Segregation, Stereotypes, and STEM

*Sarah Thébaud, Maria Charles, Department of Sociology University of California — Santa Barbara, Santa Barbara, CA ***

ABSTRACT. Scientific, technical, engineering, and mathematical (STEM) occupations are strongholds of gender segregation in the contemporary United States. While many Americans regard this segregation as natural and inevitable, closer examination reveals a great deal of variability in the gendering of STEM fields across time, space, and demographic groups. This article assesses how different theoretical accounts accord with the available evidence on the gender composition of scientific and technical fields. We find most support for accounts that allow for a dynamic interplay between individual-level traits and the broader sociocultural environments in which they develop. The existing evidence suggests, in particular, that Western cultural stereotypes about the nature of STEM work and STEM workers and about the intrinsic qualities of men and women can be powerful drivers of individual aptitudes, aspirations, and affinities. We offer an illustrative catalog of stereotypes that support women's STEM-avoidance and men's STEM-affinity, and we conclude with some thoughts on policy implications.

KEYWORDS: *Culture, gender, inequality, occupations, science, segregation, STEM, stereotypes, work*

For more than three decades, American educators, policy makers, activists, and business leaders have engaged in research and policy initiatives to increase the presence of women and other underrepresented groups in scientific, technical, engineering, and mathematical (STEM) occupations and fields of study. These efforts have been motivated by interests in broadening opportunities in lucrative, high-status occupations and in ameliorating acute STEM labor shortages that are believed to threaten national prosperity, private profits and the public welfare. Despite wide-ranging research and policy efforts, STEM occupations remain strongholds of gender segregation in the contemporary United States. Women made up nearly half of the US labor market in 2015, but only 28% of all scientific and technical workers.

Within STEM, gender segregation is also very strong, with women comprising 48% of life scientists and 60% of social scientists, but only 28% of physical scientists and 15% of engineers (NSF 2018, Appendices 3-12) (1).

While some fields have integrated over time, others have become more segregated. Women's share of US bachelor's degrees in computer science, for instance, declined from 28% to 18% between 2000 and 2015 (NSF 2018, Appendices 2-21).

While many Americans understand men's dominance of scientific and technical work as natural and universal, the gender typing of STEM fields varies a great deal across space, time, and socio-demographic groups. Recent comparative studies have shown that scientific degree recipients are disproportionately female in Iran, Saudi Arabia, Romania, and Georgia, for example, and that the gender gap in children's STEM aspirations is larger in more affluent societies (Charles, 2011a, 2017; Stoet, Geary, 2018; see also *Women in Engineering in Predominately Muslim Countries* n.d.). Within the United States, the gender composition of STEM fields has varied over time as well–including in computer programming and quantitative social science, which have transitioned from female- to male-labeled since their founding (Luker, 2008; Abbate, 2012; Ensmenger, 2015). STEM gender gaps also vary in size across groups defined by race, class, and immigration status (Xie, Shauman, 2003; Ma, 2009; Nores, 2010). In 2015, for instance, 22% of Black engineers, but only about 14% of White, Asian, Hispanic and Latino engineers were women in the US (Wong, Charles, 2018).

This strong contextual variability suggests an important role of sociocultural factors in the gender segregation of scientific and technical work. Contributors to this volume explore these factors through in-depth analyses of the STEM-relevant experiences and outcomes of US-based workers and students. The current article assesses how different theoretical accounts of segregation accord with available evidence on the gender composition of STEM fields. We find most support for accounts that allow for a dynamic interplay between individual-level traits and the broader sociocultural environments in which they develop. The evidence suggests, in particular, that Western cultural stereotypes about the nature of STEM work and STEM workers, and about the intrinsic qualities and relative social status of men and women, can be powerful drivers of gendered aspirations and affinities. Our discussion of the existing theoretical and empirical literature is followed by an illustrative catalog of stereotypes that have been found to support women's STEM-avoidance and men's STEM-affinity. We conclude with some thoughts on policy implications.

Why are STEM fields so segregated?

Sociologists commonly distinguish between micro- and macro-level explanations for gender inequality. The former consider characteristics of persons (e.g., individual workers and employers) and the latter focus on characteristics of larger units (e.g., organizations, national societies). Below, we consider how each framework accords with the available evidence on gender segregation of STEM fields, and how micro- and macro-level processes may interact to produce highly resilient forms of gender inequality (2).

Micro-level explanations

The explanations of gender segregation that are most popularly resonant invoke the personal traits of workers and employers. These are often dubbed "supply-side" and "demand-side" accounts, respectively, in reference to the sellers and buyers of labor depicted in classical microeconomic theory.

Supply-side explanations focus on differences between men and women in aptitudes, preferences, or workplace productivity (Becker, 1985; Mincer, Polachek, 1974). The segregation of STEM fields might, for example, be attributed to women's stronger orientation toward interpersonal relations and care, or to men's greater investment in the requisite human capital or greater capacity for analytical thinking. Biologically-based supply-side accounts emphasize sex hormones and brain structures as drivers of gendered behaviors and divisions of labor (Baron-Cohen, 2003; Ceci, Williams, 2011). Socialization accounts emphasize the sorting of people into binary sex categories at birth and the rewards (sanctions) that accrue for gender-conforming (-nonconforming) behaviors. Because gendered traits are eventually internalized, adult women are expected to prefer roles that draw upon feminine traits, and adult men are expected to prefer roles that draw upon masculine traits (Parsons, Bales, 1955; Marini, Brinton, 1984).

Explanations emphasizing gendered workers resonate widely and align well with the ubiquitous "Mars and Venus" mythology that depicts men and women as innately "opposite" sexes (Gray, 2012). High-profile supply-side accounts of gender inequality in STEM include a 2005 speech by Harvard president Lawrence Summers, and a 2017 memo by former Google engineer James Damore, both attributing women's underrepresentation to fundamental gender differences in abilities and preferences. These accounts generate fierce resistance among advocates for equality because they seem to blame women for their lesser status in these fields and suggest that the current gendering of occupations is inevitable.

Most social scientists view supply-side explanations as inadequate–among other things, because the gender typing of occupational roles varies strongly across time and space, and over the individual life course (Jacobs, 1989; Tolley, 2003; Penner, 2008; Grier, 2005; Charles, 2011a, 2017) and because measurable differences between men and women are too small to account for the extreme patterns of segregation observed in many occupations and workplaces. Even when men and women differ on average on some aptitude or personality trait, between-gender differences are typically much smaller than within-gender differences, and the size of observed gender gaps frequently vary by context or disappear when men and women have the same status (Epstein, 1988; Ridgeway, Smith-Lovin, 1999; Eagly, 1995; Hyde, 2005; Stoet, Geary, 2018). An exhaustive analysis of the science of sex differences accordingly concludes with the following observation:

> Personality traits and predispositions are not identical in individuals, but they are also not well captured by the binary system of gender…We aren't blank slates, but we also aren't pink and blue notepads (Jordan-Young, 2010, p. 290).

Even gendered divisions of family labor, a central focus of neoclassical micro-economists (Mincer, Polachek, 1974), appear to have little power to explain differences in career trajectories between women STEM and non-STEM professionals (Glass et al., 2013). In this volume, for instance, Sassler et al. (2017) find that differential STEM persistence of men and women degree holders in computer science and engineering are unrelated to family factors, and Shauman (2017) shows that gender disparities in early career outcomes of STEM doctorates cannot be attributed to actual parenthood/marriage patterns, as is commonly presumed. Overall, it appears that differences between men and women in the typically invoked individual-level characteristics have limited explanatory power for understanding gender-differentiated STEM career paths.

Among the standard "supply side" variables, occupational aspirations and expectations typically show the most robust effects on career trajectories: aspirations are strong predictors of occupational outcomes, and gender is a strong predictor of occupational and educational aspirations, holding constant a host of other factors, including employment continuity and expectations for marriage and children (Okamoto, England, 1999; Xie, Shauman, 2003). The causes of gendered occupational aspirations are less well documented. Further on, we identify one important causal factor: the cognitive biases that can result from stereotypes about hard-wired gender difference (i.e., "gender-essentialist" belief systems).

Demand-side explanations switch the focus from attributes of men and women workers, to actions and attributes of employers and clients (and, at the macro level, characteristics of firms and policy regimes). The simplest demand-side explanation for labor market inequality is that employers with "tastes for discrimination" are willing to pay a wage premium to hire members of preferred groups (Becker, 1957) (3). Although economic theory holds that discrimination puts employers at a competitive disadvantage, some economists have attributed its persistence to employers' imperfect information about the relative productivity of potential workers. According to "statistical discrimination" theory, employers may seek to maximize profits by discriminating against groups whose members they believe are less productive on average (Phelps, 1980). For example, if an employer believes that the average woman has a weaker capacity for analytical reasoning than the average man (and if analytical reasoning were difficult to measure directly), it might seem rational to discriminate against all women in hiring for jobs that place a premium on analytical reasoning. An important point here is that employers' personal beliefs about average gender differences need not be true to produce extreme gender segregation. Because many employers are exposed to the same taken-for granted cultural stereotypes about men's and women's average capacities, statistical discrimination can be a powerful mechanism for translating cultural beliefs about gender difference into gendered individual preferences and outcomes (Bielby, Baron 1986). We discuss this sort of macro-micro interplay further on.

Gender discrimination is difficult to measure - in part because it is illegal in the United States and few people will admit to it. Some of the most compelling evidence of discrimination in STEM hiring has been gathered through experiments and audit studies. One double-blind audit study demonstrated, for example, that STEM faculty members were less likely to hire female than male candidates for a lab manager position, because women were perceived to be less competent (Moss-Racusin et al., 2012; see also Goldin, Rouse, 2000). Other research has shown that faculty are more likely to respond to email requests for graduate mentoring from persons with male, white-sounding names (Milkman et al., 2015) and that scientific papers are judged to be of higher quality when attributed to a male author (Knobloch-Westerwick et al., 2013). In this volume, Blair-Loy et al. (2017) provide new evidence of unequal treatment in the STEM hiring process in the form of videotaped job talks that show more interruptions of women than men candidates for faculty engineering positions.

Importantly, supply-and demand-side processes can reinforce one another by generating self-fulfilling prophesies. For example, knowledge (or even rumors) of discrimination in male-dominated science and engineering fields may influence occupational aspirations, leading some girls and women to forego STEM training and thereby reducing their future competitiveness in these fields. STEM avoidance by a few girls can have multiplier effects because adolescents respond strongly to standards set by same-gendered peers (Legewie, DiPrete, 2014). Discriminatory treatment is also reinforced by behavioral responses to unbalanced gender ratios.

In her classic ethnography, Kanter (1977) showed how the intense visibility and performance pressures experienced by numerical minorities ("tokens") in work organizations give rise to stereotype-confirming behavior and interactions that reproduce existing inequalities (1977). For example, token women may react to discriminatory treatment and gender stereotyping by enacting some organizationally sanctioned version of femininity to which they can reasonably conform. The result is often constrained opportunities and feedback loops of disadvantage and personal dissatisfaction (Turco, 2010; Ridgeway, 2011; Banchefsky, Park, 2018; Garr-Schulz, Gardner, 2018).

The interactional processes that disadvantage women in male-dominated STEM workplaces are often compounded by other forms of minority status, including nonwhite or immigrant identities, and non-hegemonic forms of gender or sexuality (Fenstermaker, West, 2002; Williams et al., 2014; Alfrey, Twine, 2017; Cech, Pham, 2017; Ma, Liu, 2017; Sassler et al., 2017). In US academic physics, for example, the cultural image of the white male scientist intensifies pressure on women of color, who frequently face skepticism about their competence and belonging (Ong, 2005).

Macro-level explanations

Gender segregation of STEM is generated within social environments that vary widely. In the following, we consider how individual aptitudes and preferences are conditioned by broader structural and cultural forces.

A first set of macro-level accounts focus on societies or countries as the unit of analysis. One influential structural theory suggests a generically egalitarian effect of socioeconomic modernization-either because discrimination is too costly to sustain in competitive market economies (Treiman, 1970; Jackson, 1998; see also Cole, Cole, 1973 on meritocracy in science), or because countries absorb liberal universalistic cultural values from the affluent West as they modernize and develop tighter links to global institutions and world culture (Ramirez et al., 1997; Berkovitch, 1999; Meyer, 2010). Consistent with these evolutionary accounts, gender equality has increased around the world on many important dimensions-in particular with respect to formal legal rights and participation in labor markets and educational institutions. In other respects, however, inequality has proven to be highly resilient in the industrial West. Today some of the most gender-segregated STEM workforces are found in highly affluent, reputably gender-progressive societies (Charles, 2011b, 2017; Stoet, Geary, 2018).

The "postindustrial" restructuring of economies has had similarly uneven effects on gender stratification, supporting rising rates of female employment while also contributing to the consolidation of pink-collar "occupational ghettos" (Charles, Grusky) (4).

These shifting labor market dynamics have been reinforced by the postwar expansion of higher education—in particular, the proliferation of two-year and vocational institutions and the expansion of programs such as human development, home economics, and teacher education, which were explicitly designed to appeal to what were understood to be women's natural interests (Bradley, Charles, 2004). In short, women have often been incorporated as women into expanding labor markets and educational institutions. And since the middle of the twentieth century, "women's work" has not included most STEM occupations.

Gendered employment patterns are also heavily shaped by national policies and traditions. Social arrangements-for example, relating to hours, working conditions, family leaves, childcare, worker protection, and taxation-regulate individual behavior and reproduce normative modelsof work and

family (Buchmann, Charles, 1995; Gornick, Meyers, 2003; Thébaud, 2015; Ecklund, Lincoln, 2016). Social democratic policy regimes, which offer greater support to working parents, tend to promote more egalitarian family structures and higher rates of women's full-time employment (Charles, Cech, 2010; Pedulla, Thébaud, 2015; Hegewisch, Gornick, 2011), but they are at best weakly related to gender segregation in STEM-as evidenced in the highly segregated scientific and technical labor forces found in policy-progressive Scandinavian countries (Charles, Bradley, 2006; Charles, 2011a).

A second set of macro-level accounts focus on characteristics of workplaces and work organizations. For instance, much has been written about the role of organizational bureaucratization in reducing the operational salience of masculine, white, and heteronormative biases. Some studies show that technology firms that emphasize formal rules and procedures–as opposed to informal peer-group control–are characterized by less discrimination and more opportunities for recruitment and advancement of women scientists (McIlwee, Robinson, 1992; Baron et al., 2007). Other analyses suggest that formal bureaucracy obscures discrimination in "gendered organizations" by advancing structures that presume male workers but discourses that leave the gender of the ideal worker unspecified (Acker, 1990) (5). In one Swedish information and communication technology firm, for example, requirements for travel and long hours away from home were found to restrict women's ability to acquire advanced technological expertise and resulted in their concentration in administrative roles (Holth et al., 2017). But while workplace expectations for high temporal and spatial availability tend to elicit gendered responses (Blair-Loy, 2003; Zippel, 2017), they appear to affect advancement and retention in similar ways across different sorts of professional occupations (Glass et al., 2013). They do little, therefore, to explain the extreme gender segregation of STEM fields in particular.

Given the limited explanatory power of other accounts, it is not surprising that a growing body of research centers on the uniquely gendered cultural elements of STEM disciplines and work environments in Western societies and organizations. Gender is a dominant cultural frame that organizes everyday social relations, shapes individual identities, and inscribes gender inequality in social and economic institutions (Ridgeway, 2011). In contemporary Western societies, persons are widely presumed to occupy one of two distinct gender categories, and many work tasks are presumed to be intrinsically masculine or feminine (Bem, 1993; Faulkner, 2000; Nosek et al., 2002; Des Jardins, 2010). Many people believe, therefore, that occupations like engineering and preschool teaching are highly segregated *because* they require aptitudes and bodies that map neatly onto the "Mars and Venus" gender dichotomy. As such, occupations themselves become implicitly categorized by gender, just as people do. In the case of STEM, this categorization is often reinforced by the distinctively masculine cultural beliefs, norms, and practices that pervade STEM educational and work environments.

Of course, an occupation's gender composition depends upon diverse factors, including the economic and social conditions operative at the time of its expansion (e.g., labor shortages, technological developments, barriers to entry) and the functional and symbolic proximity of its task profile to work historically done by men or women. But, once segregated, occupational gender labels become imprinted in the popular imagination and are absorbed at an early age. "Draw-A-Scientist" studies show, for example, that young American children have taken for granted the masculinity of STEM workers for at least five decades (Miller et al., 2018). These gender labels are naturalized as people identify aspects of the work process (e.g., physical, analytical, or emotional demands) that support cultural stories about the occupation's intrinsic masculinity, often remembering evidence that is consistent with their preexisting beliefs and discounting evidence that undermines them (Bourdieu, 1975; Milkman, 1987; Fiske, 1998; Tolley, 2003; Charles, Grusky, 2004).

Greater exposure to women scientists and proximity to same-gender role-models appear to weaken these stereotype effects, however (Miller et al., 2018; Jacobs et al., 2017; Misra et al., 2017).

Evidence is growing that cultural beliefs associated with STEM occupations can bias cognition and affect individual decision-making, thereby reproducing occupational segregation. We believe that this interplay between macro and micro-level processes offers a particularly fruitful explanation for the resilience of gender segregation in STEM in advanced industrial societies.

Micro-macro interactions: cultural stereotypes into aspirations

The cultural gender stereotypes that we associate with people and jobs reproduce occupational segregation by affecting both labor demand and labor supply. On the demand side, the most obvious intermediary mechanisms are discrimination against workers and applicants whose gender does not "fit," or align with, the gender of the job, gendered recruitment practices, and biased assessments of individuals' relative qualifications (Becker, 1957; Phelps, 1980; Bielby, Baron, 1986; Foschi, 1996; Heilman, 2001). On the supply side, stereotyping reinforces segregation by leading people to make gender-conforming choices that affirm their masculinity or femininity, and avoid social sanctions and discriminatory work environments (West, Zimmerman, 1987; Ridgeway, 2011; Cech, 2013; Blair-Loy et al., 2017; Weisgram, Diekman, 2017). Research also shows that gender stereotypes affect supply-side processes by biasing people's understandings of their own aptitudes and affinities. That is, people may choose gender-conforming occupations because they believe, perhaps erroneously, that they will be more skilled at this work or enjoy it more (Correll, 2004; Charles, 2017). These biased self-understandings are powerful because they can shape occupational aspirations, and behaviors even in the absence of direct structural constraints, discrimination, or individual-level socialization.

For instance, recent research documents how cultural gender beliefs affect people's confidence in their abilities to carry out the technical tasks and assume the identities associated with gender-atypical occupational roles (Thébaud, 2010; Cech et al., 2011; Stets et al., 2017; Hill et al., 2017; Sanabria, Penner, 2017; Wynn, Correll, 2017). An important experimental study by Correll showed that women's exposure to (false) information about men's generally superior performance at a specific task led them to rate their own task performance lower and to express less interest than men in careers that purportedly draw upon related skills (2004). No gender gaps in self-assessments or aspirations were found when participants were exposed to the belief that men and women were equally proficient at the task.

Besides biasing self-assessments of ability, cultural gender stereotypes can also bias individuals' beliefs about their own affinities, so that they will more often expect to enjoy work that involves ender-conforming tasks. Cech (2013) finds that college students are more likely to later choose female-dominated occupations if they describe themselves in culturally feminine terms, such as emotional, unsystematic, and people-oriented. Comparative research suggests that this gender-typing of career aspirations is especially pronounced in affluent, "postmaterialist" societies (Charles, Bradley, 2009; Charles, 2017). In these contexts, concerns about existential security are less salient in career choices and cultural narratives emphasize "following your passions" and "doing what you love" (Inglehart, Welzel, 2005; Tokumitsu, 2015). Since many persons, especially adolescents, do not know in advance what they will love doing, postmaterialist career aspirations may be built more often upon stereotypes about what people like them (often same-gendered people) love. Girls, for example, may expect to enjoy work that they think will be more communal and interactive, and following these passions will probably not lead them toward the solitary science career depicted in Western popular culture.

The implication is that widespread cultural beliefs about how men and women are different and what they enjoy doing contribute to career choices that reproduce the gender order but are experienced as the expression of personal likes and dislikes.

This emotional buy-in contributes to the reproduction and legitimization of gender segregation in advanced industrial societies and helps account for the surprising cross-national differences in the gender composition of STEM occupations. Whereas ideologies of male primacy-and vertical inequalities-tend to weaken in affluent Western democracies, beliefs in categorical gender difference are easily reconciled with the liberal individualistic ideals that permeate these cultures (Charles, Grusky, 2004; Cotter et al., 2011; Levanon, Grusky, 2016; Knight, Brinton, 2017; Chatillon et al., 2018). Under these "postmaterialist" gender regimes, horizontal forms of gender segregation, such as professional women's underrepresentation in STEM fields, retain legitimacy because they are easily understood as the outcome of free choices by equal but innately different men and women. Culture can also affect performance in a stereotype-consistent manner. Experiments on "stereotype threat" show that people do worse on tests when they fear confirming a negative stereotype about their gender (or racial) group. In one study, a significant gender gap in test performance was observed when subjects were told that men generally do better, but not when they were told that men and women do equally well on the test (Spencer et al., 1999). Beliefs in essential gender differences in aptitudes have especially strong effects in fields such as STEM, where practitioners often attribute success to innate talent (Leslie et al., 2015). This is another way in which stereotypes can be self-fulfilling.

The preceding analysis has identified diverse ways in which cultural stereotypes contribute to the gender-typing of STEM - among other things, by influencing how men and women perceive themselves, how they are treated by others, and how societies and work environments are structured.

The cognitive schemas and life experiences that result from taken-for-granted cultural beliefs about men, women, and STEM produce aspirations and outcomes that are far more gender-differentiated than any underlying distribution of individual-level traits. They therefore have far more power to explain the extreme gender segregation of STEM fields observed in the contemporary United States. In the following section, we unpack the underlying content of cultural beliefs about the gendered nature of persons and jobs that are revealed in this volume and elsewhere. By assembling these stereotypes in one place, we hope to demonstrate their prevalence, range, and potential to shape individual cognition, aspirations, and behaviors. We also aim to articulate why the culture of many STEM disciplines and occupations remain bastions of masculinity in the contemporary United States.

Stereotypes about men, women, and STEM workers, work, and workplaces

Before discussing stereotypes that are specifically relevant to the segregation of STEM fields, we provide some general background on the descriptive and prescriptive content of gender stereotypes.

Descriptive and prescriptive gender stereotypes

For decades, social psychologists have documented the content of cultural stereotypes about men and women (see Rudman, Glick, 2008 for a summary). In the US context, men are believed to be more agentic and competent than women, whereas women are believed to be more communal than men. That is, men are not only privileged on competence-related traits like intelligence, skill, and capability, but they are also believed to be more able to get things done by

being more assertive, goal-oriented, ambitious, independent, competitive, and self-interested. By contrast, women are presumed to be primarily oriented toward others-by being more warm, kind, nurturing, friendly, and polite.

One might imagine that these descriptive stereotypes would be outdated, given women's progress toward equality in the workforce and in education over the last half-century. And indeed, a recent study suggests that that the belief that women are in general less intelligent or skilled than men has waned in more recent cohorts (Eagly, 2018). At the same time, though, research shows that especially high levels of intelligence or ability-characteristics like "brilliance," or "genius" –remain masculine-coded (Furnham et al., 2006; Stephens-Davidowitz, 2014), and stereotypes still privilege men's ability in male-typed tasks like mathematics (Ridgeway, 2011). Furthermore, there has not been any discernible change in the belief that women are less agentic than men, and stereotypes about women's greater communality are even more strongly held today than they were in earlier cohorts (Eagly, 2018).

Importantly, these commonly held beliefs do not merely describe men and women (i.e., they presumably are this way), but they also set prescriptive expectations for behavior (i.e., men and women ought to be this way) (Prentice, Carranza, 2002). For instance, being assertive and ambitious is intensely prescribed for men (i.e., cultural beliefs dictate that men really ought to possess this trait in order to be liked and respected by others), whereas being warm and kind is intensely prescribed for women (i.e., cultural beliefs dictate that women really ought to possess this trait in order to be liked and respected by others). This prescriptive dimension of gender stereotypes is critical for understanding persistent inequality, since it sets the foundation for several micro-interactional processes that ultimately motivate both men and women to behave in stereotype-consistent ways (Heilman, 2001; Rudman, Glick, 2008). It is noteworthy, however, that normative pressures to conform tend to be particularly strong for men because society places greater value on the traits and abilities associated with men and masculinity than on those associated with women and femininity (see e.g., Ridgeway, 2011). For instance, Rudman et al. (2012) demonstrate that the traits that men are supposed to possess are high in status (e.g., competitive), whereas the traits that women are supposed to possess are more neutral in status (e.g., friendly). In contrast, the traits that men are not supposed to possess are low in status (e.g., emotional) and the traits that women are not supposed to possess are high in status (e.g., aggressive). As such, it is not surprising that normative expectations and perceptions-especially when enforced by same-gender peers-are particularly relevant for understanding men's behavior, given that gender conformity translates into a status advantage for men but not for women (Kimmel, 2008; Pascoe, 2007).

Stereotype content and inequality in STEM

Both the descriptive and prescriptive content of stereotypes about men and women have direct implications for inequality in STEM. To begin, contemporary stereotypes about STEM workers, work, and workplaces simultaneously privilege masculine-coded traits like high levels of intelligence and agency while devaluing the communal traits that women supposedly possess. Many STEM fields, especially the more male-dominated ones like physics and computer science, share a culture in which high levels of raw talent and brilliance are viewed as essential to success. Recent studies suggest that differences across fields in the strength of this "brilliance narrative"- both among academics and within the broader culture-map directly onto the distribution of men and women across fields (Meyer et al., 2015; Leslie et al., 2015).

Beyond prizing high levels of raw intelligence, many science and engineering disciplines idealize workers who embody such stereotypically masculine traits as assertiveness, competitiveness, dominance, and strong identification with work (Bailyn, 2003; Cooper, 2000; Williams et al., 2006). Furthermore, a "geek" stereotype is today associated with many STEM fields and workers (Cheryan et al., 2009; Varma, 2007; Ensmenger, 2015). The "geek" cultural image is of a person who is exclusively interested in and focused on scientific or technological endeavors (e.g., someone who stays up all night coding). When the "geek" image is not valued, other forms of masculinity and masculine identity may be present. For instance, some technology workplaces have been found to valorize "brogrammers" – who are supposedly more sociable and outgoing than "geeks," but only in the way that a stereotypically party-focused fraternity brother would be (Alfrey, Twine, 2017; Wynn, Correll, 2014). Both the "geek" and frat-like "brogrammer" cultural images exemplify the agentic qualities that women supposedly lack, and they devalue the communal traits that women supposedly possess: such individuals are thought to lack "social skills," to be disconnected emotionally, and/or to be less caring toward others.

In our view, the broader implication of these numerous linkages between masculine traits and abilities and many STEM disciplines, workers, and workplaces is that men are not only perceived as a better "fit" for these social spaces from a descriptive point of view, but they are also likely to experience greater social pressure and rewards for pursuing them. That is, by pursuing one of these fields, a man can align his presumed abilities and interests with a high-status career, while also living up to prescriptive expectations for how he ought to behave. As such, his occupational choice is likely to increase his chances of being liked and respected as a man. The calculation is less clear for a woman. While she may be respected for pursuing a high status career, her choice may not necessarily be perceived as a good fit for her interests or abilities, and it may not win her greater admiration or respect as a woman. Instead, she may risk discrimination, dislike, or ostracism for being "too" aggressive, ambitious, etc. (see e.g., Heilman, 2001 on backlash effects). As such, men are more likely to experience strong incentives to pursue STEM fields and to retain commitment to them, whereas this not always the case for women, notwithstanding the material advantages of STEM careers.

This argument is supported by recent research on the linkage between masculine traits and abilities, STEM, and men's and women's decision-making. Gendered beliefs about the relationship between high levels of innate intelligence and qualification for particular pursuits have been shown to affect career aspirations from an early age. One recent study found that, by age six, girls are less likely than boys to believe that members of their gender are "really, really smart" and that they begin to avoid activities believed to be for children who are "really, really smart" (Bian et al., 2017). In this volume, Hill et al. (2017) similarly find that middle schoolers who believe that raw intelligence is a fixed trait from birth are more likely to endorse the idea that boys are better than girls at science and less likely to believe that they themselves could be a scientist. Sanabria and Penner (2017) also show that boys are more likely than girls to persist in STEM majors after failing an introductory calculus, perhaps because stereotypes about gender differences in mathematics ability make boys less likely to attribute poor test performance to a lack of intrinsic ability.

Presumptions of greater male scientific and technical competence also reinforce gender segregation through their effects on workplace interactions. Experimental studies show, for example, that women's expectations of discrimination and gender bias reduces their anticipated sense of belonging and their interest in STEM careers (Moss-Racusin et al., 2018).

Cech and Pham (2017) deepen our knowledge about this relative devaluation of feminine traits in STEM workplaces by illustrating the ways that lesbian, gay, bisexual and transgender (LGBT) workers-whose gender performance often deviates from normative expectations–experience disadvantage in STEM workplaces. It is this very disconnect between the cultural traits linked to women and the cultural traits linked to normative STEM workers and STEM workplaces that catalyzes inequality.

Men's stronger interest in and greater likelihood of persistence in STEM fields is also driven by gender-differentiated self-perceptions of fit and ability (Cheryan et al., 2009; Wynn, Correll, 2017) and the application of double standards for competence (Blair-Loy et al.; Foschi, 1996). Both of these mechanisms arise from the mismatch between expectations for STEM workers and expectations for women's behavior. Such stereotyping processes are especially insidious because they matter even when an individual personally disagrees with them (Ridgeway, Correll, 2004). That is, merely knowing that most other people hold certain beliefs about gender and STEM is enough to bias attitudes and behaviors. This is one reason why the content of stereotypes often remains relatively stable even in the face of changing occupational preferences and choices.

Finally, it is not just stereotypes about STEM workers and STEM workplace cultures that create a gender mismatch. As much of the research in this volume shows, stereotypes about the content of STEM work itself can deter women. For instance, many young people endorse the stereotype that science careers are not compatible with having a family. Weisgram and Diekman (2017) show that this belief, whether true or not, powerfully reduces many young women's interest in pursuing a science career. Similarly, Kyte and Riegle-Crumb (2017) find that holding the cultural belief that science is socially relevant-e.g., that science can help people or solve everyday problems-positively predicts young women's, but not young men's, intentions to major in a STEM field.

Sociocultural processes like these offer a fruitful alternative to the standard individual human capital and family-status explanations for gender differences in STEM entry and persistence.

The stereotypes identified here and elsewhere in the volume are important not only because they encourage social stigma and discriminatory treatment by others, but also because they cause people to under–or over-estimate their own qualifications and their own potential affinity for gender-nonconforming work. As a result, men and women (boys and girls) are likely to aspire to different occupations, pursue different educational and occupational pathways, and experience their work interactions and environments in gendered ways. In liberal egalitarian societies, many forms of gender inequality are reproduced and legitimated through the conversion of cultural stereotypes into gender-conforming preferences-and then into seemingly free choices by different-but-equal men and women (Charles, 2011b).

We turn next to consider the practical implications of this research: What, if anything, might be done to diversify STEM occupations?

Policy implications

Experimental and audit studies provide strong evidence that women's underrepresentation in scientific and technical fields is at least partly attributable to cultural gender stereotypes and discrimination, which can be converted subsequently into gender-specific aspirations and choices. Even if the composition of STEM occupations reflects gender-differentiated career

aspirations, this segregation may be problematic for at least three reasons. First, history shows that "separate but equal" principles generally produce unequal outcomes. This is evident, among other things, in the lower pay in women's than men's occupations (Levanon et al., 2009). Second, gender segregation has cultural feedback effects, reinforcing stereotypes and limiting perceived educational, family, and career options of subsequent generations. And third, women (and racial/ethnic minorities) represent an untapped labor pool globally in fields such as engineering and computer science, where shortages threaten to undermine national development or competitiveness. These concerns have motivated myriad initiatives by governments, non-governmental organizations, and industry leaders around the world to broaden and diversify opportunities in scientific and technical occupations and fields of study. The research presented in this volume suggests that gender integration will not come easy and will partly depend on increasing girls' and women's interest in STEM. This will in turn depend upon the erosion of two kinds of cultural stereotypes: those that depict women as intrinsically ill-suited for STEM work, and those that depict STEM work as uncreative, solitary, and masculine. While cultural change of this sort can only occur gradually, some efforts toward counter-stereotype programing are evident in the growing popularity of toys like GoldieBlox engineering kits and women Lego scientists, which provide parents of young girls with alternatives to toy store pink-aisle marketing. Also challenging male math nerd stereotypes are efforts to rebrand STEM as compatible with conventional femininity. These include books like Kiss my Math and Hot X: Algebra Exposed by actress Danica McKellar, and even an updated Barbie doll in 2010. While her 1992 Teen Talk sister recited canned phrases like "Math class is tough" and "Let's go shopping" Computer Engineer Barbie presents computing as both feminine and fun–a "geek chic" that essentially replaces one set of stereotypes with another.

A more aggressive strategy for reducing the salience of gender stereotypes would be to create more opportunities for girls and boys to learn directly about gender-nonconforming fields and about their own abilities to enjoy and excel in them. Expanded high school graduation requirements, including in mathematics, computer science, and engineering could help reduce reliance on stereotypes and increase girls' confidence in their mathematical and technical ability. Although such policies would seem to be at odds with American ideals of individual choice and self-expression, research suggests that they might also weaken penetration of gender stereotypes and reduce peer pressure in course taking. Comparative studies show that the gender gap in STEM aspirations and outcomes tends to be smaller in countries and schools where curricular choice is reduced or delayed and where high school science and mathematics curricula are stronger (Federman, 2007; Charles, Bradley, 2009; Cheryan et al., 2009; Legewie, DiPrete, 2014; Scheeren et al., 2018). This may be because reluctance to transgress gender norms declines with age (Gerson, 1985; Jacobs, 1989), or because exposing students to a broader array of fields provides them with better information about what they like and what they are good at.

In India, for example, a strong national mathematics curriculum makes girls more confident in their ability to learn computer skills, even if they are less likely to have computers at home, than their American counterparts (Varma, Kapur, 2015). In Malaysia and India, where women earn about 45% of information and communication technology (ICT) degrees, computing is viewed as a woman-friendly profession that offers a safe and pleasant indoor working environment.

This presents a sharp contrast with the male hacker image in the United States, where women earn only 23 percent of ICT degrees (Margolis, Fisher, 2002; Lagesen, 2008; Varma, Kapur, 2015; UNESCO, 2018).

But mandated early exposure will backfire without careful attention to the culture and organization of STEM classrooms and workspaces. Encouraging a sense of belonging for underrepresented groups requires work, study, and family environments that include diverse role models, supportive peer networks (including summer and afterschool clubs like Women in Engineering), and freedom from gender stereotypes and discrimination. Even the physical environment can matter. One experiment by Cheryan et al. (2009) showed that exposure to stereotype-consistent computer science classrooms (e.g., with Star Trek posters and video games visible) decreased girls', but not boys', interest in a computer science major, and that gender differences in interest were smaller when subjects were exposed to classrooms that did not conform to current stereotypes (e.g., with nature posters and phone books visible). College website descriptions may also attract more women by including information on the social relevance and collaborative nature of engineering (Da Costa, Stromquist, 2018). Some elite universities have recently implemented organizational changes aimed at undermining stereotypes about computer science work and diversifying the "boy hacker" culture. Changes have included revamping introductory computer science courses to offer a more inclusive and socially relevant curriculum, and increasing mentorship and peer support of underrepresented groups.

Increases in women's share of computer science graduates have been impressive, going from 10% to 40% in five years at Harvey Mudd College, for example (Cheryan et al., 2009).

Once women have entered a STEM job, organizations and governments will need to develop policies and practices that keep them there. Policies relating to work hours, flexible scheduling, family and sick leave, and childcare are important, but research shows that it is not enough to have these policies. Workplaces must have cultures that support their use – by both women and men. True or not, many STEM workers report stigma associated with using family accommodation policies (Cech, Blair-Loy, 2014). A key finding from the historical, experimental, and interview-based research reported in this volume and elsewhere, is that individual occupational preferences are social products. Aspirations for STEM work are shaped by the (real or perceived) culture of STEM fields and by deeply rooted beliefs about the intrinsic natures of men and women. American girls who aim to "study what they love" might be just as passionate about computer science and engineering as they are about teaching and nursing if they had more chances to find out whether they love these STEM fields (e.g., through required courses, after school clubs, or summer programs for underrepresented groups), and their passion might grow if they could more easily imagine themselves fitting into these professional cultures. Counter-stereotype programming, and more exposure to women scientists might help them make that leap of imagination.

Notes

(1) Even within engineering women and men tend to do different work: about 10% of mechanical and electrical engineers are women, compared to 20% of civil engineers.

(2) For a more general review of the literature on occupational gender segregation, see Wong and Charles (2018).

(3) Employer discrimination also figures prominently in queuing theory, which holds that modern labor markets are built around two queues: a labor queue in which employers rank the desirability of employees, and a job queue in which workers rank the attractiveness of jobs (Reskin, Roos, 1990). Because women are systematically ranked below men in the labor queue, they are overrepresented in the least attractive jobs.

(4) Many expanding industries (e.g., in childcare, health, elementary teaching) produce services that are symbolically or functionally linked to women's domestic work, and high labor demand has led some employers to reorganize these jobs to appeal to married women—for example, through part-time scheduling (Oppenheimer, 1973; Goldin, 1990; Charles, Grusky, 2004).

(5) Other organizational characteristics that have been linked to occupational gender segregation include firm size, personnel policies and practices, skill requirements, opportunities for team work, unionization rates, women's presence in management, and workplace traditions (Bielby, Baron, 1986; Baron et al., 1991; Reskin, McBrier, 2000; Smith-Doerr, 2004).

References

Abbate Janet (2012), *Recoding Gender: Women's Changing Participation in Computing,* Cambridge, MIT Press

Acker Joan (1990), *Hierarchies, Jobs, Bodies: A Theory of Gendered Organizations*, "Gender & Society", V. 4, N. 2, pp. 139–58

Alfrey Lauren, and France Winddance Twine (2017), *Gender-Fluid Geek Girls: Negotiating Inequality Regimes in the Tech Industry,* "Gender & Society", V.31, N. 1, pp. 28–50
https://journals.sagepub.com/doi/full/10.1177/0891243216680590#

Bailyn Lotte (2003), *Academic Careers and Gender Equity: Lessons Learned from MIT,"*Gender,Work and Organization*",* V. 10, N. 2, pp. 137–53
https://www.researchgate.net/publication/227511612_Academic_Careers_and_Gender_Equity_Lessons_Learned_from_MIT*1*

Banchefsky Sarah, and Bernadette Park (2018), *Negative Gender Ideologies and Gender-Science Stereotypes are More Pervasive in Male-dominated Academic Disciplines,* "Social Sciences", V.7, N. 2
https://www.mdpi.com/2076-0760/7/2/27

Baron James N., Mittman Brian S., and Newman Andrew E. (1991), *Targets of Opportunity: Organizational and Environmental Determinants of Gender Integration within the California Civil Service, 1979–1985,* "American Journal of Sociology", V. 96, N. 6, pp. 1362–401
https://www.jstor.org/stable/2781904?seq=1#page_scan_tab_contents

Baron James N., Hannan Michael T., Hsu Greta, and Koçak Özgecan (2007), *In the Company of Women: Gender Inequality and the Logic of Bureaucracy in Start-Up Firms*, "Work and Occupations", V. 34, N. 1, pp. 35–66
https://journals.sagepub.com/doi/10.1177/0730888406296945

Baron-Cohen, Simon (2003), *The Essential Difference: Male and Female Brains and the Truth about Autism*, New York, Basic Books

Becker Gary S (1957), *The Economics of Discrimination*, Chicago, University of Chicago Press

Becker Gary S (1985), *Human Capital, Effort, and the Sexual Division of Labor*, "Journal of Labor Economics", V. 3, N. 1, pp. S33–S58
https://www.jstor.org/stable/2534997?seq=1#page_scan_tab_contents

Bem Sandra Lipsitz (1993), *The Lenses of Gender: Transforming the Debate on Sexual Inequality,* New Haven, Yale University Press

Berkovitch Nitza (1999), *From Motherhood to Citizenship: Women's Rights and International Organizations*, Baltimore, Johns Hopkins University Press

Bian Lin, Leslie Sarah-Jane, and Cimpian Andrei (2017), *Gender Stereotypes about Intellectual Ability Emerge Early and Influence Children's Interests*, "Science", V. 355, N. 6323, pp. 389–91
https://science.sciencemag.org/content/355/6323/389

Bielby William T., and Baron James N. (1986), *Men and Women at Work: Sex Segregation and Statistical Discrimination*, "American Journal of Sociology", V. 91, N.4, pp. 616–58
https://www.jstor.org/stable/2779958?seq=1#page_scan_tab_contents

Blair-Loy Mary (2003), *Competing Devotions: Career and Family among Women Executives*, Cambridge, Harvard University Press

Blair-Loy Mary, Rogers Laura E., Glaser Daniela, Wong Y. L. Anne, Abraham Danielle, and Cosman Pamela C. (2017), *Gender in Engineering Departments: Are there Gender Differences in Interruptions of Academic Job Talks?*, "Social Sciences", V. 6, N. 1
https://www.mdpi.com/2076-0760/6/1/29

Bourdieu Pierre (1975), *The Specificity of the Scientific Field and the Social Conditions of the Progress of Reason*, "Social Science Information", V. 14, N. 6, pp. 19–47
https://journals.sagepub.com/doi/10.1177/053901847501400602

Bradley Karen, and Charles Maria (2004), *Uneven Inroads: Understanding Women's Status in Higher Education*, "Research in Sociology of Education", V. 14, pp. 247–74

Buchmann Marlis, and Charles Maria (1995), *Organizational and Institutional Factors in the Process of Gender Stratification: Comparing Social Arrangements in Six European Countries*, "International Journal of Sociology", V. 25, N. 2, pp. 66–95
https://www.jstor.org/stable/20628444?seq=1#page_scan_tab_contents

Cech Erin A. (2013), *The Self-Expressive Edge of Occupational Sex Segregation*, "American Journal of Sociology", V. 119, N. 3, pp. 747–89
https://www.jstor.org/stable/10.1086/673969?seq=1#page_scan_tab_contents

Cech Erin A., and Blair-Loy Mary (2014), *Consequences of Flexibility Stigma among Academic Scientists and Engineers*, "Work and Occupations", V. 41, N. 1, pp. 86–110
https://journals.sagepub.com/doi/abs/10.1177/0730888413515497?journalCode=woxb

Cech Erin A., and Pham Michelle V. (2017), *Queer in STEM Organizations: Workplace Disadvantages for LGBT Employees in STEM Related Federal Agencies*, "Social Sciences", V. 6, N. 1
https://www.mdpi.com/2076-0760/6/1/12

Cech Erin A., Rubineau Brian, Silbey Susan, Seron Carroll, (2011), *Professional Role Confidence and Gendered Persistence in Engineering*, "American Sociological Review", V. 76, N. 5, pp. 641–66
https://journals.sagepub.com/doi/abs/10.1177/0003122411420815

Ceci Stephen J., and Williams Wendy M (2011), *Understanding Current Causes of Women's Underrepresentation in Science*. "Proceedings of the National Academy of Sciences of the United States of America", V. 108, N. 8, pp. 3157–62
https://www.pnas.org/content/108/8/3157

Charles Maria (2011a), *What Gender Is Science?*, "Contexts", V. 10, N. 2, pp. 22–28
https://contexts.org/articles/what-gender-is-science/

Charles Maria (2011b), *A World of Difference: International Trends in Women's Economic Status*, "Annual Review of Sociology", V. 37, pp. 355–71
https://www.annualreviews.org/doi/abs/10.1146/annurev.soc.012809.102548

Charles Maria (2017), *Venus, Mars, and Math: Gender, Societal Affluence, and Eighth Graders' Aspirations for STEM*, "Socius: Sociological Research for a Dynamic World", V. 3, pp. 1–16
https://journals.sagepub.com/doi/full/10.1177/2378023117697179

Charles Maria, and Bradley Karen, (2006), *A Matter of Degrees: Female Underrepresentation in Computer Science Programs Cross-Nationally,* in *Women and Information Technology: Research on the Reasons for Underrepresentation*, edited by Joanne McGrath Cohoon and Bill Aspray, Cambridge, MIT Press, pp. 183–203

Bradley Karen, Charles Maria (2009), *Indulging Our Gendered Selves? Sex Segregation by Field of Study in 44 Countries*, "American Journal of Sociology", V. 114, N. 4, pp. 924–76
https://www.jstor.org/stable/10.1086/595942?seq=1#page_scan_tab_contents

Charles Maria, and Cech Erin (2010), *Beliefs about Maternal Employment,* in *Dividing the Domestic: Men, Women, and Household Work in Cross-National Perspective*, edited by Judith Treas and Drobnič Sonja, Palo Alto, Stanford University Press, pp. 147–74

Charles Maria, and Grusky David B. (2004), *Occupational Ghettos: The Worldwide Segregation of Women and Men*, Stanford, Stanford University Press

Chatillon Anna, Charles Maria, and Bradley Karen, (2018), *Gender Ideologies*, in *Handbook of the Sociology of Gender,* edited by Barbara J. Risman, Carissa Froyum and William Scarborough, New York, Springer, pp. 217–26

Cheryan Sapna, Plaut Victoria C., Davies Paul G, and Steele Claude M. (2009), *Ambient Belonging: How Stereotypical Cues Impact Gender Participation in Computer Science*, "Journal of Personality and Social Psychology", V. 97, N. 6, pp. 1045–60
https://www.ncbi.nlm.nih.gov/pubmed/19968418

Cole Jonathan R., and Cole Stephen (1973), *Social Stratification in Science*, Chicago, University of Chicago Press

Cooper Marianne (2000), *Being the Go-to Guy: Fatherhood, Masculinity, and the Organization of Work in Silicon Valley*, "Qualitative Sociology", V. 23, N. 4, pp. 379–405
https://link.springer.com/article/10.1023/A:1005522707921

Correll Shelley J. (2004), *Constraints into Preferences: Gender, Status, and Emerging Career Aspiration*, "American Sociological Review", V. 69, N. 1, pp. 93–113
https://journals.sagepub.com/doi/10.1177/000312240406900106

Cotter David, Hermsen Joan M., and Vanneman Reeve (2011*), The End of the Gender Revolution? Gender Role Attitudes from 1977 to 2008*, "American Journal of Sociology", V. 117, N. 1, pp. 259–89
https://www.jstor.org/stable/10.1086/658853?seq=1#metadata_info_tab_contents

Da Costa Romina B., and Stromquist Nelly P. (2018), *Framing Engineering: The Role of College WebsiteDescriptions*, "Social Sciences", V. 7, N. 1
https://www.mdpi.com/2076-0760/7/1/7

Des Jardins Julie (2010), *The Madame Curie Complex: The Hidden History of Women in Science*, New York, CUNY Press

Eagly Alice H. (1995), *The Science and Politics of Comparing Women and Men*, "American Psychologist", V. 50, N. 3, pp. 145–58
https://psycnet.apa.org/record/1995-21141-001

Eagly Alice H. (2018), *Have Gender Stereotypes Changed? Yes and No* "Presentation at INSEAD Women at Work Conference" February 17
https://www.youtube.com/watch?v=ewOsOtHB-I8 (accessed on 2 July 2018)

Ecklund Elaine Howard, and Lincoln Anne E. (2016), *Failing Families, Failing Science: Work-Family Conflict in Academic Science*, New York, NYU Press

Ensmenger Nathan (2015), *Beards, Sandals, and Other Sings of Rugged Individualism: Masculine Culture within the Computing Professions*, "Osiris", V. 30, N. 1, pp. 38–65
https://www.ncbi.nlm.nih.gov/pubmed/27066618

Epstein Cynthia Fuchs (1988), *Deceptive Distinctions: Sex, Gender and the Social Order*, New Haven, Yale University Press

Faulkner Wendy (2000), *Dualisms, Hierarchies, and Gender in Engineering*, "Social Studies of Science", V. 30, N. 5, pp. 759–92
https://www.jstor.org/stable/285764?seq=1#page_scan_tab_contents

Federman Maya (2007), *State Graduation Requirements, High School Course Taking, and Choosing a Technical College Major*, "The B.E. Journal of Economic Analysis and Policy", V. 7, N. 1, pp. 1–34
https://www.degruyter.com/abstract/j/bejeap.2007.7.1/bejeap.2007.7.1.1521/bejeap.2007.7.1.1521.xml

Fenstermaker Sarah, and West Candace (2002), *Doing Gender, Doing Difference: Inequality, Power, and Institutional Change*, New York, Routledge

Fiske Susan T. (1998), *Stereotyping, Prejudice, and Discrimination,* In "Handbook of Social Psychology", edited by Daniel T. Gilbert, Susan T. Fiske and Gardner Lindzey, New York, McGraw-Hill, pp. 357–411

Foschi Martha (1996), *Double Standards in the Evaluation of Men and Women*, "Social Psychology Quarterly", V. 59, N. 3, pp. 237–54
https://www.jstor.org/stable/2787021

Furnham Adrian, Crawshaw Julia, and Rawles Richard (2006), *Sex Differences in Self-Estimates on Two Validated IQ Test Subscale Scores*, "Journal of Applied Psychology", V. 36, N. 2, pp. 417–440
https://onlinelibrary.wiley.com/doi/abs/10.1111/j.0021-9029.2006.00013.x

Garr-Schulz Alexandra, and Gardner Wendi L. (2018), *Strategic Self-presentation of Women in STEM*, "Social Science", V. 7, N. 2
https://www.mdpi.com/2076-0760/7/2/20

Gerson Kathleen (1985), *Hard Choices: How Women Decide about Work, Career, and Motherhood*, Berkeley, University of California Press

Glass Jennifer, Sassler Sharon, and Michelmore Katherine M. (2013), *What's So Special about SEM? A Comparison of Women's Retention in STEM and Professional Occupations*, "Social Forces", V. 92, N. 2, 723–56
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4279242/

Goldin Claudia (1990), *Understanding the Gender Gap*, Oxford, Oxford University Press

Goldin Claudia, and Rouse Cecilia (2000), *The Impact of 'Blind' Auditions on Female Musicians*, "The American Economic Review", V. 90, N. 4, pp. 713–41

Gornick Janet C., and Meyers Marcia K. (2003), *Families That Work: Policies for Reconciling Parenthood and Employment*, New York, Russell Sage Foundation

Gray John (2012), *Men Are from Mars, Women Are from Venus: The Classic Guide to Understading the Opposite Sex*, New York, Harper

Grier David Alan (2005), *When Computers Were Human*, Princeton, Princeton University Press

Hegewisch Ariane, and Gornick Janet C. (2011), *The impact of work-family policies on women's employment: A review of research from OECD countries*, "Community, Work and Family", V. 14, N. 2, pp. 119–38
https://www.tandfonline.com/doi/abs/10.1080/13668803.2011.571395

Heilman Madeline E. (2001), *Description and Prescription: How Gender Stereotypes Prevent Women's Ascent up the Organizational Ladder*, "Journal of Social Issues", V. 57, N. 4, pp. 657–74
https://psycnet.apa.org/record/2001-05792-002

Hill Patricia Wonch, McQuillan Julia, Talbert Eli, Spiegel Amy, Gauthier G. Robin , and Diamond Judy (2017), *Science Possible Selves and the Desire to be a Scientist: Mindsets, Gender Bias, and Confidence during Early Adolescence*, "Social Sciences", V. 6, N. 2
https://www.ncbi.nlm.nih.gov/pubmed/29527360

Holth Line, Bergman Ann, and MacKenzie Ann (2017), *Gender, Availability and Dual Emancipation in the Swedish ICT Sector*, "Work, Employment and Society", V. 31, N. 2, pp. 230–247
https://journals.sagepub.com/doi/abs/10.1177/0950017016651378

Hyde Janet Shibley (2005), *The Gender Similarities Hypothesis,* "American Psychologist", V. 60, N. 6, pp. 581–92
https://www.apa.org/pubs/journals/releases/amp-606581.pdf

Inglehart Ronald F., and Welzel Christian (2005), *Modernization, Cultural Change, and Democracy: The Human Development Sequence*, New York, Cambridge University Press

Jackson Robert Max (1998), *Destined for Equality: The Inevitable Rise of Women's Status*, Cambridge, Harvard University Press

Jacobs Jerry A. (1989), *Long-Term Trends in Occupational Segregation by Sex,* "American Journal of Sociology", V. 95, N. 1, pp. 160–73
https://www.jstor.org/stable/2780409?seq=1#page_scan_tab_contents

Jacobs Jerry A, Ahmad Seher, and Sax Linda J. (2017), *Planning a Career in Engineering: Parental Influence on Sons and Daughters*, "Social Sciences", V. 6, N. 1
https://www.mdpi.com/2076-0760/6/1/2/pdf

Jordan-Young Rebecca M. (2010), *Brainstorm: The Flaws in the Science of Sex Differences*, Cambridge, Harvard University Press

Kanter Rosabeth Moss (1977), *Men and Women of the Corporation*, New York, Basic Books

Kimmel Michael (2008), *Guyland: The Perilous World Where Boys Become Men*, New York, Harper Collins

Knight Carly R., and Brinton Mary C. (2017), *One Egalitarianism or Several? Two Decades of Gender-Role Attitude Change in Europe*, "American Journal of Sociology", V. 122, N. 5, pp. 1485–532
https://scholar.harvard.edu/files/brinton/files/knight.brinton.ajs_.pdf

Knobloch-Westerwick Sylvia, Glynn Carroll J., and Huge Michael (2013), *The Matilda Effect in Science Communication: An Experiment on Gender, Bias* in *Publication Quality Perceptions and Collaboration Interest*, "Science Communication", V. 35, N. 5, pp. 603–25
https://journals.sagepub.com/doi/abs/10.1177/1075547012472684

Kyte Sarah Blanchard, and Riegle-Crumb Catherine (2017), *Perceptions of the Social Relevance of Science: Exploring the Implications for Gendered Patterns in Expectations of Majoring in STEM Fields*, "Social Sciences", V. 6, N. 1
https://ideas.repec.org/a/gam/jscscx/v6y2017i1p19-d90984.html

Lagesen Vivian Annette (2008), *A Cyberfeminist Utopia? Perceptions of Gender and Computer Science among Malaysian Women Computer Science Students and Faculty*, "Science, Technology, & Human Values", V. 33, N. 1, pp- 5-27

Legewie Joscha, and DiPrete Thomas A. (2014), *The High School Environment and the Gender Gap in Science and Engineering*, "Sociology of Education", V. 87, N. 4, pp. 259-80
https://journals.sagepub.com/doi/abs/10.1177/0038040714547770?journalCode=soea

Leslie Sarah-Jane, Cimpian Andrei, Meyer Meredith and Freeland Edward (2015), *Expectations of Brilliance Underlie Gender Distributions across Academic Disciplines*, "Science", V. 347, N. 6219, pp. 262-65
https://science.sciencemag.org/content/347/6219/262

Levanon Asaf, and Grusky David B. (2016), *The Persistence of Extreme Gender Segregation in the Twenty-First Century*, "American Journal of Sociology", V.122, N. 2, pp. 573-619
https://www.journals.uchicago.edu/doi/abs/10.1086/688628?journalCode=ajs

Levanon Asaf, England Paula, and Allison Paul (2009), *Occupational Feminization and Pay: Assessing Causal Dynamics Using 1950-2000 U.S. Census Data*, "Social Forces", V. 88, N. 2, pp. 865-92
http://www.statisticalhorizons.com/wp-content/uploads/2012/01/88.2.levanon.pdf

Luker Kristin (2008), *Salsa Dancing in the Social Sciences: Research in an Age of Info-Glut*, Cambridge, Harvard University Press

Ma Yingyi (2009), *Family Socioeconomic Status, Parental Involvement and College Major Choices: Gender, Race/Ethnicity, and Nativity Patterns*, "Sociological Perspectives", V. 52, N. 2, pp. 211-34
https://journals.sagepub.com/doi/10.1525/sop.2009.52.2.211

Ma Yingyi, and Liu Yan (2017), *Entry and Degree Attainment in STEM: The Intersection of Gender and Race/Ethnicity*, "Social Sciences", V. 6, N. 3

Margolis Jane, and Fisher Allan (2002), *Unlocking the Clubhouse: Women in Computing*, Cambridge, The MIT Press

Marini Margaret Mooney, and Brinton Mary C. (1984), *Sex Typing and Occupational Socialization. In Sex Segregation in the Workplace: Trends, Explanations, and Remedies*. Edited by Barbara Reskin, Washington, National Academy Press, pp. 192–232

McIlwee Judith, and Robinson J. Gregg (1992), *Women in Engineering: Gender, Power, and Workplace Culture*, Albany, SUNY Press

Meyer John W. (2010), *World Society, Institutional Theories, and the Actor*, "Annual Review of Sociology", V. 36, pp. 1-20

Meyer Meredith, Cimpian Andrei, and Leslie Sarah-Jane (2015), *Women are Underrepresented in Fields Where Success is Believed to Require Brilliance,* "Frontiers in Psychology", V. 6
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4356003/

Milkman Ruth (1987), *Gender at Work: The Dynamics of Job Segregation by Sex during World War II*, Urbana, University of Illinois Press

Milkman Katherine L., Modupe Akinola, and Dolly Chugh (2015), *What Happens Before? A Field Experiment Exploring How Pay and Representation Differentially Shape Bias on the Pathway into Organizations*, "Journal of Applied Psychology", V. 100, N. 6, pp. 1678-712
https://www.ncbi.nlm.nih.gov/pubmed/25867167

Miller David I., Nolla Kyle M, Eagly Alice H., and Utall David H. (2018), *The Development of Children's Gender-Science Stereotypes: A Meta-analysis of 5 Decades of US Draw-A-Scientist Studies*, "Child Development", V. 89, N. 6, pp. 1943-55
https://www.ncbi.nlm.nih.gov/pubmed/29557555

Mincer Jacob, and Polachek Solomon (1974), *Family Investments in Human Capital: Earnings of Women*, "Journal of Political Economy", V. 82, N. 2, pp. S76-108
https://www.jstor.org/stable/1829993?seq=1#page_scan_tab_contents

Misra Joya, Smith-Doerr Laurel, Dasgupta Nilanjana, Weaver Gabriela, and Normanly Jennifer (2017), *Collaboration and Gender Equity among Academic Scientists*, "Social Sciences", V. 6, N 1
https://econpapers.repec.org/article/gamjscscx/v_3a6_3ay_3a2017_3ai_3a1_3ap_3a25-_3ad_3a92165.htm

Moss-Racusin Corrine A., Dovidio John F., Brescoll Victoria L., Graham Mark J., and Handelsman Jo (2012), *Science Faculty's Subtle Gender Biases Favor Male Students*, "Proceedings of the National Academy of Sciences", V. 109, N. 41, pp. 16474–79
https://www.pnas.org/content/109/41/16474

Moss-Racusin Corrine A., Sanzari Christina, Caluori Nava, and Rabasco Helena (2018), *Gender Bias Produces Gender Gaps in STEM Engagement*, "Sex Roles", V. 79, N. 11-12, pp. 1–20
https://link.springer.com/article/10.1007/s11199-018-0902-z

National Science Foundation 1561430/1561507-HRD, *Women in Engineering in Predominately Muslim Countries*, n.d., WIEPMC,
http://womeninengineeringpmcs.org

Nores Milagros (2010), *Differences in College Major Choice by Citizenship Status*, "Annals of the American Academy of Political and Social Science", V. 627, N. 1, pp. 125–41
https://journals.sagepub.com/doi/10.1177/0002716209348747

Nosek Brian A., Banaji Mahzarin R, and Greenwald Anthony G. (2002), *Math = Male, Me = Female, Therefore Math ≠ Me*, "Journal of Personality and Social Psychology", V. 83, N. 1
https://www.ncbi.nlm.nih.gov/pubmed/12088131 NSF (National Science Foundation) (2018), "Science and Engineering Indicators 2018"; NSB-2018-1, Alexandria, *National Science Foundation*
https://www.nsf.gov/statistics/indicators/ (accessed on 2 July 2018)

Okamoto Dina, and England Paula (1999), *Is There a Supply Side to Occupational Sex Segregation*, "Sociological Perspectives", V. 42, N. 4, pp. 557-82
https://www.jstor.org/stable/1389574

Ong Maria (2005), *Body Projects of Young Women of Color in Physics: Intersections of Gender, Race, and Science*, "Social Problems", V. 52, N. 4, pp. 593-617

Oppenheimer Valerie K. (1973), *Demographic Influence on Female Employment and the Status of Women*, "American Journal of Sociology", V. 78, N. 4, pp. 946–61
https://www.jstor.org/stable/2776613?seq=1#page_scan_tab_contents

Parsons Talcott, and Bales Robert F. (1955), *Family, Socialization, and Interaction Process*, Glencoe, Free Press

Pascoe Cheri J. (2007), *Dude, You're a Fag: Masculinity and Sexuality in High School*, Berkeley, University of California Press

Pedulla David S., and Thébaud Sarah (2015), *Can We Finish the Revolution? Gender, Work-Family Ideals, and Institutional Constraint*, "American Sociological Review", V. 80, N. 1, pp. 116–39
https://www.ncbi.nlm.nih.gov/pubmed/26365994

Penner Andrew M. (2008), *Gender Differences in Extreme Mathematical Achievement: An International Perspective on Biological and Social Factors*, "American Journal of Sociology", V. 114, N. S1, pp. S138–70
https://www.ncbi.nlm.nih.gov/pubmed/19569403

Phelps Edmund S. (1980), *The Statistical Theory of Racism and Sexism. In The Economics of Women and Work*, edited by Alice H. Amsden, New York, St. Martin's Press, pp. 206–10

Prentice Deborah A., and Carranza Erica (2002), *What Women and Men Should Be, Shouldn't Be, Are Allowed to Be, and Don't Have to Be: The Contents of Prescriptive Gender Stereotypes*, "Psychology of Women Quarterly", V. 26, N. 4, pp. 269–81
https://journals.sagepub.com/doi/10.1111/1471-6402.t01-1-00066

Ramirez Francisco O., Yasemin Soysal, Suzanne Shanahan (1997), *The Changing Logic of Political Citizenship: Cross-National Acquisition of Women's Suffrage Rights, 1890 to 1990*, "American Sociological Review", V. 62, N. 5, pp. 735–45
https://www.jstor.org/stable/2657357?seq=1#page_scan_tab_contents

Reskin Barbara, and Branch McBrier Debra (2000), *Why Not Ascription? Organizations' Employment of Male and Female Managers*, "American Sociological Review", V. 65, N. 2, pp. 210–33
https://www.jstor.org/stable/2657438?seq=1#page_scan_tab_contents

Reskin, Barbara, and Roos Patricia (1990), *Job Queues, Gender Queues: Explaining Women's Inroads into Male Occupations*, Philadelphia, Temple University Press

Ridgeway Cecilia L. (2011) *Framed by Gender: How Gender Inequality Persists in the Modern World*, New York, Oxford University Press

Ridgeway Cecilia L., and Correll Shelley J. (2004), *Unpacking the Gender System*, "Gender & Society", V. 18, N. 4, pp. 510–31

Ridgeway Cecilia, and Smith-Lovin Lynn (1999), *The Gender System and Interaction*, "Annual Review of Sociology", V. 25, pp. 191–216
https://www.annualreviews.org/doi/abs/10.1146/annurev.soc.25.1.191

Rudman Laurie A., and Glick Peter (2008), *The Social Psychology of Gender: How Power and Intimacy Shape Gender Relations*, New York, The Guilford Press

Rudman Laurie A., Moss-Racusin Corrine A., Phelan Julie E., and Nauts Sanne (2012), *Status Incongruity and Backlash Effects: Defending the Gender Hierarchy Motivates Prejudice toward Female Leaders*, "Journal of Experimental Social Psychology", V. 48, N. 1 , pp. 165–79
https://www.sciencedirect.com/science/article/pii/S0022103111002514

Sanabria Tanya, and Penner Andrew (2017), *Weeded out? Gendered Responses to Failing Calculus*, "Social Sciences", V. 6, N. 2
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5878940/

Sassler Sharon, Michelmore Katherine, and Smith Kristin (2017), *A Tale of Two Majors: Explaining the Gender Gap in STEM Employment among Computer Science and Engineering Degree Holders*, "Social Sciences", V. 6, N. 3
https://www.mdpi.com/2076-0760/6/3/69

Scheeren Lotte, Van de Werfhorst Herman G., and Bol Thijs (2018), *The Gender Revolution in Context: How Later Tracking in Education Benefits Girls*, "Social Forces", V. 96
https://academic.oup.com/sf/article-abstract/97/1/193/4967675

Shauman Kimberlee A. (2017), *Gender Differences in the Early Employment Outcomes of STEM Doctorates*, "Social Sciences", V. 6, N. 1
https://www.mdpi.com/2076-0760/6/1/24

Smith-Doerr Laurel (2004), *Women's Work: Gender Equality vs. Hierarchy in the Life Sciences*, Boulder, Lynne Rienner Publishers

Spencer Steven J., Steele Claude M., and M. Quinn Diane (1999), *Stereotype Threat and Women's Math Performance*, "Journal of Experimental Social Psychology", V. 35, N. 1, pp. 4–28
https://www.sciencedirect.com/science/article/pii/S0022103198913737

Stephens-Davidowitz Seth (2014), *Google, Tell Me: Is My Son a Genius?*, "The New York Times", January 18
https://www.nytimes.com/2014/01/19/opinion/sunday/google-tell-me-is-my-son-a-genius.html

Stets Jan E., Brenner Philip S., Burke Peter J., and Serpe Richard T (2017), *The Science Identity and Entering a Science Occupation,* "Social Science Research", V. 64, pp. 1–14
https://www.sciencedirect.com/science/article/pii/S0049089X15300545

Stoet Gijsbert, and Geary David C. (2018), *The Gender-Equality Paradox in Science, Technology, Engineering, and Mathematics Education*, "Psychological Science", V. 29, N. 4, pp. 581–93
https://www.ncbi.nlm.nih.gov/pubmed/29442575

Thébaud Sarah (2010), *Gender and Entrepreneurship as a Career Choice: Do Self-Assessments of Ability Matter?*, "Social Psychology Quarterly", V. 73, N. 3, pp. 288–304
https://www.jstor.org/stable/27896237?seq=1#page_scan_tab_contents

Thébaud Sarah (2015), *Business as Plan B: Institutional Foundations of Gender Inequality in Entrepreneurship across 24 Industrialized Countries*, "Administrative Science Quarterly", V. 60, N. 4, pp. 671–711
https://journals.sagepub.com/doi/abs/10.1177/0001839215591627

Tokumitsu Miya (2015), *Do What You Love: And Other Lies About Success & Happiness*, New York, Simon & Schuster

Tolley Kim (2003), *The Science Education of American Girls: A Historical Perspective*, New York and London, Routledge Falmer

Treiman Donald J. (1970), *Industrialization and Social Stratification,* in *Social Stratification: Research and Theory for the 1970s*. Edited by Edward O. Laumann., Indianapolis, Bobbs-Merrill, pp. 207–34

Turco Catherine J. (2010), *Cultural Foundations of Tokenism: Evidence from the Leveraged Buyout Industry*, "American Sociology Review", V. 75, N. 6, pp. 894–913
https://journals.sagepub.com/doi/abs/10.1177/0003122410388491?journalCode=asra

UNESCO (United Nations Educational, Scientific and Cultural Organization), (2018), UIS, Stat Database
http://data.uis.unesco.org/

Varma Roli (2007), *Women in Computing: The Role of Geek Culture*, "Science as Culture", V. 16, N. 4, pp. 359–76
https://www.tandfonline.com/doi/abs/10.1080/09505430701706707?journalCode=csac20

Varma Roli, and Kapur Deepak (2015), *Decoding Femininity in Computer Science in India*, "Communications of the Association for Computing Machinery", V. 58, N. 5, pp. 56–62
https://cacm.acm.org/magazines/2015/5/186026-decoding-femininity-in-computer-science-in-india/abstract

Weisgram Erica S., and Diekman Amanda B. (2017), *Making STEM 'Family Friendly': The Impact of Perceiving Science Careers as Family-Compatible*, "Social Sciences", V. 6, N. 2
https://www.mdpi.com/2076-0760/6/2/61

West Candace, and Zimmerman Don H. (1987), *Doing Gender*, "Gender & Society", V. 1, N. 2, pp. 121–51

Williams Joan, Alon Tamina, and Bornstein Stephanie (2006), *Beyond the Chilly Climate: Eliminating Bias against Women and Fathers in Academe. Thought and Action*, "The NEA Higher Education Journal", pp. 79–96

Williams Joan C., Philipps Katherine W., and Hall Erika V. (2014), *Double Jeopardy? Gender Bias against Women of Color in Science*, UC Hastings College of the Law www.worklifelaw.org (accessed on 2 July 2018)

Wong Yan Ling Anne, and Charles Maria (2018), *Occupational Gender Segregation*, in *Companion to Gender Studies*, edited by Nancy A. Naples, Hoboken, Wiley-Blackwell

Wynn Alison T., and Correll Shelley J. (2014), *Puncturing the Pipeline: Do Technology Companies Alienate Women in Recruiting Sessions? Paper presented at the American Sociological Association Annual Meeting*, San Francisco, CA, USA, August 16–19

Wynn Alison T., and Correll Shelley J. (2017), *Gendered Perceptions of Cultural and Skill Alignment in Technology Companies*, "Social Sciences", V. 6, N. 2
https://www.researchgate.net/publication/318267548_Gendered_Perceptions_of_Cultural_and_Skill_Alignment_in_Technology_Companies

Xie Yu, and Shauman Kimberlee (2003), *Women in Science: Career Processes and Outcomes*, Cambridge, Harvard University Press

Zippel Kathrin (2017), *Women in Global Science: Advancing Academic Careers through International Collaboration*, Stanford, Stanford University Press