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Original Research

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# What a Difference a Decade Makes. The Evolving Gender Gap in Students' Goal Endorsement and STEM Career Choice

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## Abstract

Two national datasets of first-year college students, collected a decade apart, asking the same questions about career interests and life goal endorsement, allowed us to investigate the extent to which the life goals and career interests had converged among young men and women. We compared the gender differences in four types of goal endorsement (communal, material, intellectual, and free-time goals) by career interest groups (science, engineering, medicine, health, and other professions) between the two cohorts (2007 vs. 2017). Conversely, we compared the gender differences in career interests by goal endorsement between the two cohorts. Our specific focus was on science, technology, engineering, and mathematics (STEM) career interests. We found that significant differences have stubbornly persisted between male and female students preparing for STEM careers, particularly in the area of communal goals, whereas gender differences in communal, material, and intellectual goals have narrowed or disappeared for those interested in many non-STEM careers.

**Keywords**: *gender gap; generational comparison; goal endorsement; career interest; STEM*

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## Introduction

Over the decade between 2007 and 2017, there have been important developments in the economy and the labor force, but also cultural shifts, particularly in eroding the traditional dichotomy of gender socialization and encouraging girls to enter previously male domains and *vice versa*. In the science, technology, engineering, and mathematics (STEM) fields, for example, there has been a concerted effort to broaden participation and attract more females (Blackburn, 2017). Responding to a consistently observed gender difference in goal endorsement (with females more strongly endorsing communal goals, defined as the desire to help others and work with others), many of these initiatives emphasized communal goals in STEM in hopes of making STEM more attractive to girls before college (Diekman et al., 2017). Studies also showed that, within STEM careers, the gender gap in communal goal endorsement has been wide and tenacious (Eagly & Diekman, 2003; Gati & Perez, 2014; Twenge, 1997, 2001).

Two large national surveys of first-year college students (in the fall semester) in the U.S., separated by a decade, that asked identical questions about students' goal endorsement and career interests, provided the opportunity to examine the stability or malleability of the college-going cohorts' goal endorsements and of their relationships to career intentions. It is important to study the development of career-related and gender-related goal orientations between cohorts to understand how the population adapts its value system to large-scale societal trends. This study may also provide guidance as to how to effectively create incentive measures to attract the younger generation to certain careers and to narrow the gender gap.

## Literature

### Theoretical Frameworks

Our work can capitalize on the consilience of two major theoretical frameworks: the expectancy–value theory and the social-cognitive-career theory. Both theories posit a gendered association between life goals and career choices. Both theories also imply the malleability of the two constructs over time.

Expectancy–value theory, in a nutshell, posits that people tend to engage in a task if they think that it is enjoyable and has value and if they expect that they will be able to successfully perform it (Eccles, 2009). This theory has been widely applied to explain various task choices as influenced by the values (i.e., enjoyable, successful, useful) and success probabilities that individuals attach to them (Chen et al., 2020; Eccles et al., 1999; Luscombe et al., 2013; Sullins et al., 1995). Regarding the prediction of career choices, this theory emphasizes career choice as the vehicle for a person to achieve personal life goals. This theory further explains gender differences in career choices as a consequence of the different and stereotypical goals and roles that men and women acquire through socialization (Eccles et al., 1999). According to Eccles (2009), stereotypically gendered goals and roles are malleable over the course of an individual's life. These stereotypes are enhanced when a gender role is highlighted during a specific period of time or life event (i.e., preschool, adolescence, college/major choices, family formation, etc.) (Ruble et al., 2006). On the other hand, individuals may question stereotypes and adjust values and goals as they become more consciously aware of the limiting and discriminatory nature of stereotypical gender roles (Eccles & Bryan, 1994). This malleability of gendered life goals exists at the individual level as well as at the generational level. As social norms gradually render the gender stereotypes attached to specific careers less salient (Markus & Nurius, 1986), or as people collectively challenge traditional gender norms to the point that they shift towards new (e.g., feminist) gender norms (Eccles, 2009), we may observe the gender gaps narrow in both goal endorsement and career choice. We may also observe that the association between goal endorsement and career choice changes between generations as traditional stereotypes may have become less popular (e.g., "Are students who are interested in communal goals now more likely to be interested in science careers, compared with their counterparts ten years ago?").

Similarly, the social cognitive career theory posits that an individual's career choice is influenced by his/her efficacy, outcome expectations, and personal goals (Lent & Brown, 2002). Later development of this theory included a subjective well-being component constituted by the affective, cognitive, behavioral, and social aspects of job satisfaction that interact with career choices (Lent & Brown, 2008). This theory is primarily interested in predicting career choice. However, it also theorizes a reciprocal relationship between career choice and personal goals (Lent & Brown, 2019). It stresses the importance of the prior experience through which people assess their efficacy in completing a task and of the individuals' estimate of whether engaging in such a task brings them the sense of well-being that they deem important. The social cognitive career theory explains the underrepresentation of women in STEM fields as the consequence of family, school, and social environments providing unsupportive STEM learning experiences to women, which in turn compromises their science identity and science efficacy (Byars-Winston & Rogers, 2019; Hardin & Longhurst, 2016; Lent et al., 2018). This consequently reinforces their perception that STEM does not fulfill their personal goals (Lent et al., 2005). This theory also proposes that the recent social and educational movements that have strengthened the support for, and reduced barriers to, women in the STEM fields may cause a new generation of young women to feel a greater affinity for STEM careers (Chen et al., 2019; Lent et al., 2018).

## Association Between Goal Endorsement and Career Choices

In alignment with much of the career goal literature (Diekman et al., 2011; Eagly & Karau, 2002; Eccles, 2009), this study distinguishes between **communal goals** (desiring to care for, and work with, other people), **material goals** (desiring money, social power, and status), **intellectual goals** (desiring to acquire, develop, and use one's knowledge), and **free-time goals** (desiring free time for oneself and for one's family). Many studies (reviewed below) have reported associations between these life goal endorsements and career choices (particularly regarding STEM careers), with these associations often differing by gender.

### Communal goals

Communal goals encompass an orientation toward caring about and working with other people (Bakan, 1966). Women, on average, more strongly endorse communal goals than do men (Lippa, 1998; Su & Rounds, 2015). In a meta-analysis, Konrad et al. (2000) showed communal goals to have the largest gender difference among job attribute preferences. An epidemic stereotypical belief implicitly and explicitly held among the populations of western countries is that STEM careers are incompatible with communal goals (Carli et al., 2016; Diekman et al., 2011; Fuesting & Diekman, 2017). Many scholars identify this stereotype as a key reason that fewer women than men choose STEM careers (Diekman et al., 2010, 2017).

### Material goals

Material goals in this study were defined as an endorsement of the importance of monetary reward, social power, and status (Ros et al., 1999). They were mostly masculine-stereotyped "self-focused" goals. Other studies often include these goals under the category of agentic orientation (Abele & Wojciszke, 2014; Ridgeway, 2001; Rudman & Glick, 2008). However, agentic orientation also includes the motivation for mastery and competence, which this study separately investigated under the category of intellectual goals. Hence, we did not adopt the frequently used term "agentic." Males (both boys and adult men) were found to be more interested than females in jobs offering high monetary rewards (Hayes et al., 2018; Konrad et al., 2000; Weisgram et al., 2010); men also were more interested in leadership roles, which are traditionally deemed congruent with men's social roles (Neff et al., 2007) and incongruent with women's roles (Eagly & Karau, 2002). Interestingly, studies found that material goal endorsement was positively associated with career interests in mathematics-intensive fields (Eccles, 1999; Guo et al., 2018), which may partly explain the underrepresentation of women in math-intensive fields (Diekman et al., 2015).

### Intellectual goals

Intellectual goals are aspirations to acquire and develop one's knowledge and to make use of one's intellectual competence. Intellectual goals are traditionally a masculine-stereotyped pursuit. The barriers women experience against developing career interests in STEM (Deemer et al., 2014), medicine (Burgess et al., 2012), and leadership positions (Hoyt & Murphy, 2016) have been partially attributed to women's stereotype-threat-induced reluctance to actualize masculine-stereotyped goals, such as intellectual goals. Social identity theory (Tajfel, 1981) and stereotype content theory (Fiske & Durante, 2016) both posit that women under stereotype threat avoid embracing intellectual goals and instead intentionally pursue feminine-stereotyped goals, such as communal goals (Tellhed et al., 2018).

**Free-time goals**

Holding free-time goals is defined as desiring free time for oneself and for one's family. It is central to the work-life balance debate in career choice theories (Bonebright et al., 2000; Schneider & Waite, 2005; Whitmarsh et al., 2007). Traditional feminine values emphasize caregiving roles that demand free time be used for family (Eccles, 2009). To fulfill this expectation, women often sacrifice their career development (Wang et al., 2015; Wang & Degol, 2017). Numerous studies have shown the endorsement of free-time goals to be negatively associated with careers that have a culture of over-work (Padavic et al., 2020), such as STEM careers (Ferriman et al., 2009; Frome et al., 2008; Weisgram et al., 2010), and professional careers, such as marketing (Smith, 2010), accounting (Crompton & Lyonette, 2011), or medicine (Keeton et al., 2007; Kiolbassa et al., 2011).

## The Changing Landscape

Most of the above review of goal endorsements and their association with career interests is grounded in traditional perspectives on gender roles and concomitant gender differences in goal endorsements. These perspectives rest on two key stereotypical assumptions: a) certain careers afford certain types of values in a fixed way, and b) the genders have largely fixed, and different, goal endorsements. Both assumptions have been challenged over the past decades.

Popular culture often holds chronic, over-simplified, and incorrect impressions of what certain careers may or may not afford for one's life goal attainment. These conceptualizations are known as goal affordance stereotypes (Diekman et al., 2011). Such stereotypes may impede (e.g., steering young people who value communal goals away from STEM professions) or facilitate (e.g., steering them toward healthcare professions) the development of certain career interests. In an experiment, Diekman and colleagues (2011) portrayed a scientist's career as either collaborative or independent. They found that female participants under the collaborative condition reported a stronger interest in science careers than did those under the independent condition. This study also indicated that goal affordance stereotypes were malleable and that, after revising such stereotypes, barriers that impede career interest development could be lifted. Based on this principle, a series of fruitful communal affordance interventions has been developed for women students (Diekman et al., 2010, 2015; Diekman & Steinberg, 2013; Smith et al., 2015) in the past decade to encourage them to develop interests in STEM careers and also to encourage those who are interested in STEM careers to think from a more communal and humanistic perspective.

Men and women have redefined their work and family roles and values over the past several decades. In the 1970s, life satisfaction was more strongly associated with career satisfaction for men than for women, but this gender difference disappeared by the late 1980s (Tait et al., 1989). From the 1990s to the 2000s, women became increasingly interested in achieving economic and social status through work (Twenge, 1997, 2000; Eagly & Diekman, 2003). From 1990 to 2010, gender differences attenuated regarding interest in executive and management roles, but widened for interests in community service or counseling—areas increasingly preferred by women (Gati & Perez, 2014).

The past decade was marked by dramatic changes in the workforce. Although the U.S. unemployment rate was similar in 2007 (5.0%) and 2017 (4.1%) (with a peak of 9.9% during the 2008–2009 recession), a tremendous amount of work has been automated (Pew Research Center, 2017). This has rendered many jobs obsolete, while creating new jobs (Acemoglu & Restrepo, 2018) that require higher levels of analytical, management, and social skills, in turn requiring greater levels of educational preparation (Pew Research Center, 2016). These new jobs may afford more opportunities for intellectual (e.g., analytic skills), material (e.g., managing skills), and communal (e.g., social skills) goals. This may also have implications for free-time goals, considering that technology has made work more efficient, but also more competitive.

Steady progress toward achieving gender equality has also occurred on the cultural, educational, and political fronts. On the cultural front, for example, between the 1980s and 2000s, among all Disney princess behaviors, 39%–47% were classified as showing masculine characteristics; in the 2010s, the number rose to 52%–62% (Hine et al., 2018).

On the educational front, first-time graduate school enrollment grew by about 2% for both men and women, with wide variation among different academic fields, according to the Council of Graduate Schools (2018). For example, enrollment in health science (excluding medicine) grew 7.3% for men and 6.8% for women; mathematics and computer sciences grew 11.1% for men and 14.7% for women; engineering grew 3.4% for men and 6.4% for women; business grew by 2.1% for men and 4.1% for women; public administration grew by 1.6% for men and 2.8% for women; enrollments in the arts, humanities, and education dropped by 1.4–1.7% for men and 1.2%–1.4% for women. In terms of doctoral-level enrollment, women's growth outpaced men's in all STEM fields as well as in business and public administration fields. At a glance, these numbers indicate that the student population is undergoing structural changes in professional and academic training, leaning toward STEM and STEM-aligned fields, with women's interest growing by a wider margin than men's in the hard sciences and advanced (doctoral) educational attainment.

On the political front, the America Competes Act, which was passed by the U.S. Congress in 2007 and reauthorized in 2010 and 2015–2016, is intended to support young women's participation in STEM careers. Increasing numbers of educational interventions have adopted a value-affirmation strategy intended to counteract and ameliorate hostile academic environments by boosting female students' sense of self-value (Brady et al., 2016).

The situation on the economic front, by contrast, has been slow-moving and even stagnant: The percentage of women working full time stayed steady at 75% from 2007 to 2017 (it dropped to 73% in the 2008–2009 recession), according to the Bureau of Labor Statistics (2017). Women's full-time wages were 80% of their male counterparts' in 2007 (Bureau of Labor Statistics, 2008). This percentage grew only slightly to 82% by 2017 (Bureau of Labor Statistics, 2018).

The abovementioned evolving landscape of the workforce, social roles, and cultural and political discourse is theoretically captured by the gender convergence hypothesis. Originally, the gender convergence hypothesis was proposed to conceptualize the observed convergence in expectations and self-concepts between boys and girls as they grow older (Fredricks & Eccles, 2002; Jacobs et al., 2002). This hypothesis was recently borrowed by scholars in generational studies (e.g., Goodkind et al., 2009) to propose that women's behavior, both positive (e.g., financial independence, intellectual pursuits) and negative (e.g., violence, alcohol consumption), is becoming similar to men's because, generationally, 1) women are socialized to be more masculine (Garbarino, 2006; Moen et al., 2009; Prothrow-Stith & Spivak, 2005), and 2) alterations in the labor market have introduced greater temporal flexibility regarding the career–family balance, allowing women to increase their participation in the workforce (Goldin, 2014; McMunn et al., 2015).

## Research Questions

Most of the generational comparisons in gender studies, for pragmatic human-resource-related reasons, primarily focused on career (or college major) choices as the outcome of interest (e.g., Blackburn, 2017; Hilton & Lee, 1988; Huang et al., 2020; National Science Foundation, 2018; Valian, 1999). Nevertheless, both expectancy-value theory and social cognitive career theory posit a reciprocal relationship between career choice and personal goal endorsement that may also place goal endorsement as the outcome of interests. Under the social cognitive career theory framework, the fulfillment of one's career goals constitutes one's lifelong well-being (Lent & Brown, 2008). The expectancy-value theory further specifies the individual's occupational pursuit as the vehicle to achieve personal goals (Eccles, 2009). Therefore, in this study we are interested in gender convergence in both career choice and goal endorsement. We further argue that these two constructs should not be studied separately. Instead, we should examine the change in the gendered associations between the two constructs. For example, do men and women who are interested in science careers value communal goals differently? If so, has this science-career-specific gender gap in communal goals changed between cohorts? Given a specific communal goal endorsement for men and women, what is the likelihood of science career interests? Has this relationship changed for men and women between cohorts? The answers to these questions may inform us about what the current generation of youth wishes to achieve in their lives by choosing a specific career and what roles the commonly observed life goals play in the career decision-making process of the current generation of youth. The change in such patterns for each gender may also inform us about the malleability of the gendered stereotypes that often couple specific life values with specific careers.

In this study, we compared the endorsement of communal, material, intellectual, and free-time goals by various career interest groups (science, engineering, health, medicine, and non-SEHM [nonscience, engineering, health, medicine]), by gender and by cohort (2007 vs. 2017). In other words, we predicted students' goal endorsement, using their career interest groups, gender, and cohort, while controlling for other covariates. Conversely, we predicted students' career interests as a function of their goal endorsement (hereafter the goal-career function, to differentiate it from the bilateral association) and compared these goal-career functions between gender and cohort. We asked:

> **RQ 1.1.** Did the goal endorsements of entering college students shift between 2007 and 2017 a) overall, b) by intended career, and c) by gender?
>
> **RQ 1.2.** Did the gender differences in goal endorsement within each career interest group change between 2007 and 2017? Specifically, how did any such changes within STEM compare with the corresponding changes in other career fields?
>
> **RQ 2.1.** Did the career interests of entering college students shift between 2007 and 2017 a) overall, b) by gender, and c) by goal endorsement?
>
> **RQ 2.2.** Did the goal-career function (the likelihood of a career interest as predicted by the degree of a goal endorsement) change between 2007 and 2017 for men or women who were entering college students?

According to the gender convergence hypothesis, in combination with expectancy-value theory and social cognitive career theory, which anticipate the malleability of gender differences in goal endorsement and career choices, we hypothesized that (H1-A) goal endorsement (for RQ 1.1) and STEM career interests (for RQ 2.1) may converge between genders over the decade between the two cohorts (as opposed to the null hypothesis—H1-0—of no gender convergences). The null hypotheses (H2-0) for RQ 1.2 and RQ 2.2 posit that, within a career interest group, the gender difference in a specific goal endorsement remained the same between two cohorts; and that, conversely, the gender difference in the probability of a career interest as a function of goal endorsements should remain the same between cohorts. The alternative hypotheses (H2-A) posit that such gender differences have changed (converged or widened) between cohorts. We should note that we were rather ambivalent about H2-0 and H2-A because our literature review showed that stereotypical associations between career choice and goal endorsement can be both malleable and tenacious.

## Data and Methods

### Sample

Two large national random samples (stemming from the NSF-supported projects titled *Persistence Research in Science and Engineering* and *Collaborative Research: A study of How Informal Activities Influence Female Participation in STEM*) of college students were collected in 2007 and 2017, respectively. We first stratified our samples based on a distinction between 2-year and 4-year colleges. Each of the two groups was further stratified by the size of the institution (small: 1000 to 7,789 students; medium: 7800 to 16,195 students; and large: 16,520 to 81,668 students). In each stratum, institutions were randomly selected. Institutions with an enrollment of fewer than 1,000 students were excluded. We administered our survey to students enrolled in mandatory English classes for first-year students. Because nearly all students were required to enroll in such classes, we were able to sample students who were interested in different career paths.

The 2007 sample was collected for a national study of in-class STEM activities and the 2017 sample was collected for a national study of out-of-school STEM activities. However, both surveys included the same questions about the participants' goal endorsements, career interests, and background information (the variables we used in this comparison study). The two surveys differed in the questions regarding STEM learning activities (which we did not use in this study).

**2007 sample**

In the 2007 cohort, we sampled 34 higher education institutions with 7,507 students; 56.4% of the students were enrolled at 4-year and 43.6% were enrolled at 2-year institutions. Of the participants, 41.8% attended large-sized, 26.0% attended medium-sized, and 32.2% attended small-sized institutions. Among the participants, 46.9% identified as male and 53.1% identified as female. Additionally, 35.3% identified with non-white race groups and the average SAT math score was 528 (*SD* = 126).

**2017 sample**

In the 2017 cohort, we sampled 119 institutions with 15,725 students total. Of these institutions, 63.5% were 4-year institutions and 36.5% were 2-year institutions. Of the participants, 48.4% attended large-sized institutions, while 28.5% attended medium-sized and 23.2% attended small-sized institutions. Among the participants, 45% identified as male and 55% identified as female. Forty percent identified with non-white race groups, and the average SAT score was 579 (*SD* = 121). Compared with the 2007 cohort, the 2017 cohort had higher SAT scores ($p < 0.001$). Statistically, the two samples were otherwise not significantly different from each other with respect to other variables. That the two samples differed in sample size is noteworthy because the 2017 project built upon the success of the 2007 project and was more ambitious in collecting a larger sample than the predecessor project. The unequal sample sizes, to a small extent, reduced our statistical power to detect significant differences between the cohorts, although the large numbers still afforded us high statistical power (0.89) to detect even small differences (0.05 *SD*).

## Measurement

### Career goal endorsement

Using a list of 15 items of career goal statements, the participants rated (from 1 = "not at all important" to 6 = "extremely important") the importance of each goal to them. Factor analyses showed that ten items (see Table 1) fell into four categories: communal (help others, work with other people), material (make money, become well-known, have others working under my supervision), intellectual (invent new things, develop new knowledge or skills, make use of my talent), and free-time (have lots of time for myself/friends, have lots of family time). Items that did not meet the loading threshold of 0.4 were omitted. This grouping solution was the same in both cohort samples, as shown by separate factor analyses, which yielded the same item grouping solution for the two cohort samples, with slight differences in the loading coefficients (Table 1). We computed the composite scores by calculating the unweighted average rating of the corresponding items and then standardized the average ratings to *z*-scores (mean of zero, standard deviation of 1, standardized after pooling two cohorts together).

**Table 1:** *Factor Loadings for Goal Endorsement Item ("The Importance of […] to Career Satisfaction," Rating From 1 to 6) on Each of the Four Factors. Loading Coefficients Larger Than 0.40 Are Shown in Bold*

| | Material | | Communal | | Intellectual | | Free time | |
|---|---|---|---|---|---|---|---|---|
| Cohort | 2007 | 2017 | 2007 | 2017 | 2007 | 2017 | 2007 | 2017 |
| Items (the importance of […]) | | | | | | | | |
| Money | **0.46** | **0.40** | -0.02 | -0.14 | -0.10 | -0.13 | 0.19 | 0.21 |
| Fame | **0.67** | **0.64** | 0.09 | 0.08 | 0.09 | 0.05 | -0.07 | -0.05 |
| Leading | **0.63** | **0.58** | 0.08 | 0.08 | 0.05 | 0.01 | 0.00 | 0.05 |
| Helping others | 0.02 | 0.01 | **0.66** | **0.57** | 0.10 | 0.15 | 0.01 | 0.04 |
| Working with people | 0.13 | 0.19 | **0.63** | **0.53** | -0.06 | -0.04 | 0.04 | 0.07 |
| Inventing | 0.18 | 0.18 | -0.21 | -0.21 | **0.51** | **0.49** | -0.01 | -0.01 |
| Developing new knowledge | -0.04 | -0.06 | 0.10 | 0.10 | **0.64** | **0.66** | 0.08 | 0.05 |
| Using talent | 0.00 | 0.04 | 0.21 | 0.17 | **0.40** | **0.40** | 0.09 | 0.05 |
| Time for family | -0.08 | -0.04 | 0.20 | 0.08 | 0.05 | 0.01 | **0.66** | **0.84** |
| Time for self | 0.04 | 0.07 | -0.08 | -0.12 | 0.03 | 0.02 | **0.79** | **0.67** |

**Career interest**

Participants reported their career interest at the end of high school by choosing one of 24 items (e.g., astronomy, business, health profession, medicine, engineering). These careers were divided into the following larger groups:

- Science ("astronomer," "chemist," "biologist," etc.)
- Engineering ("engineer," "computer programmer/IT specialist")
- Medicine ("medical doctor")
- Health (health professional")
- Non-SEHM (all other careers, such as "businessperson," "lawyer").

In case of multiple mentions in the career interest, we prioritized science > engineering > medicine > health > non-SEHM. For example, if a participant chose both chemistry and physician, he/she would be placed into the Science interest group.

According to this categorization, 54.0% of the 2007 cohort and 58.8% of the 2017 cohort were in the non-SEHM group; 12.2% of the 2007 cohort and 13.0% of the 2017 cohort were in the science group; 11.8% of the 2007 cohort and 7.3% of the 2017 cohort were in the engineering group; 11.0% of the 2007 cohort and 9.1% of the 2017 cohort were in the health group; and 11.0% of the 2007 cohort and 11.7% of the 2017 cohort were in the medicine group. Statistically significant differences occurred between the two cohorts in the proportion of engineering (dropped by 4.5%, $p < 0.001$) and non-SEHM (increased 4.8%, $p < 0.001$) from 2007 to 2017.

**Background information**

A key background variable of interest was gender. In addition to the above data, we collected a list of background information to control for variables such as race/ethnicity, parental education, if any parent had a STEM-related profession, and SAT total scores.

### Analysis

First, treating goal endorsement as the outcome variable, for each of the four-goal endorsement factors, we estimated a regression model that predicted goal endorsement from career interest, gender, and cohort, while controlling for other background variables. For each factor, we first specified a model with only main effects (e.g., Communal.Main). We then included all two-way interaction and three-way interaction terms between career interest group, cohort, and gender (e.g., Communal.Full) to examine the change of the gender gap in goal endorsement between cohorts within each career interest group.

Second, we treated career choice, a categorical variable with five values, as the outcome variable. We correspondingly selected a multinomial logistic regression model to predict career choice (treating the Non-SEHM career group as the reference group) as a function of gender, cohort, and goal endorsement, while controlling for other background variables. We first specified a base model that contained all main effects and an interaction effect between cohort and gender to examine if the gender differences changed between cohorts. We then specified a full model that contained the two-way and three-way interaction effects between gender, cohort, and each of the four-goal endorsement variables.

Because participants were nested in institutions, we ran multilevel models that clustered participants by institutions. Nevertheless, the intraclass correlations were extremely small (ranging between 0.008 to 0.02), which indicated that nearly none of the variation was explained by institution clustering. Moreover, the fixed effects estimations were nearly identical with the coefficients from flat models. For simplicity, therefore, we report only the flat models.

Owing to this exhaustive approach to interaction testing, a false discovery rate adjustment (FDA) was employed. It is important to note that, although we adopted a modeling approach, we intended this research to be a descriptive study that presents the general trends in the multivariate landscape. Whereas this article focuses on the science and engineering groups, we also present results about medicine, health, and non-SEHM groups for a more complete picture.

## Results

### Goal Endorsement as the Outcome Variable.

For each of the goal endorsements, Table 2 shows the estimated parameters of career interests, gender, cohort, and interaction effects, while controlling for participants' background information. Each time, we present the results for 1) the main-effect-only model, 2) the full model that includes career × cohort × gender three-way interaction effects, together with the constituent two-way interactions. We first focus on goal endorsement by cohort based on the main-effect models. We then move to gender-related effects based on the full models, aided by graphical interpretations. We will focus on the science and engineering groups, and, for brevity, we will not discuss the parameters of the control variables included in the models because they are not the focus of the study.

Table 2. Result of regression models predicting standardized goal endorsement as a function of career interests, cohort, gender and the interaction effects

| | Communal.Main | | Communal.Full | | Material.Main | | Material.Full | | Intellectual.Main | | Intellectual.Full | | FreeTime.Main | | FreeTime.Full | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | β | se | β | se | β | se | β | se | β | se | β | se | β | se | β | se |
| (Intercept) | 0.305 | 0.052 *** | 0.367 | 0.055 *** | 0.058 | 0.053 | 0.028 | 0.056 | -0.439 | 0.053 *** | -0.432 | 0.056 *** | 0.406 | 0.054 *** | 0.422 | 0.057 *** |
| Health | 0.352 | 0.038 *** | 0.280 | 0.054 *** | -0.109 | 0.038 ** | -0.053 | 0.055 | -0.051 | 0.038 | -0.046 | 0.055 | 0.080 | 0.039 * | 0.099 | 0.056 |
| Medicine | 0.335 | 0.033 *** | 0.215 | 0.057 *** | -0.044 | 0.034 | 0.000 | 0.058 | 0.078 | 0.034 * | 0.066 | 0.058 | -0.129 | 0.035 *** | -0.171 | 0.059 ** |
| Science | -0.329 | 0.033 *** | -0.337 | 0.073 *** | -0.130 | 0.034 *** | -0.051 | 0.074 | 0.300 | 0.033 *** | 0.235 | 0.074 ** | -0.183 | 0.034 *** | -0.075 | 0.076 |
| Engineering | -0.317 | 0.035 *** | -0.449 | 0.091 *** | -0.059 | 0.036 | -0.015 | 0.093 | 0.438 | 0.036 *** | 0.390 | 0.093 *** | -0.059 | 0.036 | -0.235 | 0.095 * |
| Male | -0.310 | 0.022 *** | -0.449 | 0.039 *** | 0.282 | 0.023 *** | 0.295 | 0.039 *** | 0.175 | 0.023 *** | 0.142 | 0.039 *** | -0.063 | 0.023 ** | -0.104 | 0.040 ** |
| Cohort2017 | 0.152 | 0.022 *** | 0.053 | 0.039 | 0.196 | 0.023 *** | 0.259 | 0.040 *** | 0.378 | 0.023 *** | 0.383 | 0.040 *** | -0.075 | 0.023 ** | -0.099 | 0.041 * |
| Mom.Edu | 0.022 | 0.013 | 0.022 | 0.013 | -0.016 | 0.014 | -0.017 | 0.014 | -0.003 | 0.014 | -0.004 | 0.014 | -0.003 | 0.014 | -0.002 | 0.014 |
| Dad.Edu | -0.023 | 0.014 | -0.022 | 0.014 | -0.017 | 0.014 | -0.016 | 0.014 | -0.021 | 0.014 | -0.019 | 0.014 | -0.014 | 0.014 | -0.014 | 0.014 |
| SAT Score | -0.061 | 0.012 *** | -0.060 | 0.012 *** | -0.078 | 0.012 *** | -0.080 | 0.012 *** | -0.016 | 0.012 | -0.017 | 0.012 | -0.065 | 0.013 *** | -0.064 | 0.013 *** |
| Parent_STEM_ | -0.042 | 0.023 | -0.042 | 0.023 | -0.014 | 0.023 | -0.014 | 0.023 | 0.085 | 0.023 *** | 0.086 | 0.023 *** | -0.034 | 0.024 | -0.036 | 0.024 |
| Race.Black | 0.162 | 0.039 *** | 0.161 | 0.039 *** | 0.527 | 0.039 *** | 0.526 | 0.039 *** | 0.402 | 0.039 *** | 0.404 | 0.039 *** | 0.118 | 0.040 ** | 0.120 | 0.040 ** |
| Race.Asian | 0.010 | 0.039 | 0.014 | 0.039 | 0.250 | 0.040 *** | 0.251 | 0.040 *** | 0.134 | 0.040 *** | 0.134 | 0.040 *** | 0.068 | 0.041 | 0.072 | 0.041 |
| Race.Other | 0.115 | 0.034 *** | 0.112 | 0.034 *** | 0.236 | 0.035 *** | 0.232 | 0.035 *** | 0.220 | 0.034 *** | 0.217 | 0.034 *** | 0.052 | 0.035 | 0.049 | 0.035 |
| Health × Male | | | 0.074 | 0.119 | | | 0.030 | 0.121 | | | 0.183 | 0.121 | | | -0.128 | 0.123 |
| Medicine × Male | | | 0.290 | 0.092 ** | | | 0.040 | 0.094 | | | 0.154 | 0.094 | | | 0.167 | 0.096 |
| Science × Male | | | 0.135 | 0.092 | | | 0.030 | 0.094 | | | 0.178 | 0.094 | | | -0.122 | 0.096 |
| Engineering × Male | | | 0.156 | 0.103 | | | -0.010 | 0.105 | | | 0.043 | 0.105 | | | 0.191 | 0.107 |
| Health × Cohort2017 | | | 0.094 | 0.087 | | | -0.097 | 0.089 | | | -0.012 | 0.089 | | | -0.019 | 0.091 |
| Medicine × Cohort2017 | | | 0.092 | 0.083 | | | -0.064 | 0.084 | | | -0.006 | 0.084 | | | -0.019 | 0.086 |
| Science × Cohort2017 | | | -0.043 | 0.100 | | | -0.113 | 0.102 | | | -0.010 | 0.101 | | | -0.092 | 0.104 |
| Engineering × Cohort2017 | | | 0.198 | 0.137 | | | -0.029 | 0.139 | | | 0.315 | 0.139 * | | | 0.066 | 0.142 |
| Male × Cohort2017 | | | 0.202 | 0.058 *** | | | 0.017 | 0.059 | | | 0.052 | 0.059 | | | 0.056 | 0.060 |
| Health × Male × Cohort2017 | | | 0.070 | 0.192 | | | -0.231 | 0.196 | | | -0.516 | 0.196 ** | | | 0.078 | 0.200 |
| Medicine × Male × Cohort2017 | | | -0.167 | 0.140 | | | -0.193 | 0.143 | | | -0.275 | 0.143 | | | -0.051 | 0.146 |
| Science × Male × Cohort2017 | | | -0.167 | 0.132 | | | -0.195 | 0.135 | | | -0.141 | 0.135 | | | 0.051 | 0.138 |
| Engineering × Male × Cohort2017 | | | -0.131 | 0.161 | | | -0.103 | 0.164 | | | -0.334 | 0.164 * | | | 0.049 | 0.167 |
| Adjusted R-squared | 0.121 | | 0.124 | | 0.052 | | 0.063 | | 0.091 | | 0.094 | | 0.022 | | 0.024 | |

Notes: *** p < 0.001, ** p < 0.01, * p < 0.05 after FDR adjustment.   N=19,060

**Changes in goal endorsement by cohort**

Based on the main effect models, we found that, compared to the 2007 cohort, the 2017 cohort, on average, had higher communal goal endorsement ($b$ = 0.152, $SE$ = 0.022), higher material goal endorsement ($b$ = 0.196, $SE$ = 0.023), higher intellectual goal endorsement ($b$ = 0.378, $SE$ = 0.023), and lower free-time goal endorsement ($b$ = -0.075, $SE$ = 0.023).

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**Changes in gender gaps in goal endorsement**

According to the full-models, many of the gender gaps have disappeared (become non-significantly different from zero) or narrowed in the 2017 cohort. Remaining gender gaps exist in the science and engineering groups regarding communal goals, in the non-SEHM group regarding material goals, and in the science and non-SEHM groups regarding intellectual goals.

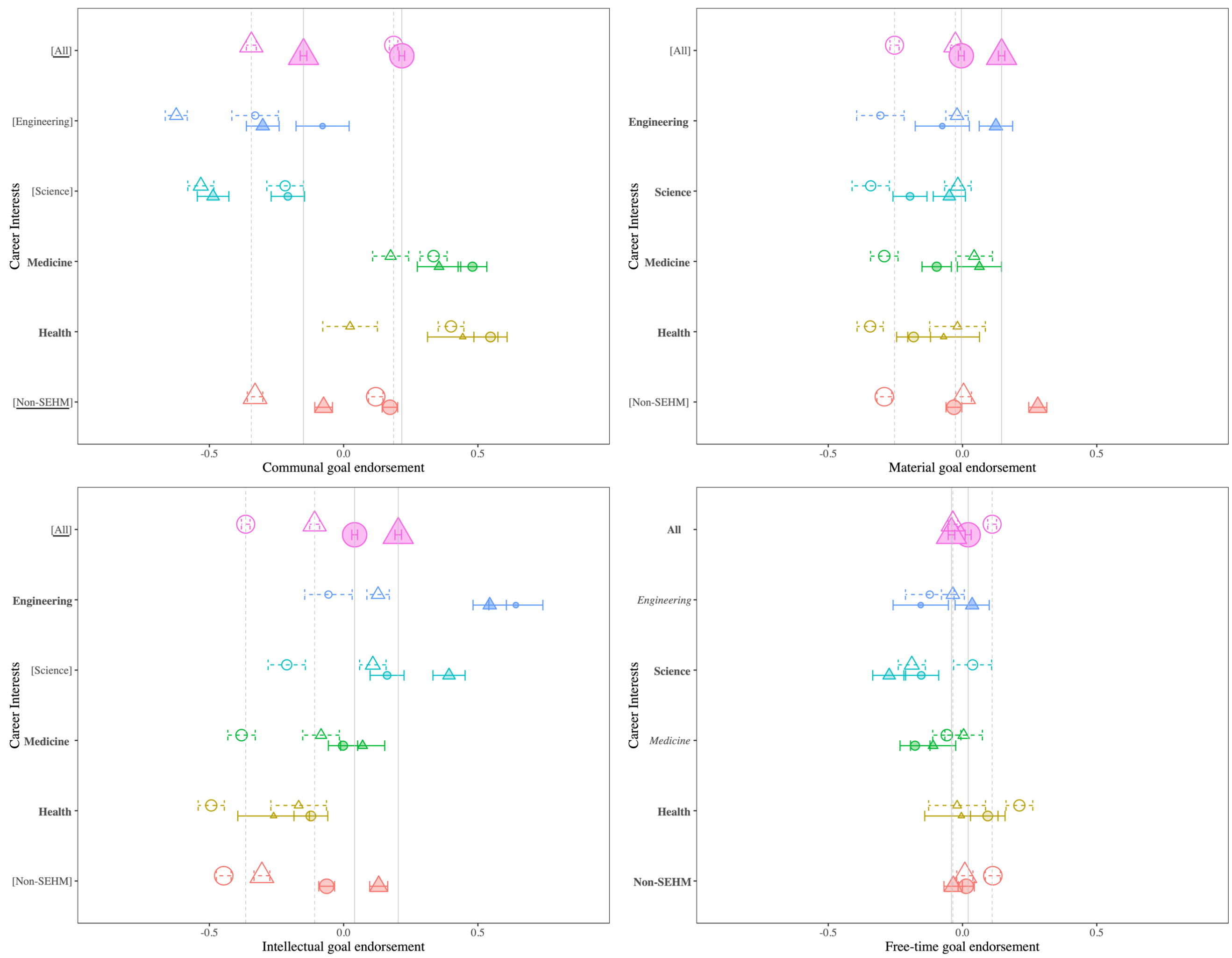


**Figure 1**: Figure 1 shows the full-model predicted means and 95% confidence intervals of each of the four goal endorsements for each career interest group, gender, and cohort. The solid shapes refer to the 2017 cohort, and the hollowed shapes to the 2007 cohort; the triangle indicates males, and the circle represents females; each color represents a career interest group. The size of the shapes is proportional to the sample sizes of the group. In the first row of each figure, we plotted the grand mean of each gender in each cohort after aggregating all career interests. For ease of comparing each career interest group with the grand mean, we plotted a vertical ruler as a reference to the grand means.

Based on the post-hoc test results, we marked in bold type cases in Figure 1, in which significant gender differences existed in cohort 2007 but became non-significant in cohort 2017. We marked cases in which the gender differences were significant in both the 2007 and 2017 cohorts with a bracket around the career interest variables. We further marked with an underline cases in which the gender differences were significant in both 2007 and 2017, but the margin was reduced significantly, and we marked with italics cases where the gender difference was not significant in either 2007 or 2017.

As shown in Figure 1, in nearly all career interest groups, the gender gap moved towards zero across all goals from 2007 to 2017.

**Change in the gender gaps in goal endorsement within the science and engineering groups**
Because STEM career interests are the focus of this article, we now describe the results for these career groups in greater detail. Regarding communal goals, in both the science and engineering groups, the gender gap was significant in both 2007 (for the science group, average marginal effect [*AME*] = 0.314, *SE* = 0.083, $p < 0.001$; for the engineering group, *AME* = 0.294, *SE* = 0.096, $p < 0.01$) and 2017 (for the science group, *AME* = 0.278, *SE* = 0.084, $p < 0.001$; for the Engineering group, *AME* = 0.223, *SE* = 0.115, $p < 0.05$), and the changes in the marginal effect between cohorts were not significant. This was in contrast to the general finding that the gender gap narrowed significantly for the whole sample ($F = 10.66$, $p < 0.001$) as measured by the change in AME.

Regarding material goals, the science group (*AME* = -0.324, *SE* = 0.085, $p < 0.001$) and the engineering group (*AME* =
-0.285, *SE* = 0.097, p < 0.01) had significant gender gaps in 2007, with males endorsing material goals more strongly than females did. These gender differences became non-significant.

Regarding intellectual goals, the science group (*AME* = -0.231, *SE* = 0.086, $p < 0.01$) and the engineering group (*AME* = -0.185, *SE* = 0.097, $p < 0.05$) had significant gender gaps in 2007, with males endorsing intellectual goals more strongly than did females. In 2017, the science group still showed a significant gender gap that had not been significantly reduced in size (*AME* = -0.231, *SE* = 0.086, p < s0.01). However, for the engineering group, the marginal effect flipped from negative (women lower than men) in 2007 to positive (women higher than men, but not statistically significant) in 2017 (*AME* = 0.097, *SE* = 0.117).

Regarding free-time goals, the science group had a significant gender gap in 2007, with females endorsing free-time goals more strongly than did males (*AME* = 0.226, *SE* = 0.087, $p < 0.01$). The engineering group did not have a significant gender gap in free-time goals among the 2007 cohort. In 2017, there was no longer a significant gender gap in the science group, and, in engineering, the gender gap remained absent.

In summary, focusing on the science and engineering groups, the gender gap closed or narrowed in material and intellectual goal endorsement for the engineering group and free-time goal endorsements for the science group. The most conspicuous exceptions to the overall trend of shrinking gender differences were the persistent gender gaps in communal goals in the science and engineering groups. In these two cases, women maintained, by the same margin, higher ratings for communal goal endorsement than did men. In addition, the gender gap was also maintained in the science group regarding intellectual goals.

**Career Choice as the Outcome Variable.**

Table 3 shows the result of multinomial logistic regressions that predict career choices (using the non-SEHM group as the reference group) as a function of cohort, gender, and goal endorsement, after controlling for other background covariates. Unlike the above models that predict mean values of goal endorsement for a given career interest, these models predict the change in the conditional probability (converted from odds ratios) of taking an interest in a career (e.g., science) as one's goal endorsement (e.g., communal goals) increases. The multinomial logistic regressions yield goal-career function curves (using goal endorsement to predict career interest) between each type of goal endorsement and each career choice. We are primarily interested in comparing these curves between genders and between cohorts.

Table 3 displays two multinomial logistic models—a base model and a full model. The base model used only one interaction term—gender (male) × Cohort (2017)—to detect if the gender gap in a specific career interest has changed between cohorts. Focusing on the columns for science and engineering, we found that the odds of a career interest in science (over non-SEHM) in the 2017 cohort was 1.9 times of the odds of the 2007 cohort (logit = 0.622), and the odds of a career interest in engineering (over non-SEHM) for the 2017 cohort was 0.8 times the odds of the 2007 cohort. Across both cohorts, males were more likely than females to have career interests in science (logit = 0.546, odds ratio = 1.7) and engineering (logit = 1.268, odds ratio = 3.6). However, this gender difference narrowed from a male-to-female odds ratio of 1.7 for science and 3.6 for engineering in 2007 to 1.2 for science and 2.5 for engineering in 2017.

The full model included the three-way interactions (and constituent two-way interactions) between gender, cohort, and each of the four-goal endorsements. Because the parameter estimates in a multinomial regression are sensitive to the reference group selected for the outcome variable and the categorical predictor variables, these parameters and their p-values in the full model can be difficult to interpret or may be misleading, especially when many interaction terms are involved. The patterns become easier to understand when we visualize the conditional probabilities of career choices based on the full model after controlling the covariates at their means (see Figure 2). Based on the full model, we conducted post-hoc testing to compare the levels of career interest.

Table 3. Result of multinomial logistic regression models predicting career interests as a function of goal endorsement, cohort, gender and the three-way interaction effects.

| | Multinomial Logistic Model.Base | | | | | | | | | | | | Multinomial Logistic Model.Full | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Health | | | Medicine | | | Science | | | Engineering | | | Health | | | Medicine | | | Science | | | Engineering | | |
| | β | s.e | | β | s.e | | β | s.e | | β | s.e | | β | s.e | | β | s.e | | β | s.e | | β | s.e | |
| (Intercept) | -1.122 | 0.145 | *** | -1.286 | 0.115 | *** | -1.527 | 0.101 | *** | -2.063 | 0.109 | *** | -1.047 | 0.119 | *** | -1.225 | 0.110 | *** | -1.519 | 0.114 | *** | -2.064 | 0.138 | *** |
| Male | -1.014 | 0.129 | *** | -0.313 | 0.102 | *** | 0.546 | 0.102 | *** | -1.268 | 0.116 | *** | -1.004 | 0.138 | *** | -0.350 | 0.109 | *** | 0.576 | 0.110 | *** | 1.268 | 0.124 | *** |
| Cohort2017 | 0.227 | 0.172 | | 0.064 | 0.120 | | 0.291 | 0.094 | *** | 0.592 | 0.098 | *** | 0.062 | 0.117 | | 0.171 | 0.104 | | 0.621 | 0.110 | ** | -0.398 | 0.164 | *** |
| External Goals | -0.117 | 0.042 | *** | -0.035 | 0.038 | | -0.128 | 0.037 | *** | -0.091 | 0.041 | * | -0.062 | 0.061 | | 0.015 | 0.064 | | -0.063 | 0.083 | | -0.031 | 0.104 | |
| Communal Goals | 0.511 | 0.050 | *** | 0.457 | 0.043 | *** | -0.385 | 0.036 | *** | -0.435 | 0.040 | *** | 0.382 | 0.072 | *** | 0.320 | 0.073 | *** | -0.373 | 0.079 | *** | -0.451 | 0.097 | *** |
| Intellectual Goals | -0.136 | 0.045 | *** | 0.046 | 0.040 | | 0.486 | 0.037 | *** | 0.641 | 0.042 | *** | -0.143 | 0.066 | * | 0.024 | 0.069 | | 0.359 | 0.086 | *** | 0.532 | 0.108 | *** |
| Free-Time Goals | 0.060 | 0.042 | | -0.187 | 0.036 | *** | -0.121 | 0.035 | *** | -0.039 | 0.040 | | 0.057 | 0.063 | | -0.252 | 0.062 | | -0.051 | 0.081 | | -0.228 | 0.099 | * |
| Mom.Edu | -0.095 | 0.050 | | -0.046 | 0.046 | | -0.047 | 0.046 | | -0.094 | 0.047 | * | -0.095 | 0.050 | | -0.048 | 0.046 | | -0.048 | 0.046 | | -0.091 | 0.047 | |
| Dad.Edu | -0.097 | 0.053 | | -0.024 | 0.048 | | -0.050 | 0.047 | | 0.016 | 0.049 | | -0.101 | 0.052 | | -0.026 | 0.048 | | -0.049 | 0.048 | | 0.015 | 0.049 | |
| SAT Math Score | 0.001 | 0.044 | | 0.345 | 0.042 | *** | 0.489 | 0.040 | *** | 0.865 | 0.048 | *** | 0.004 | 0.044 | | 0.348 | 0.042 | *** | 0.494 | 0.040 | *** | 0.866 | 0.048 | *** |
| Parent_STEM_career | 0.250 | 0.087 | *** | 0.376 | 0.075 | *** | 0.167 | 0.073 | | 0.231 | 0.081 | ** | 0.240 | 0.087 | ** | 0.372 | 0.075 | *** | 0.168 | 0.073 | * | 0.233 | 0.082 | *** |
| Race.Black | 0.181 | 0.141 | | 0.425 | 0.124 | *** | 0.182 | 0.132 | | 0.357 | 0.151 | * | 0.170 | 0.141 | | 0.415 | 0.125 | *** | 0.192 | 0.133 | | 0.360 | 0.152 | |
| Race.Asian | 0.455 | 0.161 | *** | 0.779 | 0.126 | *** | 0.799 | 0.117 | | 0.191 | 0.144 | | 0.447 | 0.161 | ** | 0.769 | 0.127 | *** | 0.789 | 0.117 | *** | 0.185 | 0.145 | |
| Race.Other | 0.052 | 0.127 | | 0.151 | 0.114 | | 0.148 | 0.110 | | 0.227 | 0.122 | | 0.040 | 0.127 | | 0.144 | 0.115 | | 0.133 | 0.110 | | 0.218 | 0.122 | |
| Male ✕ Cohort2017 | 0.040 | 0.193 | | -0.160 | 0.147 | | -0.331 | 0.137 | ** | -0.340 | 0.171 | * | -0.017 | 0.223 | | -0.076 | 0.160 | | -0.376 | 0.149 | ** | -0.166 | 0.195 | |
| Male ✕ External Goals | | | | | | | | | | | | | -0.036 | 0.127 | | -0.075 | 0.101 | | 0.041 | 0.105 | | -0.005 | 0.120 | |
| Cohort2017 ✕ External Goals | | | | | | | | | | | | | -0.081 | 0.098 | | -0.007 | 0.095 | | -0.106 | 0.112 | ** | -0.096 | 0.159 | * |
| Male ✕ Communal Goals | | | | | | | | | | | | | 0.031 | 0.147 | | 0.250 | 0.118 | * | 0.064 | 0.103 | | 0.005 | 0.115 | |
| Cohort2017 ✕ Communal Goals | | | | | | | | | | | | | 0.244 | 0.118 | * | 0.151 | 0.109 | | -0.046 | 0.106 | | 0.042 | 0.149 | |
| Male ✕ Intellectual Goals | | | | | | | | | | | | | 0.211 | 0.138 | | 0.104 | 0.110 | | 0.227 | 0.109 | * | 0.081 | 0.124 | |
| Cohort2017 ✕ Intellectual Goals | | | | | | | | | | | | | -0.008 | 0.104 | | 0.034 | 0.101 | | 0.030 | 0.114 | | 0.391 | 0.167 | * |
| Male ✕ Free-Time Goals | | | | | | | | | | | | | -0.169 | 0.132 | | 0.094 | 0.103 | | -0.173 | 0.104 | | 0.181 | 0.117 | |
| Cohort2017 ✕ Free-Time Goals | | | | | | | | | | | | | 0.023 | 0.099 | | 0.045 | 0.090 | | -0.053 | 0.105 | | 0.071 | 0.143 | |
| Male ✕ Cohort2017 ✕ External | | | | | | | | | | | | | -0.136 | 0.207 | | -0.193 | 0.158 | | -0.201 | 0.151 | | -0.140 | 0.191 | |
| Male ✕ Cohort2017 ✕ Communal | | | | | | | | | | | | | 0.235 | 0.250 | | -0.143 | 0.181 | | -0.064 | 0.146 | | 0.033 | 0.182 | |
| Male ✕ Cohort2017 ✕ Intellectual | | | | | | | | | | | | | -0.442 | 0.215 | * | -0.248 | 0.165 | | -0.071 | 0.153 | | -0.300 | 0.199 | |
| Male ✕ Cohort2017 ✕ Free-Time | | | | | | | | | | | | | 0.316 | 0.209 | | 0.103 | 0.155 | | 0.256 | 0.144 | * | 0.140 | 0.177 | |

Notes: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, after FDR adjustment. N = 19,060; pseudo r-squared for base model = 0.114; pseudo r-squared for full model = 0.118

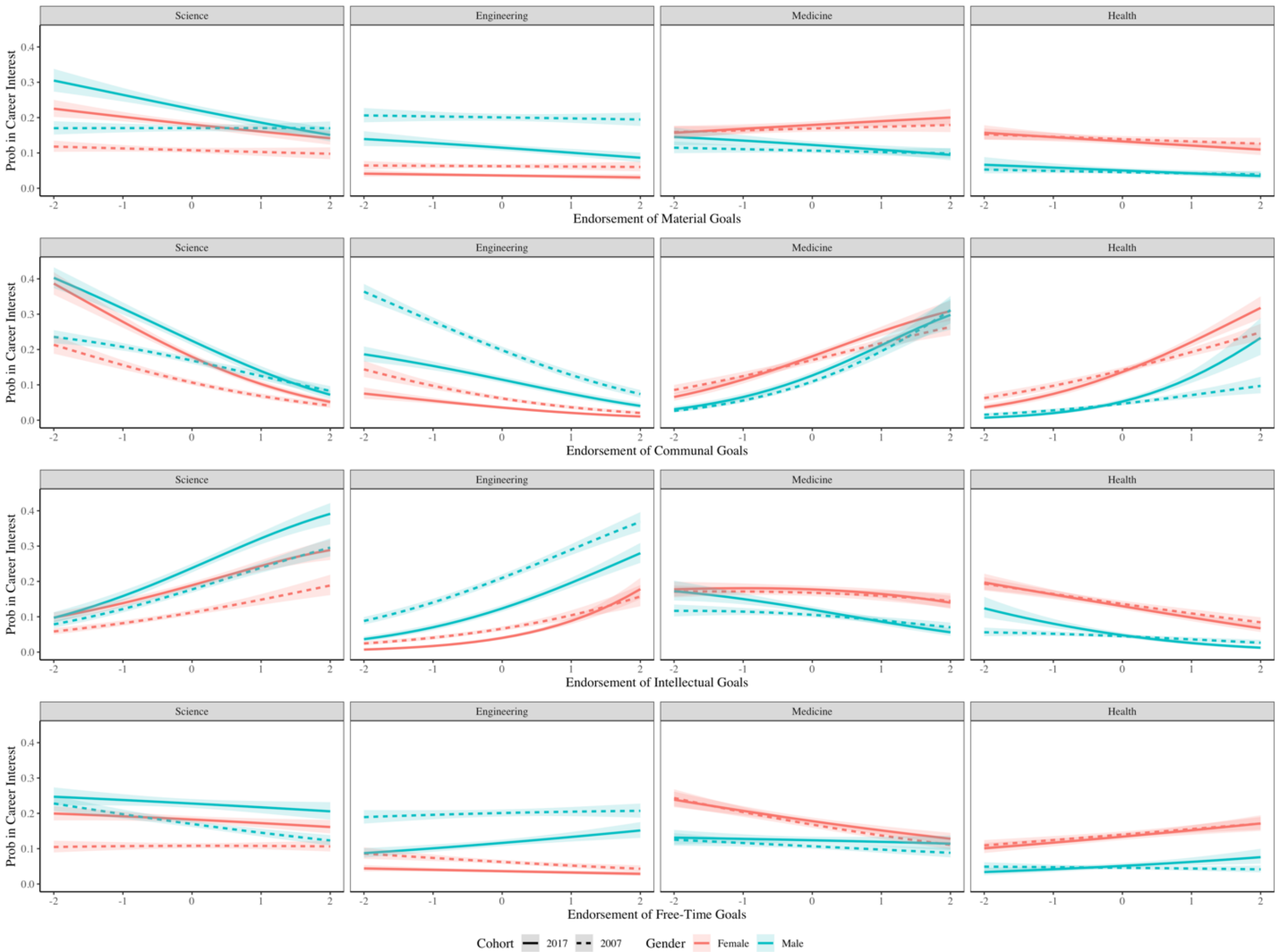


**Figure 2**. The probability on career interest (with +/- 1 *SE* interval) as a function of goal endorsement by gender (color), and cohort (solid/dashed).

Each panel in Figure 2 presents a specific goal-career function curve by gender (color) and cohort (solid or dashed). Take the top left panel for example. This panel shows the conditional probability of a career interest in science as a function of material goal endorsement for each gender in each cohort. The two dashed lines show that, in the 2007 cohort, the curves were both flat, indicating that a science career interest was largely independent of a person's interest in material goals. This was true for both genders in the 2007 cohort. The male (blue) dashed curve was above the female (red) dashed curve, which indicated that males, on average, had a higher probability of a science career interest than females at any value of material goal endorsement in the 2007 cohort. Shifting attention to the solid lines in the same panel, we see a steep downward slope for males in 2017, with its left-end tail rising above the 2007 cohort line by 8% and its right-end tail overlapping with the 2007 cohort line, indicating that male students who were not interested in material goals were more likely to be interested in science careers than were male students who were interested in material goals. At the same time, the curve for the female students in the 2017 cohort appears to be very similar to the curve of the male students in the 2007 cohort, indicating a general increase in science career interest among women in the 2017 cohort, as compared with women in the 2007 cohort. This increased interest had a very weak relationship with material goal endorsement. When comparing the two solid lines, we found that, in the 2017 cohort, male students were more interested in a science career than were female students when material goals were not important to them. When material goals were important to them (the threshold was 1.1 standard deviation above the mean according to post-hoc testing), males and females had a similar probability of entertaining science career interests. A similar pattern can be found in the intellectual-science and free-time-science panels, in which the goal-career function curves for females in the 2017 cohort largely overlapped with the curves for males in the 2007 cohort. An exception to this pattern occurred in the communal-science panel, in which the curves for females and males were largely similar within the 2017 cohort. In 2017, both men and women had higher science career interests at the lower end of communal goal endorsement and lower science career interests at the higher end of communal goal endorsement. When we compare the 2017 curves with the 2007 curves in this panel, we see that male and female students on the lower end of communal goal endorsement in the 2017 cohort were much more likely (by a margin of 18%) to be interested in science careers than were their counterparts in the 2007 cohort, yet those at the higher end of communal goal endorsement retained the same level of science career interest between the two cohorts, regardless of gender.

Focusing on the column for engineering career interests, we found that the goal-career function curves for females in the 2017 cohort were largely the same as those of female students in the 2007 cohort, with only a slight drop in elevation. The gender gap in engineering career interests did decrease from the 2007 to 2017 cohort, largely because male students' engineering career interests dropped more than those of female students from 2007 to 2017.

Focusing on the columns for the health and medicine career interests, we found very little change in the patterns between the 2007 and 2017 cohorts. The most salient change was that male students who value communal goals were more likely to be interested in health careers in the 2017 cohort than in the 2007 cohort.

## Discussion

Answering each of the four research questions, we found that (RQ 1.1), compared with the 2007 cohort, the 2017 cohort more strongly endorsed nearly all goals (supporting hypothesis H1-A), except the free time goal; and that (RQ 1.2), from 2007 to 2017, the gender gaps in goal endorsement within specific career interest groups were converging in general (largely supporting hypothesis H2-A). The most noticeable exception was communal goal endorsement. Although the gender gap in communal goal endorsement narrowed when viewed across all career interests, the margin remained nearly the same among those who were interested in science and engineering careers. (RQ 2.1) The gender gap in science and engineering career interest narrowed from 2007 to 2017 (supporting hypothesis H1-A again). (RQ 2.2) In both 2007 and 2017 cohorts, at a given goal endorsement, men were more likely to be interested in science or engineering careers than women (supporting H2-0). Interestingly, for science careers, the goal-career function for females in the 2017 cohort became similar to the function for males in the 2007 cohort (partially supporting H2-A), whereas, for engineering careers, the goal-career function for females in the 2017 cohort remained largely the same as that of female students in the 2007 cohort (supporting H2-0). Revisiting our hypotheses, we found that hypothesis H1-A was supported in general—there was indeed a gender convergence in goal endorsement (except for free-time goals) and in science and engineering career interests. Our findings were in favor of H2-A, which predicted the association between goal endorsement and career interests to become more similar between genders between 2007 and 2017. However, in science or engineering career groups, specifically, our findings were in favor of H2-0, which predicted the gendered association between goal endorsement and STEM career interests to remain tenacious.

We did not have a way to causally attribute these results to any event that occurred over the course of the decade. Nevertheless, we suggest that the findings should be interpreted within the framework of economic and socio-cultural change, introduced earlier.

## Students want more of everything, except free time (RQ 1.1)

As noted, dramatic sector shifts have occurred in the job market, increasing demands for interpersonal service, management, analytic, creative, and intellectual skills (Pew Research Center, 2016, 2017). The demands for such skills may have contributed to the observed rise in goal endorsements related to intelligence, leadership, and service. In addition, it was not surprising to find heightened interest in material goals, considering the dramatic growth of the wealth gap since the 2007 recession and the ballooning financial burden carried by college graduates (Perrone-McGovern et al., 2014): the sum of outstanding student loans nearly tripled from $544 billion (3.83% of GDP) in 2007 to $1,443 billion (7.53% of GDP) in 2017 (Board of Governors of the Federal Reserve System, 2019; U.S. Bureau of Economic Analysis, 2019).

In light of the increased interest in earning, learning, and serving, it appears consistent that the younger cohort is prepared to devote more time to work and allocate less time for leisure or family. The household income started picking up in 2014, yet the average hourly wage (at least for the middle class) remained level or even declined. The explanation for stagnating or falling hourly wages while income levels are rising is that people are working longer hours (U.S. Census Bureau, 2018). Specifically, the number of hours worked by women increased by about 3% from the 2000s to 2016, whereas men's hours worked remained unchanged (Wilson & Jones, 2018). The median age of first marriage increased from 27.5 for men and 25.6 for women in 2007 to 29.8 for men and 27.8 for women in 2017 (U.S. Census Bureau, 2018). Although technology has increased work efficiency and provided greater flexibility in terms of the work platform, it has also blurred the barrier between work and non-work spaces. A lot of the work that had to be done in the office ten years ago can be done on a smartphone today (the first smartphone—the first-generation iPhone—was only introduced in 2007). By 2017, the U.S. had 1.3 million Uber drivers, 69% of whom had other jobs (Benenson Strategy Group, 2015). Forty percent only worked during weekends, evenings, and late nights (Chen et al., 2019).

## The narrowing gender gap in goal endorsement, except for communal goals among the STEM group (RQ 1.2)

As mentioned above, great amounts of effort pushing for gender equality have been expended on the cultural, political, economic, and educational fronts. All of these efforts may contribute to the trend that more women are choosing traditionally male-dominated academic or career fields, but to what extent do they narrow the gender gap in career goals?

Our findings show that, in most career groups, goal endorsement has been moving in the direction desired by those social and educational efforts—narrowing the gender gap. In 2017, women who were interested in engineering or in health professions even had higher gender mean scores in intellectual goal endorsement than did men; however, this difference was not statistically significant. The gap in free-time became non-significant across all career interest groups. Men continued to more strongly endorse material goals than did women in the non-SEHM group, but this gap became non-significant for the science, engineering, health, and medicine groups. Men in the medicine and health groups were more interested in communal goals in 2017 than in 2007, reaching the same level as their female counterparts.

The most noticeable case where the gender gap showed unmitigated strength was the communal goal gap for the science and engineering groups. We replicated the findings of prior studies that repeatedly showed the communal gap between genders in the STEM careers to be particularly tenacious (Eagly & Diekman, 2003; Twenge, 1997, 2001). Although many intervention programs have engaged in reframing STEM fields in accordance with communal and humanistic values, and although studies have demonstrated the possibility of ameliorating the "science is not communal" stereotype, these developments have not manifested themselves in the male population of STEM-interested students.

### Women in 2017 are similar to men in 2007 in terms of their goal-career functions (RQ 1.2 and RQ 2.2)

The participation rates in higher education, cited earlier, indicate that, while STEM fields have been expanding overall, women's interest in STEM has been growing by a larger proportion than men's in some key disciplines and in advanced educational attainment across all STEM areas. It is worth mentioning that our data confirmed the general trend that the gender gap in STEM career interests narrowed during the past decade.

Our major contribution to the discussion of gender differences in career choices is the examination of career choice as a function of goal endorsement and a comparison of this function between gender and cohort. By determining and comparing these functions, we were able to reveal how personal goals influence the career decision-making process of entering college students. We further showed how this influence has changed over the past decades for men and for women. This approach brought to light the most interesting patterns with regard to the science careers.

First, in most cases within the science career group, with the exception of communal goals, the goal-science function for women in the 2017 cohort became very similar to the function for men in the 2007 cohort. In terms of goal-career functions, the young women of the 2017 cohort caught up to where the young men had been a decade earlier. Part of this similarity can be attributed to the fact that more women became interested in science careers (this increase exceeded the increase among men) from the 2007 to the 2017 cohort. This shift effectively elevated the intercept of the function for women and emulated the intercept of the function for men in 2007. However, because the intercept of the function also increased from 2007 to 2017 for men, women did not catch up to men in 2017. In addition, the slope of the functions for women in 2017 became steeper (indicating an increased sensitivity of career interest to goals), particularly in the case of the material goal-science function and the intellectual goal-science function. In the 2017 cohort, women who were less interested in material goals and more interested in intellectual goals were more likely to be interested in science careers than were their counterparts in the 2007 cohort.

Second, the shape of the communal goal-science function for women in the 2017 cohort was similar to that of the men in the 2017 cohort. In the 2007 cohort, we had already observed a negative communal–science function for both men and women. In the 2017 cohort, this trend has been amplified.

In combination, these patterns suggest that, contrary to our hypothesis that the stereotypical association between goal endorsement and career choice might have been attenuated, it has been enhanced. Both male and female students in the 2017 cohort who were uninterested in material goals, uninterested in communal goals, and interested in intellectual goals, were even more interested in science careers, compared with students who exhibited the same profile in the 2007 cohort.

### Limitations and Future Work

In this study, it was impossible to assert a causal direction between career choice and goal endorsement, which was one of the reasons that we explored the relationship between the two constructs in both directions. We also could not attribute the difference between the two cohorts to any event that occurred in the past decade. We suggest that this study, although it adopted a modeling approach, should be regarded as a descriptive study that presents the general trends in the career interest-goal endorsement landscape. Because there were many groups and conditions, we made many comparisons. This fact inevitably increased the Type I error. We tried to reduce the likelihood of Type I errors by adopting a false discovery rate *p*-value adjustment. However, the risk of false discovery remains. Again, our intent for this study is to provide an overall description of the multivariate relationship, so that future researchers can target the components that they find most interesting. Finally, we did not know if the students would actually pursue their reported career interest and persist in their personal goals. The malleability of these constructs, which was the foundational assumption of this study, may lead these students to pursue different career tracks and life courses. This fact calls for future longitudinal studies at the individual level.

**Implications and Conclusion**

The gender convergence hypothesis posits convergence to be a general pattern because broad social, cultural, and economic factors are thought to have impacts on all walks of life. No component of this hypothesis posits that any specific value or career will resist convergence. However, our finding joins numerous prior studies (e.g., Diekman et al., 2017; Twenge, 1997, 2001) which have shown that the communal gap between genders has remained tenaciously steady across cohorts. Thus, we call for a revision to the gender convergence hypothesis that reflects the fact that not all goal endorsements converge in lockstep. The communal gap, in particular, remains resistant to gender convergence.

Further, goal congruency theory (Diekman et al., 2017) explains the gender gap in STEM career interests as partly rooted in the gender gap in communal goal orientation: Because women are more interested in communal goals, and, among all careers, STEM is typically and particularly perceived to not afford communal opportunities, women are less likely to choose STEM careers. This perspective was partially supported by our findings that showed 1) women in general were more interested in communal goals than men were; 2) the gender gap in communal goals narrowed in some career groups but not in science and engineering groups; and 3) there was a sharper declining communal–science slope among women than among men. As more women enter STEM, STEM instructors and policy makers should realize that they are dealing with male and female student populations that are still very different from each other in terms of the average strength of their communal goals, and they may want to address this in college STEM education and curricula—perhaps even trying to instill a greater communal sense among male STEM students, as stronger communal goals appear to be the overall trend among college-going males (in medicine, health, and non-SEHM).

On the other hand, the goal congruency theory would also expect that, with increasing educational efforts to relate STEM careers to communal values, women in the 2017 cohort who placed a high value on communal goals should be more interested in science or engineering careers than were their counterparts in the 2007 cohort. However, our study did not support this hypothesis. On the contrary, science careers became more attractive to women (and men) who were not interested in communal goals. This somewhat counterintuitive finding makes us question whether the decades-long effort to raise STEM interest among women has failed to transform STEM to be more communal, has failed to successfully transmit a communal image of STEM, or whether STEM more effectively selects and recruits women (and men) who are not driven by communal values.

In any case, higher education instructors and policy makers need to be aware that, whereas incoming college men and women have overall become more similar in terms of their goal endorsements and career choice, generally shrinking that gender gap, traditional stereotypical associations (such as the negative association between communal goals and science careers) remains alive and well among students interested in science.

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