1.64)

Table 7

*Means (and standard deviations) for perceived enjoyableness ratings of academic fields among men and women*

		Men	Women
STEM	Electrical Engineering*	4.35 (1.83)	3.66 (1.90)
	Computer Science*	5.12 (1.65)	4.10 (1.87)
	Information Technology*	4.80 (1.54)	4.20 (1.86)
	Physics*	3.99 (1.72)	3.25 (1.67)
	Industrial Engineering*	4.12 (1.72)	3.42 (1.79)
	Overall*	4.24 (1.32)	3.72 (1.50)
Social Science / Humanities / Education	Sociology*	4.03 (1.76)	4.60 (1.65)
	Philosophy	4.41 (1.85)	4.37 (1.83)
	English Language and Lit.	4.17 (1.84)	4.66 (1.84)
	Art History	4.16 (2.00)	4.54 (1.95)
	Early Childhood Education	4.11 (1.85)	4.41 (1.77)
	Overall	4.18 (1.42)	4.52 (1.33)
Business	Economics*	3.90 (1.61)	3.35 (1.70)
	Business Administration	4.06 (1.71)	3.76 (1.85)
	Overall*	3.97 (1.47)	3.56 (1.60)

\*Significant gender difference ( $ps < .05$ ).

Table 8

*Means (and standard deviations) for perceived lucrativeness ratings of academic fields among men and women*

		Men	Women
STEM	Electrical Engineering	5.78 (1.38)	5.68 (1.35)
	Computer Science	5.93 (1.28)	5.83 (1.33)
	Information Technology	5.93 (1.25)	5.78 (1.29)
	Physics	4.63 (1.52)	4.64 (1.53)
	Industrial Engineering	5.64 (1.23)	5.69 (1.36)
	Overall	5.58 (.99)	5.52 (1.07)
Social Science / Humanities / Education	Sociology	3.47 (1.55)	3.40 (1.55)
	Philosophy	2.66 (1.56)	2.78 (1.67)
	English Language and Lit.	2.99 (1.45)	3.06 (1.69)
	Art History	2.35 (1.45)	2.64 (1.69)
	Early Childhood Education	3.73 (1.62)	3.86 (1.51)
	Overall	3.04 (1.18)	3.15 (1.28)
Business	Economics	4.88 (1.49)	4.99 (1.30)
	Business Administration	5.34 (1.35)	5.38 (1.38)
	Overall	5.11 (1.27)	5.19 (1.11)

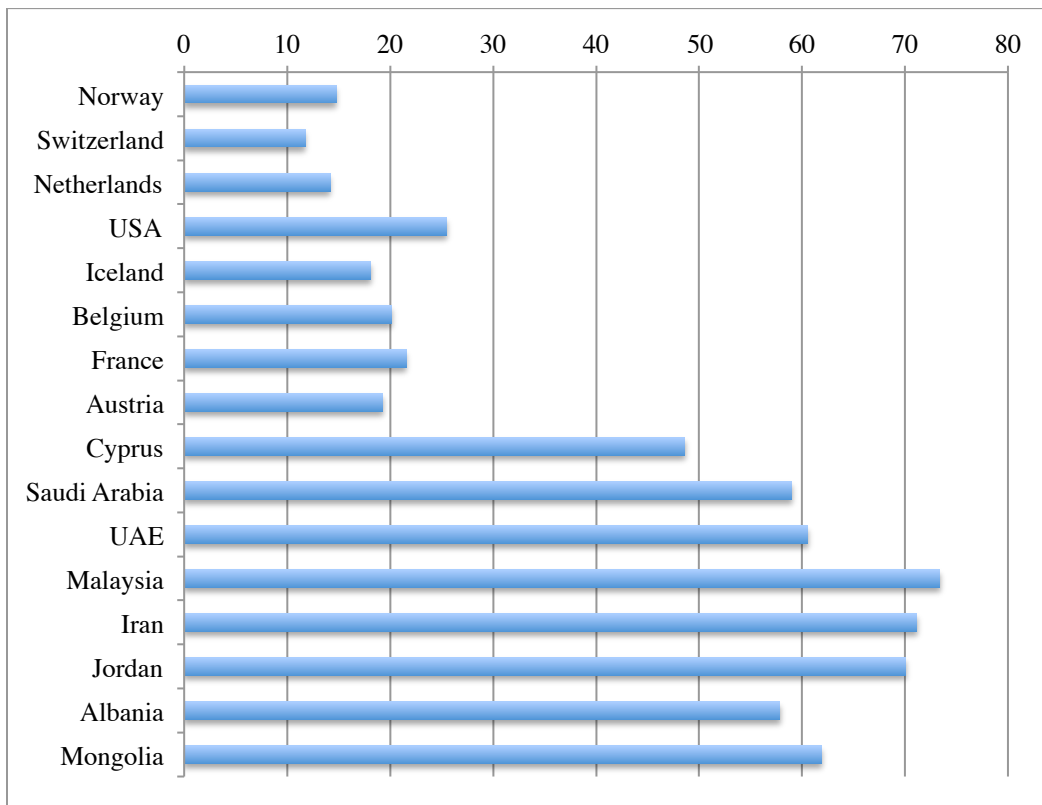


Table 9

*Correlations between STEM, Business, and Social Science interest & motivation, and perceived lucriveness and enjoyableness of each field*

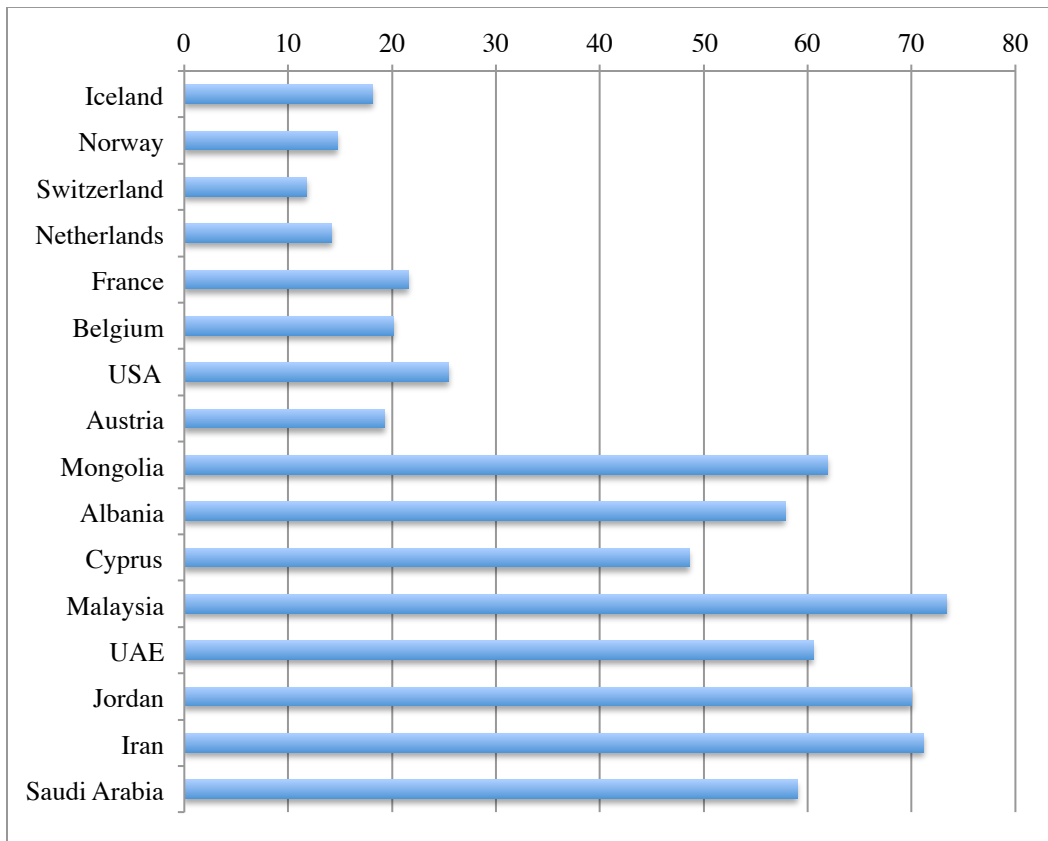
	STEM motiv	Business motiv	Soc Sci motiv	STEM enjoy	STEM lucrative	Soc Sci enjoy	Soc Sci lucrative	Business enjoy	Business lucrative	SSS
STEM motiv	1	-.11	-.34	.49**	.22*	-.11	-.07	.07	-.08	-.05
Business motiv	.12	1	.00	.07	.03	-.04	-.00	.48**	.21*	.1
Soc Sci motiv	-.41**	-.06	1	-.39**	-.13	.43**	.28**	-.08	.11	.05
STEM enjoy	.40**	.26**	-.15	1	.24**	-.03	.16	.48**	.09	.01
STEM lucrative	.04	-.12	.04	.17	1	.05	-.07	.05	.53**	-.02
Soc Sci enjoy	-.22*	-.07	.37**	.14	.20*	1	.43**	.16	.19*	.14
Soc Sci lucrative	.03	.13	.22*	.34**	-.05	.24*	1	.30**	.24**	.14
Business enjoy	.14	.56**	-.08	.61**	-.03	.13	.33**	1	.27**	.16
Business lucrative	-.17	.15	.21*	-.01	.50**	.23*	.20*	.17	1	-.05
SSS	.16	.14	-.07	.11	-.08	-.18	-.02	.08	-.33	1

Notes. Correlations for men appear above the diagonal; correlations for women appear below the diagonal. "SSS" denotes subjective social standing.



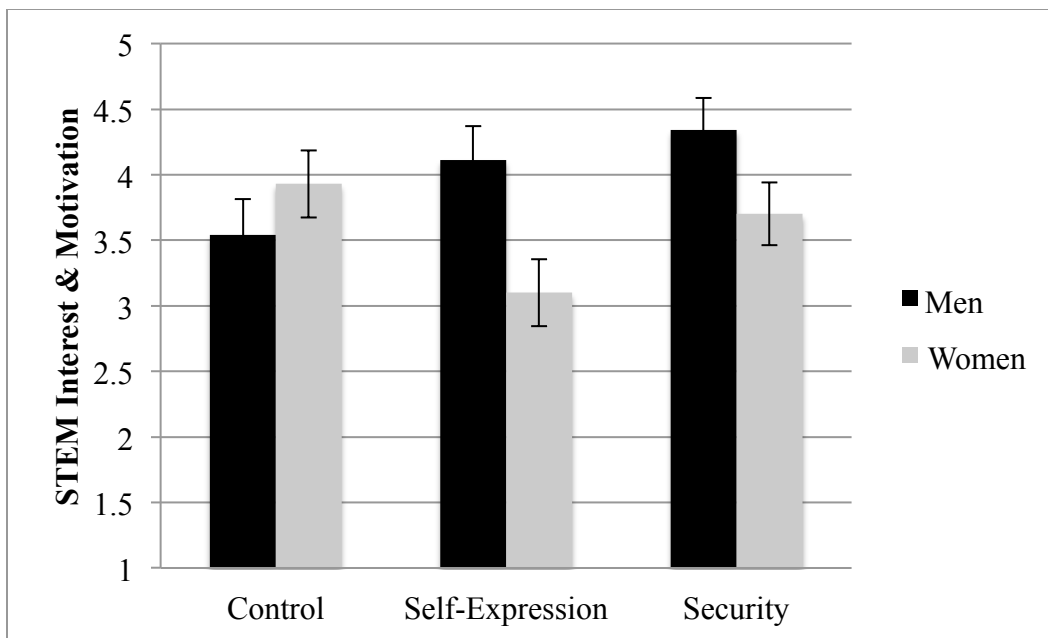
*Figure 1.* Percentage of women in math and computer science fields across countries ranked by levels of human development.

Notes. The measure of human development used to rank the countries is the Human Development Index (HDI), which includes economic development, educational attainment, and life expectancy. Data on women's participation are obtained from National Science Board (2016); HDI rankings are obtained from United Nations Development Programme (2015).

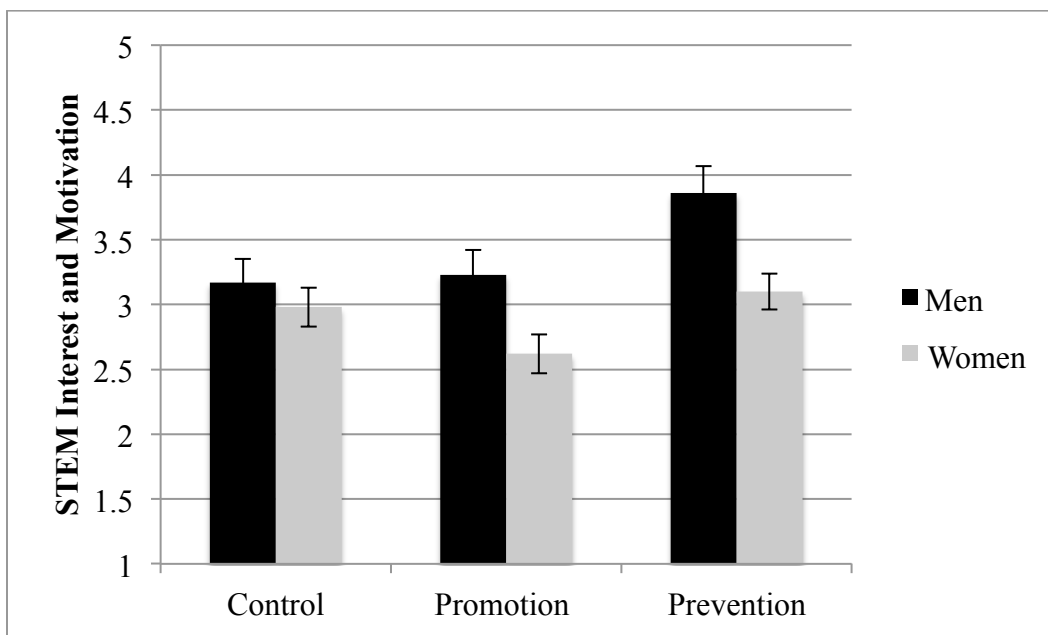


*Figure 2.* Percentage of women in math and computer science fields across countries ranked by levels of gender equality.

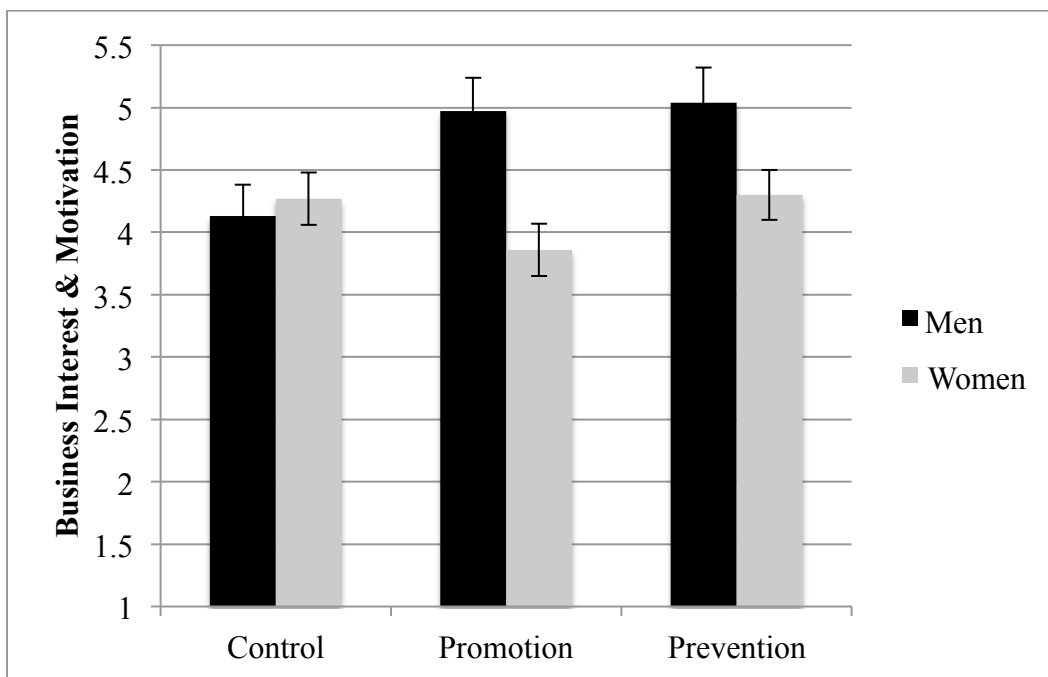
Notes. The measure of gender equality used to rank the countries is the Gender Gap Index (GGI). Higher values indicate greater gender equality across the domains of health, education, economics, and politics. Data on women's participation are obtained from National Science Board (2016); GGI rankings are obtained from World Economic Forum (2016).



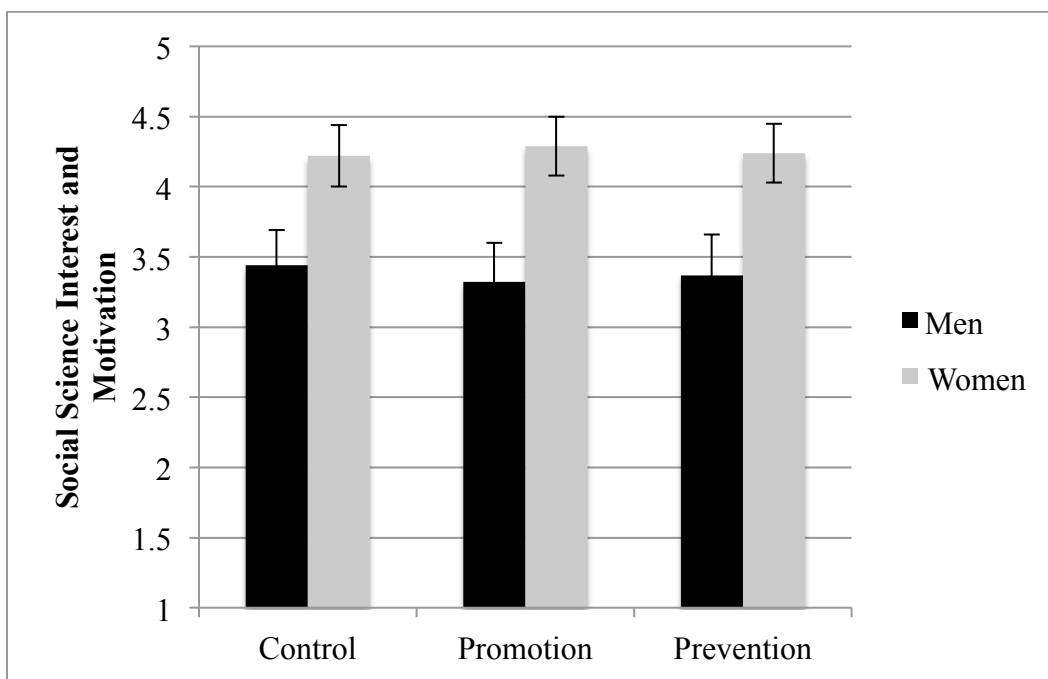
*Figure 3.* The effect of the construction of academic choice manipulation on STEM interest and motivation as a function of gender in Study 1.



*Figure 4.* The effect of the regulatory focus manipulation on STEM interest and motivation as a function of gender in Study 2.



*Figure 5.* The effect of the regulatory focus manipulation on Business interest and motivation as a function of gender in Study 2.



*Figure 6.* The effect of the regulatory focus manipulation on Social Science interest and motivation as a function of gender in Study 2.

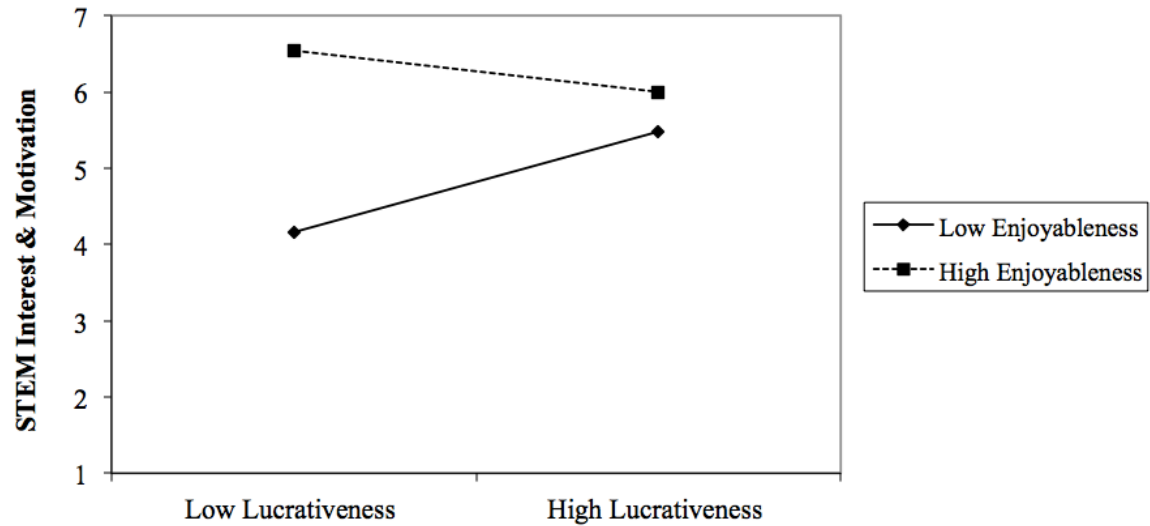
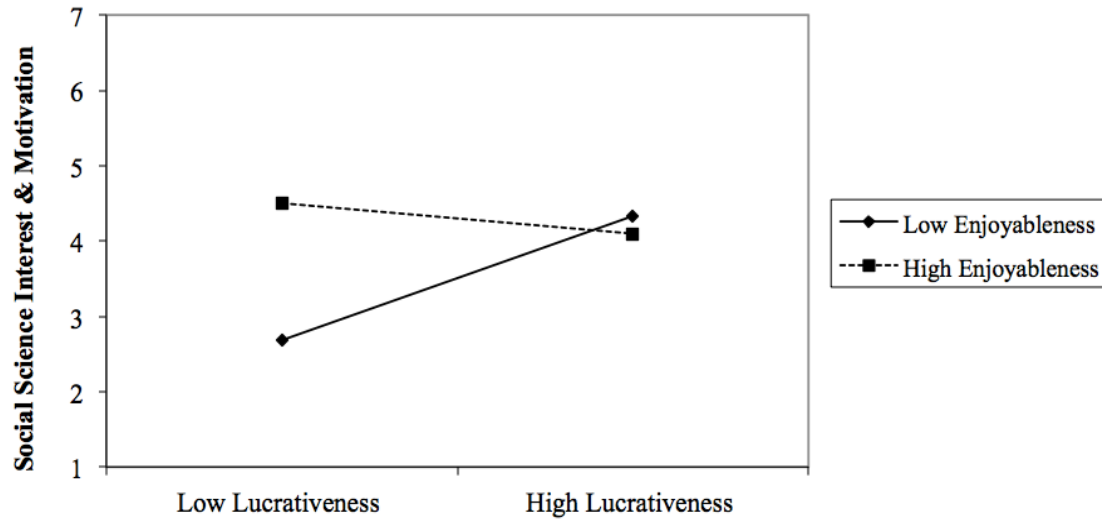


Figure 7. The interaction between perceived lucrativeness and perceived enjoyableness on STEM interest and motivation among men in Study 3.

Note. Low and high levels of enjoyableness are plotted at 1 SD below and above the mean, respectively. Simple slope is significant for low enjoyableness ( $b = .67$ ,  $SE = .20$ ,  $t(117) = 3.35$ ,  $p = .001$ ), but not for high enjoyableness  $b = -.02$ ,  $SE = 0.17$ ,  $t(117) = -.1$ ,  $p = .9$ ).





*Figure 8.* The interaction between perceived lucrativeness and perceived enjoyableness on Social Science interest and motivation in Study 3.

Note. Low and high levels of enjoyableness are plotted at 1 SD below and above the mean, respectively. Simple slope is significant for low enjoyableness ( $b = .73$ ,  $SE = .19$ ,  $t(227) = 3.81$ ,  $p < .001$ ), but not for high enjoyableness ( $b = -.21$ ,  $SE = .16$ ,  $t(227) = -1.35$ ,  $p = .2$ ).

## **Appendix A: Manipulation of Constructions of Academic Choice (Study 1)**

### **Self-expression Condition:**

“When choosing academic majors and careers, people often need to keep in mind various considerations. Of course, one of the most important considerations is personal fulfillment. The college experience provides a valuable period for students to discover and experience their true passions, and has important implications for their personal life in the future. Students need to follow their hearts and consider whether the career path they choose will provide them with opportunities for personal growth and self-expression.”

### **Security Condition:**

“When choosing academic majors and careers, people often need to keep in mind various considerations. Of course, one of the most important considerations is future economic security. Students invest substantial amounts of time and money into their education, and they often emerge from college with a burden of debt or without any savings. Students need to consider whether the career path they choose will provide them with economic resources and financial stability in order for them to have good life standards in the future.”

### **Control Condition:**

“When choosing academic majors and careers, people often need to keep in mind various considerations.”

## **Appendix B: Manipulation of Regulatory Focus (Study 2)**

### **Promotion Condition:**

“Please think about the hopes, aspirations, and dreams you currently have. List and briefly explain two of them.”

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“Please think about the hopes, aspirations, and dreams you currently have. List and briefly explain two of them.”

---

### **Prevention Condition:**

“Please think about the duties, obligations, and responsibilities you currently have. List and briefly explain two of them.”

---

“Please think about the duties, obligations, and responsibilities you currently have. List and briefly explain two of them.”

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### **Control Condition:**

“Please think about your typical day. Briefly explain how you spend a typical day, what you do, where you go, etc.”

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“Please think about your ideal day. Briefly explain how you would spend it, what you would like to do, where you would like to go, etc.”

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