Geena Davis Institute on Gender in Media
If she can see it, she can be it.™

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AN INITIATIVE OF THE LYDA HILL FOUNDATION

PORTRAY HER:

Representations of Women STEM Characters in Media

THE LYDA HILL FOUNDATION & THE GEENA DAVIS INSTITUTE ON GENDER IN MEDIA

MESSAGE FROM GEENA DAVIS

At the Geena Davis Institute on Gender in Media, we've conducted numerous studies over the years showing that diverse and high-quality portrayals of women and girls are quite simply missing from children's media. This has a real impact on young viewers' ideas about themselves and the occupations
they pursue.

Nowhere is this phenomenon more apparent than in the Science, Technology, Engineering, and Math (STEM) fields, where only one-quarter of scientists and engineers in the United States are female. The factors that contribute to women's slim presence in the sector are undoubtedly complex, but we know that media play a contributing role. In 2012, my Institute analyzed occupations in children's media and found that for every 15 male characters shown in STEM jobs there was only one female character portrayed in a STEM profession. When girls in their formative years don't see female characters on screen as biochemists, software developers, engineers, or statisticians, they are less likely to imagine or pursue those career paths for themselves.

GEENA DAVIS

However, when girls do see women in STEM in media, it has a significant impact. Our 2018 study, "The Scully Effect," looked at the influence of The X-Files' protagonist Dana Scully on girls and women entering the STEM field. Nearly two-thirds of women working in STEM today say that Scully served as their personal role model and increased their confidence to excel in a male-dominated profession. In other words, as we say, "If she can see it, she can be it."

Because of our early focus on this area, we've been eager to examine this issue more closely and give STEM representation in children's media the full attention it deserves. As Michelle Obama says, "We need all hands on deck. And that means clearing hurdles for women and girls as they navigate careers in science, technology, engineering, and math."

That's why I was thrilled with the opportunity to partner with Lyda Hill, an entrepreneur and philanthropist with a passion for science and math, and a spirit for bucking the status quo, on this groundbreaking new study. With her support, we have conducted an extensive ten year content analysis of STEM characters in entertainment media and a nationally representative survey of girls and young women. These two methods enabled us to assess how STEM professions are represented in media, and how these representations (and messages from society more broadly) affect girls' perceptions of and participation in STEM. The results published here show once again the profound role that media play in shaping young people's aspirations and career paths.

Increasing media depictions of women in STEM is easy to do, and provides a big bang for the buck. There are concrete steps that those of us within the entertainment industry can take to encourage more girls and women to pursue jobs in this important sector, raising up all of those with the potential to become our future STEM visionaries and innovators.

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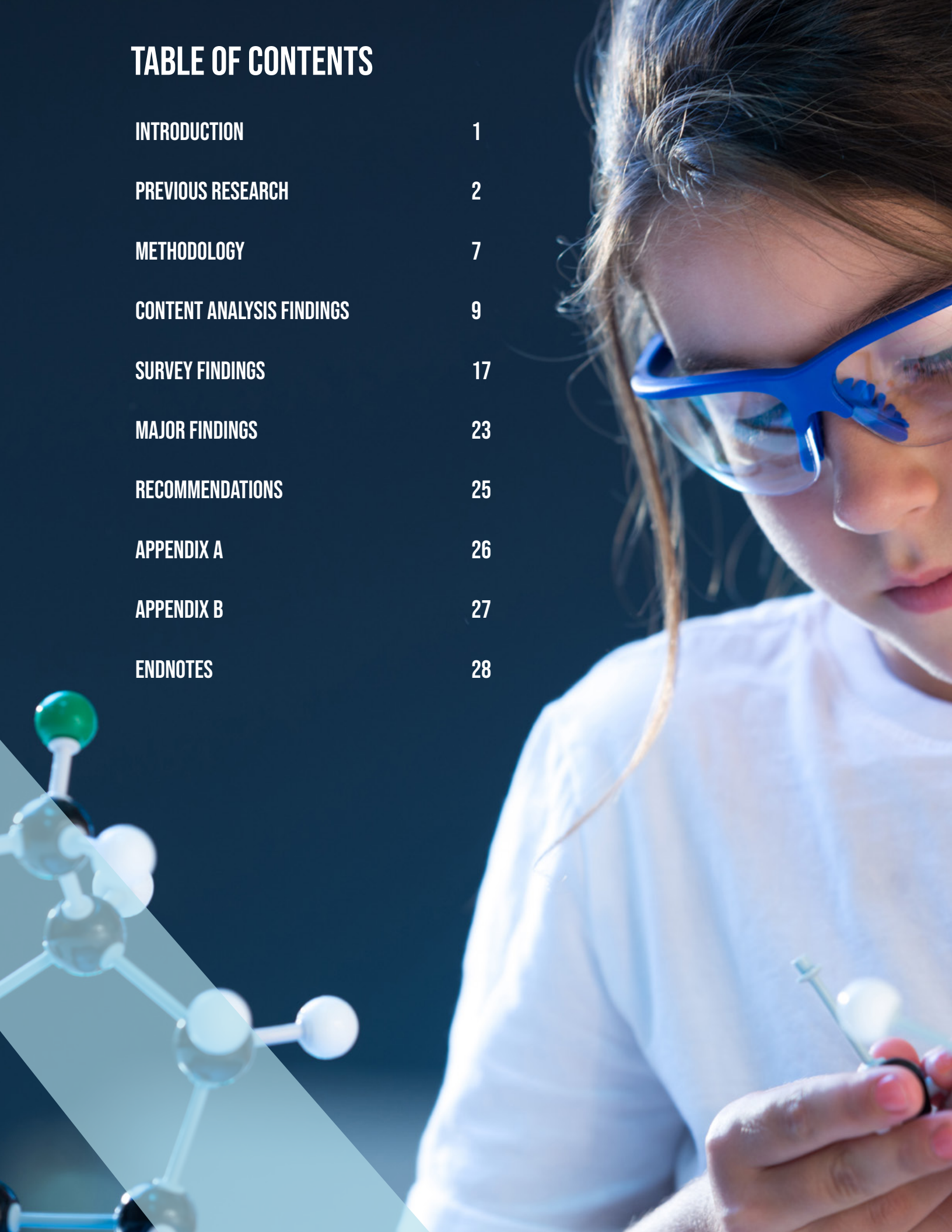


INTRODUCTION

Women have experienced rapid advances in many professional roles in recent decades, but they remain underrepresented in science, technology, engineering, and mathematics (STEM) professions.[1]

Women constitute half (48%) of the college-educated workforce in the U.S., but hold only a quarter (24%) of jobs in STEM.[2] Women, especially Latinx and Asian-American women,[3] have seen a marked increase in STEM participation starting in the late 1990s, but their numbers remain low.

The purpose of this report is to better understand why women are persistently underrepresented in STEM, and to examine the role of entertainment media in contributing to this underrepresentation. To this end, we conducted a content analysis of STEM characters in entertainment media and a nationally representative survey of girls and young women. These two methods enable us to assess how STEM professions are represented in media, and how these representations (and messages from society more broadly) affect girls' perceptions of and participation in STEM.

This report was produced through a collaboration between the Lyda Hill Foundation, a private foundation committed to funding transformational advances in science and nature, and the Geena Davis Institute on Gender in Media, the first research-based organization working within the media and entertainment industry to improve gender representation. This alliance between Dallas entrepreneur and philanthropist Lyda Hill, and Academy Award winning actor Geena Davis, epitomizes the power women have to create a more equitable world when they combine their influence with a singular goal in mind.

PREVIOUS RESEARCH

THE LEAKY PIPELINE

Three decades of research on gender disparities in STEM have produced the apt metaphor of a "leaky pipeline" in which girls and women leave STEM at every key joint.[4] The "joints" in this metaphor represent childhood, high school, college, graduate school, STEM professions, and STEM leadership positions. Existing research finds that boys receive more encouragement than girls to get involved in STEM as children, are more active in STEM activities in high school, more likely to pursue STEM degrees in college, more likely to enter a STEM profession, more likely to stay in a STEM profession, and are more likely to advance to leadership positions within STEM. We begin with a description of what happens at each joint of the pipeline, then examine the larger underlying issues that drive down the number of girls and women in STEM.

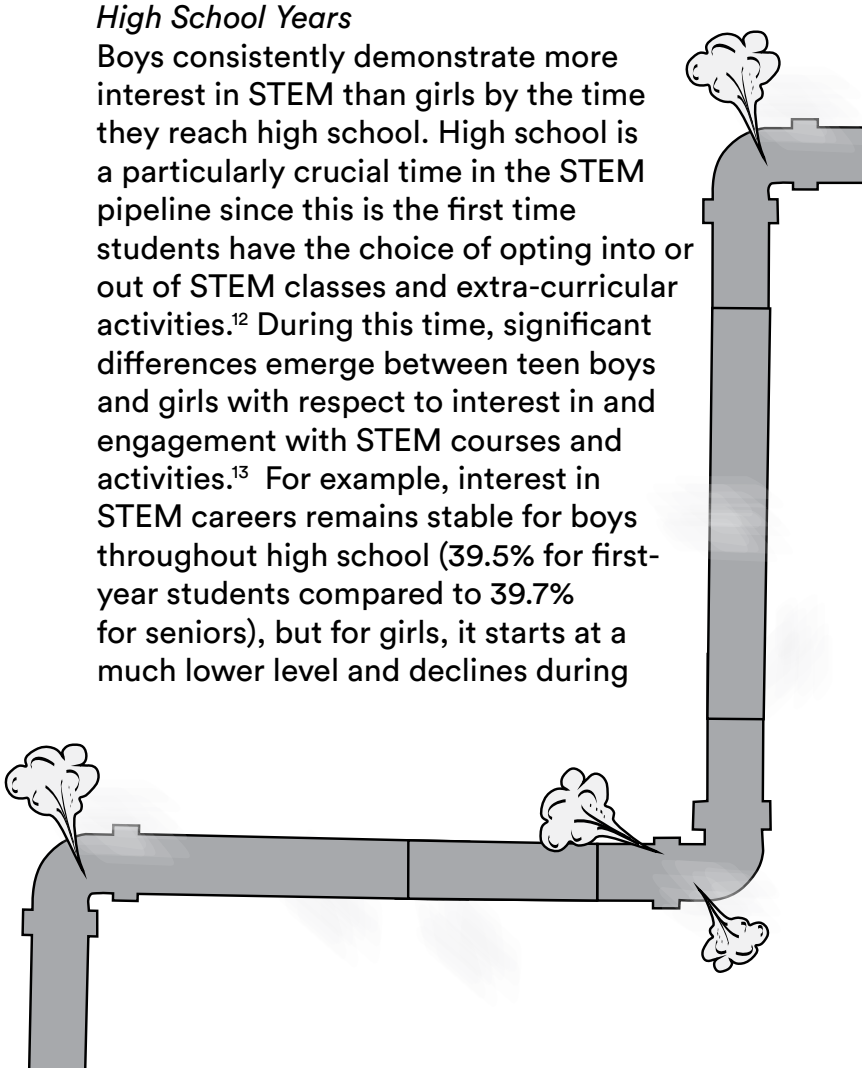
Childhood

Gender bias in STEM begins in childhood. Although girls and boys engage in STEM-related activities at a similar rate, they vary in the type of activity and the encouragement they receive from adults. Following gender stereotypes, boys are more likely to engage with tools (e.g., microscopes) and girls with planting and related activities (e.g., growing food).[5] Also, parents provide boys with more opportunities to learn about STEM than girls, and these opportunities are contingent upon expressed interest for girls but not boys.[6] In other words, boys receive encouragement from parents to pursue STEM, whether or not they appear to be interested in these subjects. Parents also offer more encouragement to boys than girls in subtle ways. One study finds that, during visits to interactive science museums, parents are three times more likely to explain scientific concepts to boys than girls.[7]

Boys and girls show similar levels of interest in STEM from the first through sixth grades,[8] but gender biases in exposure to and encouragement of STEM pursuits produce a gap in interest and engagement by early adolescence.[9] According to Amanda Deikman, the gender gap in expressed interest in pursuing a STEM career is moderate among middle school and high school students, but becomes larger among college students.[10] These early gaps in interest are important because they predict STEM career choices in adulthood.[11]

High School Years

Boys consistently demonstrate more interest in STEM than girls by the time they reach high school. High school is a particularly crucial time in the STEM pipeline since this is the first time students have the choice of opting into or out of STEM classes and extra-curricular activities.[12] During this time, significant differences emerge between teen boys and girls with respect to interest in and engagement with STEM courses and activities.[13] For example, interest in STEM careers remains stable for boys throughout high school (39.5% for first-year students compared to 39.7% for seniors), but for girls, it starts at a much lower level and declines during



high school (15.7% for first-year students compared to 12.7% for seniors).[14]

College Years
High school girls and college women outperform male students in math classes,[15] but college women are significantly less likely than men to choose STEM majors, and remain underrepresented in the number of bachelor's degrees earned in STEM majors.[16] Since the late 1990s, women earned a majority (57.0%) of bachelor's degrees and roughly half of all degrees in biological science,[17] but they receive far fewer degrees in computer science (17.9%), engineering (19.3%), physical science (39.0%), and mathematics (43.1%).[18]

When it comes to advanced degrees, women earn about one-fourth of the doctorates in mathematics and statistics.[19] Only 10% of graduate degrees earned by women are in STEM fields compared to 24% of graduate degrees earned by men.[20] At the Ph.D. level, STEM-granting programs with better resources and higher levels of student funding have significantly lower inclusion of women students than other Ph.D. programs.[21]

STEM Professions
Fewer women pursue careers in STEM than men. Over 6.7 million men in the U.S. have a degree in STEM compared to 2.5 million women.[22] Of women with a STEM degree, only 26% work in a STEM occupation compared to 40% of men.[23] In other words, fewer women pursue STEM degrees than men, and women who do have such degrees often choose occupations outside of STEM (such as education).

Women in STEM also experience bias in hiring, promotion, and compensation. For example, a pioneering study of gender inequality at the Massachusetts Institute of Technology found that women STEM faculty are paid less, promoted less often, and awarded fewer resources than men faculty.[24] Additionally, women faculty members tend to spend more time on teaching and less time on research than men faculty members.[25] And perhaps most notably, men in STEM are more likely to advance to leadership positions than women, even in fields with roughly equal numbers of men and women.[26]

ROOT CAUSES

Research from the past decade definitively concludes that gender differences in ability do not account for the gender gap in STEM.[27] So what factors do account for the attrition of girls and women at each joint in the leaky pipeline? We know that parents and educators are more likely to encourage boys and young men to pursue STEM, and that women in STEM face gendered obstacles to success in the field, but what are the root causes behind this gendered treatment? Decades of research on the subject finds that stereotypes, gender role incongruity, gendered family concerns, perceptions of gender discrimination, and available career options are driving the gender gap in STEM. We address each of these issues in turn.

Stereotypes

Jennifer Saucerman and Kris Vasquez find that "parents, teachers, toys, social norms, and media representations all play a part in discouraging girls and women from entering into STEM fields."[28] These people and institutions are reinforcing stereotypes that define science as a stereotypical pursuit for men.

Stereotypes that align science with men have existed for the better part of a century and continue to surface in media depictions. These portrayals often reinforce the stereotype of the lone, nerdy scientist in a lab coat, mostly portrayed as an awkward white man (seen in Best Buy's Geek Squad ads)[29] or a "mad scientist."[30] Media also depicts STEM as a masculine domain. According to Lori Kendall, "nerd" culture that emerged in the 1980s was built around a limited idea of masculinity that excluded most men of color, gay men, and women.[31] This culture framed science as a pursuit of charming misfits that excluded girls and women. Additionally, these characters portray science as a "masculine" pursuit, and adolescent girls demonstrate less interest than boys in pursuing occupations they see as "masculine."[32]

The stereotype of science being a man's pursuit is widespread, held by children, adolescents, adults, and scientists. For example, in David Chamber's classic 1983 analysis, only 28 "scientists" out of 5,000 drawn by children were women, and all were drawn by girls. Boys and girls continue to draw mostly men scientists in updated versions of this experiment.[33] Children pair men and math as early as age seven,[34] and from an early age they perceive of men as being better at science than women. Studies of implicit stereotype bias find that most men and women hold stereotypes pairing men and math.[35]

Stereotypes affect women's interest in and pursuit of STEM careers. Women who hold implicit stereotypes pairing men and math have more negative attitudes toward STEM.[36] Additionally, high school girls who hold stereotypes linking men and math are less likely to be interested in STEM or choose a science major.[37] Many women internalize stereotypes about STEM abilities and see themselves as less competent than men in math.[38] Furthermore, women perceive of themselves as less confident in STEM, which leads to poorer test performance.[39]

A recent study from the American Association of University Women finds that girls and women internalize the stereotype of STEM as being for men, and this, coupled with experiences of gender bias from parents, teachers, and professors, discourages many from pursuing a STEM career.[40]

Stereotypes also affect the attitudes of others toward girls and women in STEM. Elizabeth Gunderson finds that parents' stereotypes about their daughter's math ability predict her interest and performance in math classes.[41] Stereotypes also influence evaluations of women scientists. In one experiment, identical research abstracts were submitted to scientists with the only difference being the gender of the name. Abstracts with a woman's name were rated as lower in quality and less worthy of collaboration by scientists than abstracts with a man's name.[42] Another experiment shows that STEM faculty are more likely to hire men for mathematical work than women based on identical resumes.[43] Women's career options in STEM are constrained by cultural assumptions about their supposed lack of ability.[44]

Role Congruity

Researchers have identified a second major cause of the gender gap in STEM professions: goal incongruity. Girls in the U.S. are raised with more of a community orientation than boys,[45] which means they are more likely to prioritize working with others and helping others.[46] Role congruity theory, developed by Alice Eagly, contends that women and men are given different social roles, and these roles are reinforced through social rewards and consequences.[47] STEM professions are less attractive to women because stereotypes of scientists show this work as highly individualized and mostly performed for personal benefit.[48] Community-oriented individuals avoid STEM professions because they are not seen as meeting the goals of collaborative work,[49] altruism,[50] and benefitting others.[51]

Stereotypes of lone scientists are misleading and do not reflect the communal nature of scientific work and motives. STEM work is often collaborative and aimed at helping others, but is stereotyped to the contrary, even amongst STEM majors in college.[52] Although women value communal goals more than men, both groups value communal goals, which means more people would pursue STEM careers if they were more accurately perceived. People who perceive STEM as achieving communal goals have more positive attitudes toward STEM,[53] and students in middle school, high school, and college who perceive science as helping others are more inclined to pursue a science career.[54]

Work-Family Challenges

Work-family challenges are another barrier to women in STEM. Adolescent girls are more likely than adolescent boys to value work that enables them to spend time with family,[55] and this value orientation carries forward into their college years and professional life. High school students who desire a family-flexible job tend to avoid fields they perceive as masculine, including STEM occupations.[56] One study of scientifically talented women in their mid-30s finds that they place more value on community and family relationships than their male counterparts.[57]

Media reinforces the idea that STEM fields are not family-flexible. In television programming aimed at children in middle school, the typical scientist is a highly intelligent, unmarried white man who does not have children.[58] Women scientists are rare in these programs, but when shown, they are also typically portrayed as highly intelligent, white, unmarried, and without children. These depictions reinforce the idea that being a scientist is incompatible with being a parent.

Adolescents and young adults view STEM careers as providing little family-flexibility,[59] and these perceptions are accurate. Women in STEM fields experience professional penalties for having children that their men colleagues do not experience.[60] For example, Stephen Ceci et al. finds that it is difficult for women to pursue a career in math and raise a family because children "interrupt" educational and professional timelines and promotions.[61] Women avoid and drop out of STEM careers because these occupations do not provide family-flexibility.

Gender Discrimination

Emerging research finds that college-bound women avoid specific majors if they believe they will face gender discrimination in that field later on.[62] More specifically, researchers find that women headed to college do not avoid STEM fields because more math and science are required, but because they think they will encounter gender discrimination in STEM professions. In fact, perception of gender bias in professions is "the dominant predictor of gender balance in college majors" for both STEM and non-STEM majors.[63]

When it comes to actual rates of gender discrimination and sexual harassment in the workplace, women in majority-male professions (such as STEM) report higher rates than women in other professions (49% compared to 32%).[64] Furthermore, women working in STEM report that gender discrimination and sexual harassment are common problems. According to a 2018 study from the Pew Research Center, for women in STEM, "the workplace is a different, sometimes more hostile environment than the one their male coworkers experience. Discrimination and sexual harassment are seen as more frequent, and gender is perceived as more of an impediment than an advantage to career success."[65] Specifically, half (50%) of women in STEM say they have experienced gender discrimination, while one-third (36%) say sexual harassment is a problem in their workplace.[66] Perceptions of sexism in STEM fields come from lived experiences of discrimination, which pose an impediment to recruiting college women into STEM-related majors.

"Choice"

Another challenge for recruiting women into STEM professions is their abundance of options. Students with both high verbal and mathematical skills have greater career options to choose from, and people with both skill sets tend to choose non-STEM careers. Girls with high math competency are more likely than boys with high math competency to also have high verbal ability, so they have more career choices than the typical mathematically inclined boy.[67] The broader career pathways available to young women partially accounts for their tilt away from STEM careers.[68]

METHODOLOGY

We used a mixed methods approach (a content analysis and survey) to address our primary questions of why women are persistently underrepresented in STEM, and how entertainment media contributes to this.

CONTENT ANALYSIS

We conducted a content analysis of STEM characters in entertainment media, the most comprehensive longitudinal content analysis of STEM characters to date. Initially, we wanted to assess the portrayals of STEM characters in children's media, but discovered that there were too few STEM characters in kids' programming to analyze in a statistically meaningful way, so we broadened our sample to include entertainment media for all ages.[69] A team of eleven researchers analyzed these characters in the top rated television/cable shows, films, and streaming platforms. We were able to draw conclusions about STEM representations over time and across the various platforms.

Prior to initiating the work, the research team engaged in a total of 48 hours of training that included codebook development and tests to measure inter-coder reliability. Initial inter-coder reliability tests were performed on characters in a popular STEM show to ensure that agreement was reached on each of the variables being measured. Inter-rater reliability was achieved in terms of both absolute agreement (.88) and interclass correlation coefficient (.76) measures. We describe the samples generated for each platform below.

Television/Cable

We analyzed STEM characters in the most watched television/cable programs from 2007 to 2017. To locate characters, we first generated a list of the 100 most watched television/cable shows each year from 2007 to 2017 based on ranking data from Nielsen. Then we excluded shows that could not have featured leading or major STEM characters (e.g., Monday night football). For the purpose of this study, leading and major characters were defined as those featured prominently in more than one scene and integral to the plot. Of the remaining shows, we identified STEM characters in each show using online industry character information. Overall, 21,932 characters fit our criteria for inclusion in the study, and from this list, we generated a representative random sample for analysis with a +3% confidence interval at the 95% level. Our final TV/cable sample included 587 STEM characters.

Film

We also analyzed STEM characters in the top 100 grossing films each year from 2007 to 2017 based on ranking data from *Variety*.[70] We used character names and plot summaries from online sources to identify STEM characters. A total of 977 leading or major characters in films of the last decade fit our inclusion criteria. From that universe, we selected a representative sample of 191 film characters to analyze.

Streaming Platforms

We also analyzed STEM characters from 60 of the most popular 2017 shows on Hulu, Netflix, and Amazon, the three most popular streaming platforms. We then identified STEM characters in these shows using character and plot descriptions from online sources. Overall, we identified 2,178 episodes with STEM characters in streaming shows. We took a

random sample of STEM characters in these shows, which produced a representative sample of 229 STEM characters for analysis.

Our total content analysis dataset includes 1,007 STEM characters across all platforms. In this report, we present figures from our longitudinal analysis of characters in film, television, and streaming platforms across the decade. It is important to note that for streaming content, we analyzed the top-watched shows of 2017, but the shows consumed in 2017 spanned the decade in terms of the years in which they were originally aired.

STEM SURVEY

For the survey part of our study, we worked with The GfK Group (formerly Knowledge Networks), a leading survey research organization operating in more than 100 countries with over 13,000 research staff. GfK created the first online research panel that is representative of the entire U.S. population. Panel members are randomly recruited through probability-based sampling, and households are provided with access to the Internet and hardware if needed. GfK recruits panel members by using address-based sampling methods. Once household members are recruited for the panel and assigned to a study sample, they are notified by email for survey taking, or panelists can visit their online member page for survey taking. The online nature of the sample allows surveys to be fielded quickly and economically. In addition, this approach reduces the burden placed on respondents, since email notification is less intrusive than telephone calls and respondents have the convenience to choose what day and time to complete their assigned survey.

We administered our STEM survey from April 5, 2018 to April 23, 2018. The sample included three groups: girls in middle school, girls in high school, and young women ages 18-24 years old who are currently full-time college students. To generate the sample, GfK identified parents of 11-18 year old girls from its KnowledgePanel and 18-24 year old women panelists. The response rate for the survey was 52%.

KnowledgePanel is a probability-based web panel designed to be representative of the United States. A nonprobability sample was selected to augment the 18-24 year college sample, who confirmed gender, age and education level to qualify for this study. The overall sample was weighted to account for parent's selection probability, the selection of one woman/child per household, college student selection probability, and the geodemographic distribution of eligible girls/women. See Appendix A for a more detailed summary of the sample weighting process. The final survey dataset includes 915 respondents with 306 middle school students, 305 high school students, and 304 college students.

CONTENT ANALYSIS FINDINGS

In this part of the report, we present findings from our content analysis of a decade of STEM characters in film, television, and streaming content. We begin with an analysis of the demographics of STEM characters to determine whether biases are found in terms of gender, race/ethnicity, and age representations. In the next section, we examine how STEM characters are represented with a specific eye on portrayals of intelligence and competence. We also examine occupational stereotypes of STEM as a solo, self-interested, family-inflexible pursuit. We then analyze representations in children's programming (films and shows for viewers ages 12 and younger). Throughout the report, we analyze differences between characters in life sciences versus other STEM fields. We only report differences that are significant at the .10 level. Please note that not all percentages in this report will add up to 100%.[71]

BACKGROUND CHARACTERISTICS

We begin with an analysis of the portrayals of STEM characters from the last decade in terms of gender, race, and age.

Gender

- Men STEM characters significantly outnumbered women STEM characters in film, television, and streaming content from 2007 - 2017 (62.9% compared to 37.1%). This sends the message to girls and women that STEM professions are primarily for men (Figures 1 & 2).
- Women STEM characters were twice as likely to appear in television (41.1%) and streaming (40.6%) content than in films (20.9%). This stark difference shows that while television and streaming content are approaching equity in their representation of women in STEM, films rarely include women STEM characters.

Race/Ethnicity

- The vast majority of STEM characters in entertainment media were White (71.2%), while fewer were Black (16.7%), Asian/Asian-American (5.6%), Latinx (3.9%), and Middle Eastern (1.7%) (Figure 3). We compare White characters and characters of color throughout this report to assess whether significant racial differences exist.

FIGURE 1

GENDER OF STEM CHARACTERS IN FILM, TELEVISION & STREAMING

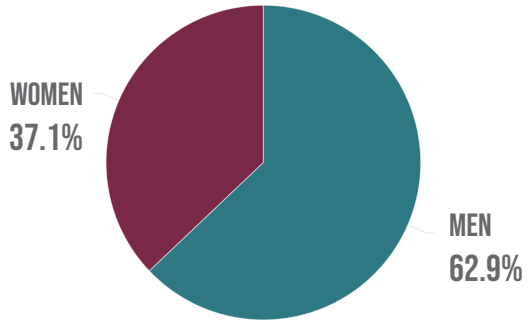


FIGURE 2

PERCENTAGE OF WOMEN STEM CHARACTERS, 2007-2017

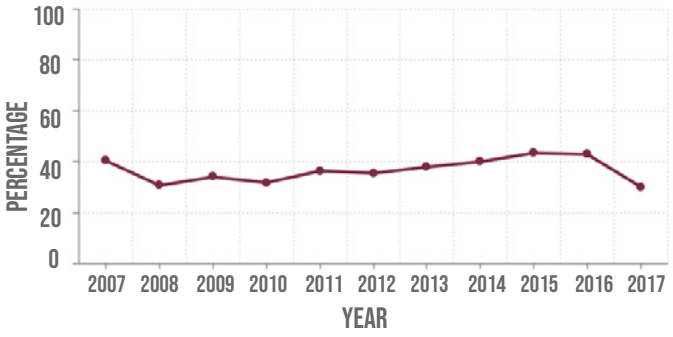
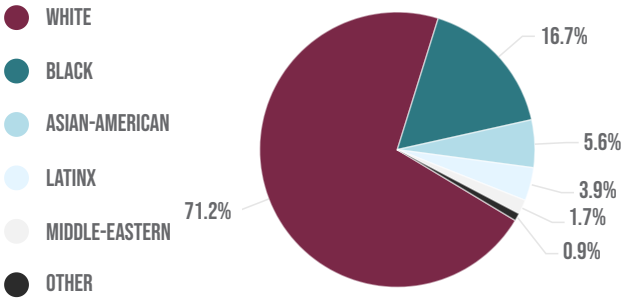


FIGURE 3

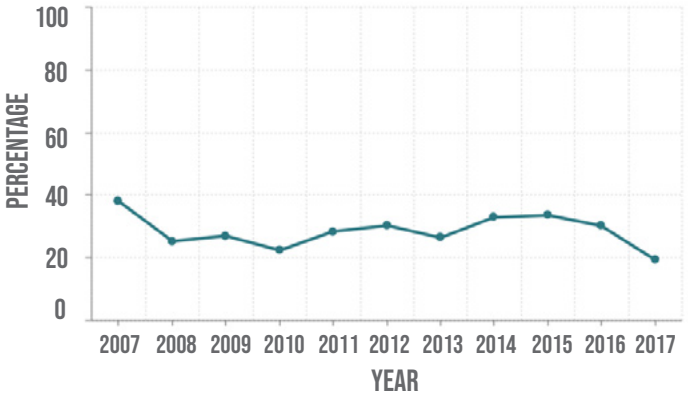
RACE OF STEM CHARACTERS IN FILM, TELEVISION & STREAMING



- STEM characters of color were better represented in streaming content (33.2%) than television programs (28.3%) and films (25.1%).
- As shown in Figure 4, the percentage of STEM characters of color fluctuated over the last decade, with a notable drop in 2017. This indicates that the underrepresentation of STEM characters of color has not improved in the last decade.

FIGURE 4

PERCENTAGE OF STEM CHARACTERS OF COLOR, 2007-2017

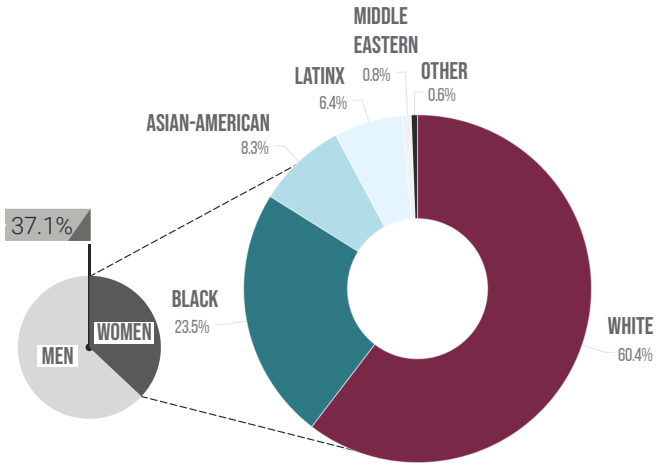


Throughout this report, we analyze the intersection of race and gender (when the numbers within categories are large enough to do so). Intersectionality is the concept that social identities, such as race, class, and gender, create overlapping systems of discrimination and oppression.[72] In other words, at the individual level, experiences of bias are amplified if a person fits multiple categories of marginalization.

- Three-in-five women STEM characters were White (60.4%), while 23.5% were Black, 8.3% were Asian/Asian-American, 6.4% were Latinx, and less than one percent were Middle Eastern (Figure 5). This means that although women were underrepresented in STEM professions overall, women of color and white women appeared at rates that roughly match their percentages in the population.

FIGURE 5

RACE OF WOMEN STEM CHARACTERS



Age

- Researchers estimated character age by decade. About half of the STEM characters from the last decade were in their 30s (45.9%), while fewer were in their 40s (23.9%) and 20s (14.3%). Far fewer were older – in their 50s (7.9%) or 60s (6.3%). This means that when STEM characters were shown, they were typically shown as relatively early professionals in their career (given that most STEM careers require college and graduate school degrees that take the better part of a decade to complete).

This analysis of demographic characteristics finds that women and people of color were underrepresented as STEM characters in entertainment media, and these gaps have been particularly pronounced in films of the last decade compared to television programs and streaming content. We also found that the bias in gender and race portrayals of STEM characters fluctuated year to year, but did not show steady improvement in the last decade.

CHARACTER PROMINENCE

This section summarizes our analysis of the prominence of STEM characters in terms of gender and race. We measured prominence in three ways: whether the

character was the protagonist, whether they played a hero, and whether they played a villain.

The gender of protagonists matters because it sends a subtle message about whose stories are worth telling. The hero archetype holds particular importance because it speaks to the hero we see in ourselves: a person who triumphs over the inherent struggles we all face. The villain is also important because this archetype tends to be complex and crucial to the plotline. Protagonists, heroes, and villains are the characters that are the most prominent and therefore the most influential.

Leading Characters

- STEM characters were rarely featured in leading roles, and when they were, men STEM characters were moderately (but significantly) more likely than women STEM characters to be leads (10.8% compared to 7.5%).
- Figure 6 shows the percentage of women STEM leads over the last decade. While the percentage fluctuated, reaching a high of 14.8% in 2012, the representation of women as leads in STEM has not shown steady improvement over the decade.
- White women STEM characters were far more likely to be featured as leads than women of color STEM characters (11.1% compared to 2.0%) (Figure 7).

FIGURE 6

PERCENTAGE OF WOMEN STEM LEADS, 2007-2017

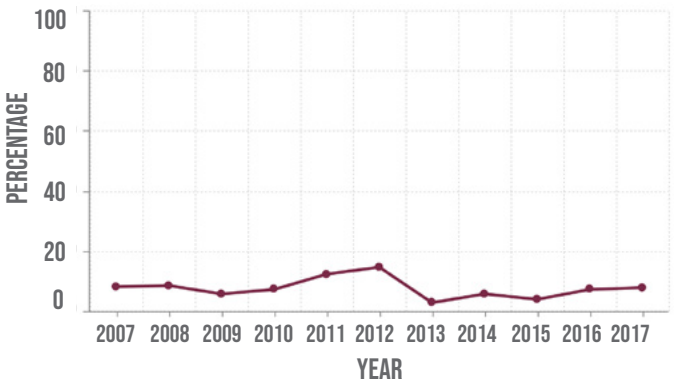
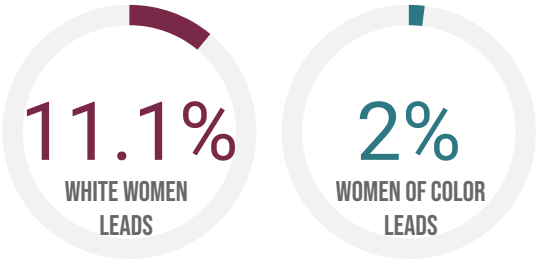


FIGURE 7

STEM LEADS WHO ARE WHITE WOMEN, WOMEN OF COLOR



Hero Portrayals

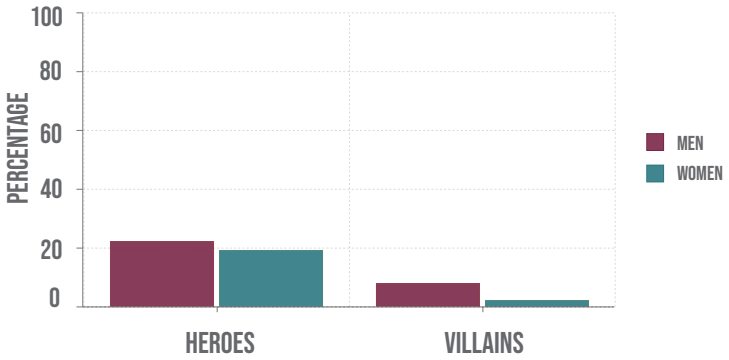
- A roughly equal percentage of men and women STEM characters were shown as heroes (22.1% and 19.3%) (Figure 8).
- White women were more likely to be portrayed as heroes than women of color (22.6% compared to 14.2%).

Villain Portrayals

- Men STEM characters were nearly four times more likely to be shown as villains than women STEM characters (7.8% compared to 2.1%).
- While few women STEM characters were shown as villains, white women were four times more likely than women of color to be portrayed as villains (3.1% compared to 0.7%).

FIGURE 8

STEM CHARACTERS WHO ARE HEROES & VILLAINS



To summarize, men in STEM were more prominently featured as leading characters and villains than women in STEM. This sends the subtle message to girls and boys that the stories of men in STEM are more important than the stories of women in STEM. We also found that

white women who play STEM characters had greater prominence in films, television programs, and streaming content than women of color as measured by leading roles, or portrayals as heroes and villains. This intersectional gap signals to viewers that women of color in STEM are not as important as men or white women in STEM.

STEM WORK

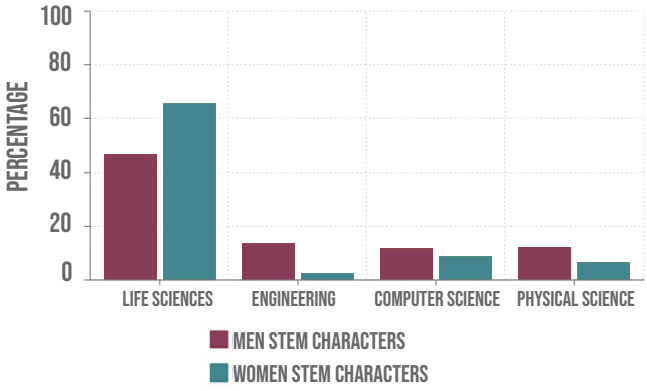
In this section, we analyze gender differences in STEM occupations. We begin with an examination of character occupation type and STEM leadership by gender. The type of STEM occupation matters because, in addition to being vastly underrepresented overall in STEM professions, women are especially underrepresented in the more "masculinized" fields of physical science, computer science, and engineering. It is also important to analyze whether characters are shown as leaders in their profession since women are underrepresented in leadership positions in general, and in STEM in particular. Presenting women as leaders in STEM in entertainment media makes it normal for women to be leaders in STEM in the real world. In the imagined worlds created by entertainment media, STEM portrayals can immediately be gender equitable. The question is whether media uses its considerable influence by presenting equity or reinforcing existing gender biases in STEM.

Given that nearly two-thirds of women STEM characters in entertainment media were shown as medical doctors or a related life science profession, we also analyzed whether women characters in life sciences are portrayed differently than women characters in other STEM occupations. For more information about the types of STEM occupations shown in film, television, and streaming content, please refer to Appendix B.

We also analyzed the personal traits of STEM characters – whether they were shown as competent, intelligent, and empowered. Competence was measured by the character's ability to solve problems and overcome challenges in their STEM work. Intelligence was measured by the extent to which the character is clever, bright, and quick-witted. Empowerment was measured by the extent to which the character has control over their life. A character who is very empowered possesses the strength and confidence to control their life course.

FIGURE 9

PERCENTAGE OF STEM CHARACTERS BY PROFESSION TYPE



STEM Profession Type

- A majority of women STEM characters were shown as working in life sciences (65.8%) – significantly more than men STEM characters in the life sciences (46.8%).
- Men STEM characters were more likely than women characters to be shown as engineers (13.7% compared to 2.4%), as physical scientists (11.8% compared to 6.4%), and in computer occupations (11.5% compared to 8.6%) (Figure 9).[73]

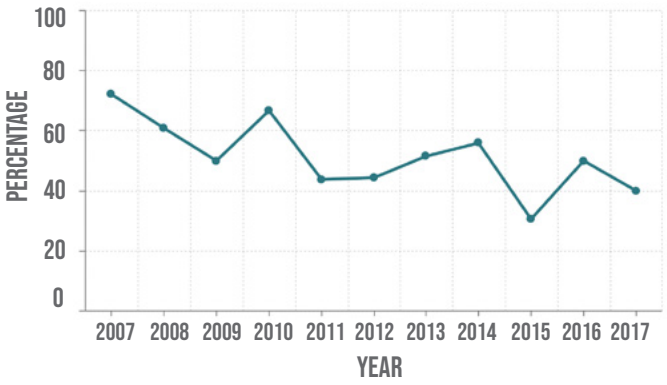
Portrayals of Leadership

- About half of women (50.5%) and men (50.0%) STEM characters were shown as leaders in their occupation, so we

do not find a gender gap in portrayals of STEM leadership.
- Women characters in the life sciences and women in other STEM fields were equally likely to be portrayed as leaders.
- As shown in Figure 10, the percentage of women STEM characters that are portrayed as leaders in STEM fluctuated over the past decade, but is trending down from a high of 72.2% in 2007.

FIGURE 10

PERCENTAGE OF WOMAN CHARACTERS PORTRAYED AS LEADERS, 2007-2017



Character Traits
- No gender differences were found in terms of the competence of STEM characters.
- Women STEM characters were more likely to be portrayed as highly intelligent than men STEM characters (78.3% compared to 64.8%), while men STEM characters were more likely to be shown as not very intelligent (9.6% compared to 0.5%).
- No gender differences were found when it comes to level of character empowerment and gender.
- White women and women of color in STEM were shown as equally competent, intelligent, and empowered in entertainment media.
- Women characters in life sciences were portrayed as equally competent and intelligent as women characters in other STEM fields.
- Women STEM characters in the life sciences were less likely to be "very empowered" than women characters in other STEM professions (46.7% compared to 51.6%).

Adversity
- Men and women STEM characters were roughly as likely to face adversity in entertainment media plotlines (43.2% and 40.9%, respectively), with men more likely to overcome adversity (16.6% compared to 10.6%).
- Women characters who work in the life sciences were far less likely than women characters in other STEM fields to face adversity in their professional life (35.4% compared to 51.6%).
- Among characters who faced adversity, women characters in the life sciences were far less likely than women characters in other STEM fields to fully overcome the adversity (11.4% compared to 25.0%).

Discrimination
- Only 4.0% of women STEM characters were shown experiencing gender discrimination, but they were three times more likely to experience it than men STEM characters (1.3%).

Harassment
- Only 4.0% of women STEM characters were portrayed as experiencing sexual harassment, but they were three times more likely to experience it than men STEM characters (1.3%).[74]

To summarize, fewer women STEM characters were portrayed as natural scientists, engineers, or computer scientists than men, which means that entertainment media reinforces existing gender biases about which STEM fields are for women. Women are adequately represented in the ranks of medical doctors and other life science professionals in the real world, as well as

in the created worlds in entertainment, but less so in other STEM professions.

We also found that women STEM characters were just as likely to be portrayed as leaders in STEM as men, a positive finding considering the gender disparity with STEM leadership in the real world. However, women characters shown as STEM leaders have declined in the past decade. When it comes to character traits, women STEM characters were shown in an equally or more positive light than men characters when it comes to competence, intelligence, and empowerment. This is a positive finding– that even though women were underrepresented as STEM characters, when they were present, they were portrayed as possessing similar traits to men characters.

Additionally, men and women STEM characters were shown as facing adversity at the same rates. With that said, women characters in the life sciences were less likely than women characters in other STEM fields to encounter adversity, and when they did encounter it, they were less likely to fully overcome it. Women STEM characters were portrayed as experiencing sexual harassment and gender discrimination at higher rates than men STEM characters, which reinforces the idea that women are not fully accepted as STEM professionals.

STEM PROFESSIONS

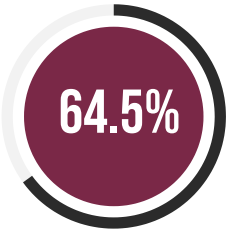
We also analyze a series of questions about how STEM professions are portrayed in entertainment media. More specifically, we test whether portrayals of STEM characters reinforced stereotypes of these fields, such as working alone rather than collaboratively, being self-interested instead of community-serving, and being family-inflexible instead of family accommodating.

Solo Versus Collaborative Work

- Two-thirds of STEM characters were shown working in collaboration with others (64.5%) rather than working alone (9.4%) or a combination of both (7.7%) (Figure 11).[75]
- STEM characters in film (18.8%) were far more likely than STEM characters in streaming content (11.4%) or television (5.6%) to be shown working alone rather than in collaboration with others.

FIGURE 11

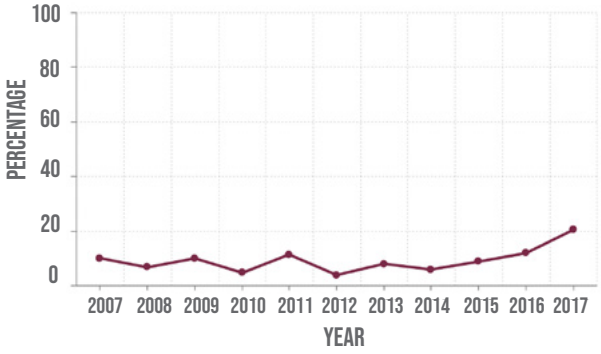
STEM CHARACTERS SHOWN WORKING IN COLLABORATION



- As indicated in Figure 12, the percentage of STEM characters shown working alone instead of in collaboration fluctuated in the past decade, but became more pronounced in 2016 and 2017.

FIGURE 12

PERCENTAGE OF STEM CHARACTERS SHOWN WORKING ALONE, 2007-2017



- Men characters were far more likely to be shown working alone in STEM than women characters (11.1% compared to 6.7%) (Figure 13).
- Women characters were more likely to be portrayed working collaboratively with others in STEM than men characters (69.8% compared to 61.5%).

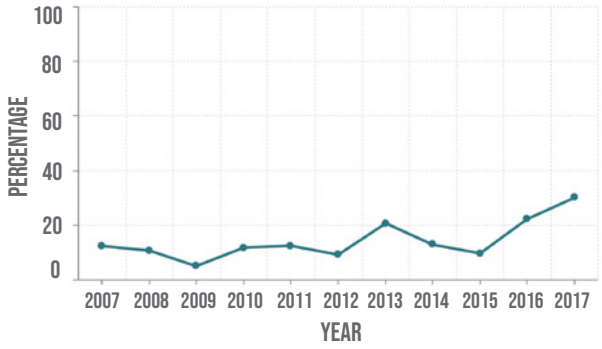
FIGURE 13
STEM CHARACTERS SHOWN WORKING ALONE

- Women of color were more likely to be portrayed as working collaboratively with others in STEM than white women (79.1% compared to 63.7%).
- Women characters in the life sciences were less likely to be portrayed as working in collaboration than women characters in other STEM fields (67.1% compared to 75.0%).

Self-Interested Versus Community-Serving

- Two-thirds of STEM characters were shown engaging in STEM work to help others (64.0%) rather than working for their own self-interest (14.4%) or a combination of both (4.9%).
- STEM characters in film (28.3%) were more likely to be shown as being self-interested than characters in streaming content (19.7%) or television (7.8%).
- STEM characters in television (71.0%) were far more likely to be shown as using STEM to help others than characters in film (59.7%) and streaming content (49.3%).
- Figure 14 indicates that the percentage of characters using STEM for self-interest rather than helping others has not improved in the past decade, and in fact STEM characters have gotten more self-interested in entertainment media in recent years.
- Men characters were more than twice as likely as women characters to be portrayed as self-interested in their STEM work (18.6% compared to 7.2%).
- Women characters were far more likely to be shown using their STEM training to help others than men characters (71.7% compared to 59.6%).
- Women of color were more likely to be shown helping others with STEM

FIGURE 14
PERCENTAGE OF CHARACTERS SHOWN USING STEM FOR SELF-INTEREST, 2007-2017

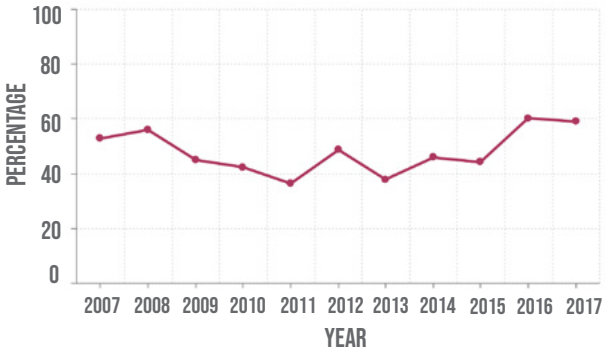


than white women (80.4% compared to 65.9%).
- Women characters in the life sciences were more likely to be shown helping others with STEM than women characters in other fields (73.6% compared to 68.0%).

Portrayals of Family-Inflexibility

- A sizeable number of STEM characters (42.9%) were shown as sacrificing their personal life a moderate amount or a great deal in order to work in STEM, and 30.7% of films/episodes portray STEM professions as not at all family-flexible.
- STEM characters in film (74.9%) were far more likely to be shown sacrificing their personal lives for STEM work than characters in streaming (30.6%) and television (46.5%) content.
- As shown in Figure 15, the percentage of characters shown sacrificing their private life for STEM has not improved

FIGURE 15
PERCENTAGE OF CHARACTERS SACRIFICING PERSONAL LIFE FOR STEM, 2007-2017



over the last decade, and has in fact gotten more common with characters in 2016 and 2017.
- Men and women characters were equally likely to be shown as sacrificing their personal life for STEM work.
- More than one-third (37.8%) of women of color in STEM sacrificed their personal life for STEM work compared to more than half (56.6%) of white women.
- Women characters in the life sciences were less likely (36.6%) to be shown sacrificing their personal lives for their career than women in other STEM professions (48.5%).

To summarize, STEM professions were portrayed as inflexible to varying degrees in entertainment media. Films, television programs, and streaming content mostly showed STEM as collaborative professions that helped others, and the work of women STEM characters was shown as more collaborative and community-serving than the work of men characters. However, entertainment media reinforced the stereotype of STEM work as family-inflexible, which sends a discouraging message to young women that they will not be able to balance STEM work with family life.

STEM CHARACTERS IN CHILDREN'S PROGRAMMING

In this section, we report gender differences for the 135 STEM characters who appear in kids' programming (rated for children twelve years old and younger). These portrayals were remarkably similar to STEM characters in entertainment media created for all ages:
- Most STEM characters in kids' programming were male (59.3%) and white (71.9%).
- Women STEM characters in kids' programming were adequately represented in the life sciences (52.7%), but underrepresented in other STEM fields.
- Men STEM characters were shown as more competent in their occupation than women STEM characters (27.8% compared to 23.6%).
- More women STEM characters were portrayed as highly intelligent than men STEM characters (54.5% compared to 46.8%) (Figure 16).

FIGURE 16
STEM CHARACTERS IN KIDS' PROGRAMMING SHOWN AS HIGHLY INTELLIGENT

- Women and men STEM characters in kids' programming faced similar levels of adversity in their work, but men characters were more likely to overcome it (20.3% compared to 16.4%).
- Men STEM characters were shown as doing STEM work for self-interested reasons far more often than women STEM characters (16.5% compared to 3.6%) (Figure 17).

FIGURE 17
STEM CHARACTERS IN KIDS' PROGRAMMING SHOWN AS SELF-INTERESTED

- Men in STEM were portrayed as working alone more often than women in STEM (11.4% compared to 3.6%).
- One-third (36.3%) of STEM professionals were shown as working in family-inflexible jobs in kids' programming.

SURVEY FINDINGS

In this part of the report, we present findings from a nationally representative survey of girls in middle school, high school, and young women ages 18 – 24 who are currently full-time college students. We begin with an examination of how entertainment media shapes the choice to go into STEM. Then we analyze girls'/women's perceptions of STEM as work that is done alone versus collaboratively, as self-interested versus community-serving, as family-inflexible versus family-flexible and as fields that are biased against women. In the third section, we measure the extent to which girls/women are supported in pursuing STEM. We conclude our survey analysis with an assessment of how different factors shape attitudes toward STEM and intentions to go into a STEM field. Only differences that are significant at the .10 level are reported here.

STEM MEDIA EFFECTS

We asked a series of questions to determine whether entertainment media influences whether girls/women choose to go into STEM. Four-out-of-five survey respondents -- 82.7% -- say that seeing girls/women as STEM characters on television is important to them.

For girls/women who say they intend to pursue a STEM career, we asked about the extent to which popular STEM characters in film and television influenced this choice. The majority of women characters who are popular in film and television shows work in medicine/life sciences, which may be why more women choose to go into these STEM fields over other STEM fields.

These are the percentages of girls and women who say each character inspired them to pursue STEM:

1. 79.0% - April Sexton, Chicago Med
2. 78.5% - Addison Montgomery, Private Practice
3. 77.7% - Temperance Brennan, Bones
4. 76.7% - Meredith Grey, Grey's Anatomy
5. 75.9% - Abby Sciuto, NCIS
6. 75.6% - Abby Lockhart, ER
7. 74.3% - McKeyla McAlister, Project Mc2
8. 73.0% - Alexx Woods, CSI:Miami
9. 68.7% - Dana Scully, The X Files
10. 64.1% - Amy Farrah Fowler, Big Bang Theory
11. 63.9% - Mindy Lahiri, The Mindy Project
12. 51.4% - Doc McStuffins, Doc McStuffins

In short, we find that virtually all girls and women in our sample think it is important to see girls/women in STEM in film and television shows, and popular STEM characters have influenced many girls/women to pursue a STEM major/career.

PERCEPTIONS OF STEM

Solo Versus Collaborative Work

- A sizeable number of girls/women (72.7%) perceived STEM work as being collaborative rather than work that is done alone (Figure 18).
- The older the student, the less likely she is to believe that STEM work is collaborative: 76.8% of middle school girls believe this compared to 73.5% of high school girls and 71.1% of college women. This likely contributes to declining interest in STEM across these age groups.
- Girls/women of different races/ethnicities were equally likely to think that STEM work takes place mostly alone.

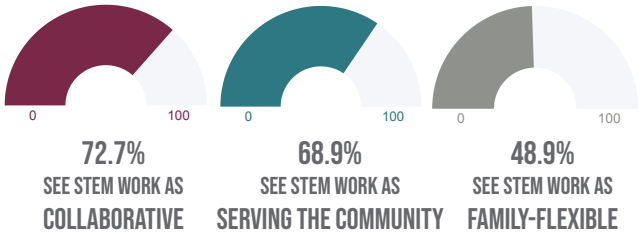
Self-Interested Versus Community-Serving

- Two-thirds of girls/women (68.9%) perceived STEM professionals as serving the community rather than being self-interested.
- Middle school, high school, and college respondents were equally likely to think of STEM as a community-serving rather than a self-interested pursuit.
- Girls/women who are "other" races (76.6%) were more likely than White (72.0%), Black (67.8%), and Latinx (59.8%) girls/women to see STEM work serving the community rather than being simply self-interested.

Perceptions of Family-Inflexibility

- About half of the sample (48.9%) perceived STEM fields as family-flexible, meaning that people who work in STEM also have time to spend with their families. This means a (slim) majority of girls/women see STEM as family-inflexible.
- Perceptions of STEM as family flexible did not vary by age or race.

FIGURE 18
SURVEY RESULTS: STEM PERCEPTIONS



Perceptions of Sexism

- One-third of girls/women in the sample (34.9%) strongly or very strongly agreed that women face sexism in STEM fields.
- Perceptions of sexism in STEM increased dramatically with student age. One-fourth (26.4%) of middle school students reported that women face sexism in STEM compared to nearly one third (31.6%) of high schoolers and over half (50.8%) of college women.
- Perceptions of sexism in STEM did not vary by student race/ethnicity.

Perceptions of Gender Bias

- Nearly half of girls/women (47.9%) in the sample agreed that women have to work harder than men in STEM to achieve the same as men.
- The perception that women have to work harder than men in STEM increased with age. Forty-three percent of middle schoolers agreed, while 50.0% of high schoolers and 53.7% of college women agreed.
- Perceptions that women have to work harder in STEM than men to achieve the same did not vary by student race/ethnicity.

To summarize, a vast majority of girls/women saw STEM work as collaborative

(rather than solo) and community-serving (rather than self-interested), which is positive given that girls/women prioritize these aspects of their work life. Just under half of girls/women saw STEM work as family-flexible, which may discourage them from pursuing this career path. When it comes to perceptions of bias, one-third of girls/women thought women face sexism in STEM, and nearly half said that women have to work harder than men in STEM to achieve the same status.

SUPPORT FOR STEM PURSUITS

In this section, we report the extent to which girls and women in the sample know of people in STEM, have someone to look up to in a STEM field, and are encouraged in their STEM pursuits by friends and family.

Knows Someone in STEM

- A sizable number (40.0%) said they personally know someone in a STEM profession.
- Women in college (47.3%) were more likely to know someone in a STEM profession than girls in high school (42.2%) or middle school (33.2%).
- Girls/women of "other races" (50.8%) and White girls/women (47.0%) were more likely to know someone in STEM than Latinx (31.0%), and especially, Black (19.7%) girls/women.

STEM Role Models

- One-third (30.9%) of all girls/women said they have someone to look up to in STEM.
- Girls in middle and high school, and women in college, were equally likely to report that they have a role model, someone they look up to, in STEM.
- Girls/women of "other" races (43.8%) were the most likely to report that they have a role model in STEM, followed by White (34.1%), Latinx (22.5%), and Black (22.3%) girls/women.

Encouragement from Teachers

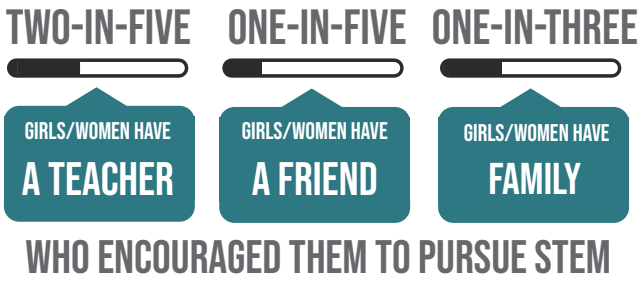
- Two-in-five girls/women in the sample (40.3%) say their teachers have encouraged them to pursue STEM.
- Teacher encouragement for STEM did not vary by age group. Middle school, high school, and college respondents were equally likely to say their teachers encouraged them to pursue STEM.
- Girls/women of "other" races (50.0%) were the most likely to say their teachers have encouraged them to pursue STEM, followed by White (42.8%), Latinx (33.4%) and Black (29.5%) girls/women.

Encouragement from Friends

- One-in-five (19.8%) girls/women in the sample say their friends encourage them to study STEM.
- Friends become more encouraging of STEM with age. Only 12.8% of middle school girls said their friends encourage them to study STEM compared to 20.7% of high school girls and 25.2% of college women.
- Girls/women of "other" races (38.5%) were twice as likely to report that their friends encouraged them to study STEM than Black (21.3%), Latinx (17.1%) or White (17.5%) girls/women.

FIGURE 19

SURVEY RESULTS: SUPPORT FOR STEM PURSUITS



Encouragement from Family

- One-third (36.6%) of girls/women said their family encouraged them to pursue a STEM field (Figure 19).
- Girls in middle school and high school, and women in college, reported the

same levels of encouragement from their family to pursue STEM.
- Girls/women of "other" races (60.9%) were significantly more likely to say their family encouraged them to study STEM than Latinx (35.4%), White (34.9%), or Black (27.1%) girls/women.

In summary, fewer than half of girls/women know someone in STEM or have a STEM role model, and even fewer report that teachers, friends, and family encouraged them to pursue STEM. When it comes to STEM role models and encouragement to pursue STEM, Latinx and Black girls/women are especially disadvantaged.

STEM ATTITUDES

We measured attitudes toward STEM using the STEM Semantics Survey, a classic scale that is commonly used in studies on this topic. The STEM Semantics Survey asks people to evaluate their attitudes about science, technology, engineering, and math as separate fields, then asks them to evaluate STEM overall. Respondents are asked to rate STEM using a 7-point scale with fascinating/mundane, appealing/unappealing, exciting/unexciting, means a lot/means nothing, and interesting/boring on either end. Scores on the STEM Semantics Scale range from 1 (very negative attitude) to 7 (very positive attitude).

- Girls and women in our sample gave STEM overall an average rating of 4.3, which is moderately positive.
- Technology received the most positive average rating (4.9) followed by science (4.8), engineering (3.8), and math (3.7).
- Overall attitudes toward STEM did not vary by age group. Middle school girls, high school girls, and college women had similar attitudes toward STEM.
- Attitudes toward STEM did vary by race. Students of "other" races (4.8) rated STEM more positively than White (4.3), Latinx (4.1), and Black (4.0) students.

To sum up, girls/women in our sample had moderately positive attitudes toward STEM, and rated technology and science more positively than engineering and math. Girls/women rated STEM the same across age groups. Students of "other" races (which includes Asian-American students) had more favorable attitudes toward STEM than other students in the sample.

STEM INTENTIONS

In this section, we examine girls' and women's intentions of going into a STEM-related profession.

FIGURE 20

SURVEY RESULTS: STEM INTENTIONS OF GIRLS/WOMEN

36.9% ARE CONSIDERING A STEM-RELATED CAREER

27.2% PLAN TO GRADUATE WITH A STEM DEGREE

25.3% BELIEVE THEY WILL MAKE A SUBSTANTIAL STEM CONTRIBUTION

Considering a Career in STEM

- One-third of all girls/women (36.9%) reported that they probably or definitely would consider a STEM-related career (Figure 20).
- Middle school girls (43.5%) were the most likely to probably or definitely consider a STEM-related career, while 31.8% of high school girls and 41.1% of college women reported the same.
- Girls/women of "other" races (50.0%) were significantly more likely than Latinx (39.8%), White (35.2%), and Black (30.4%) girls/women to say they

probably or definitely will consider a career in STEM.

Planning to Graduate with a STEM Degree

- Across all age groups, 27.2% of girls/women said they plan to graduate with a college degree in a STEM field.
- College women (32.3%) were more likely to agree that they will graduate with a STEM degree than high school (23.9%) or middle school (27.6%) girls.
- No significant differences were found with respondent race and intention to graduate with a college degree in a STEM major.

Making a Substantial STEM Contribution

- One-in-four survey respondents (25.3%) strongly or very strongly agreed with the statement: "I will make a substantial contribution to a STEM field."
- College women (33.3%) were more likely to strongly or very strongly agree that they will make a substantial contribution to STEM than high school (20.6%) and middle school (27.8%) girls.
- Girls/women who are White (23.3%), Black (26.0%) and Latinx (23.8%) were less likely than girls/women of "other" races to say they intend to make a substantial contribution to a STEM field.

Overall Intention to Pursue STEM

We created a combined measure of intention to pursue a STEM major/career into a scale ranging from 1 (no intention) to 7 (certain to pursue STEM).

- On average, girls/women in the sample rated their intention to pursue STEM as a 4.5.
- Our overall measure of intent to pursue STEM did not vary by age group.
- Intention to pursue STEM varied by race. More girls/women of "other" races intend to pursue a STEM major/career (4.8) than White (4.6), Latinx (4.5), and Black (4.0) girls/women.

To summarize, one-third of the sample said they are considering a STEM career. Our overall measure of intention to go into STEM did not vary by age group, but it did vary by race. Girls/women classified as "other" in terms of race (which includes Asian-Americans) were the most likely to say they intend to go into STEM, while Black girls/women were the least likely.

DETERMINANTS OF STEM ATTITUDES AND INTENTIONS

In this section, we address two final questions. First, what factors influence attitudes toward STEM? Secondly, what factors influence intention to go into STEM?

Attitudes Toward STEM

We use the STEM Semantics scale to measure attitudes toward STEM. The following items significantly improved survey respondents' attitudes toward STEM:

- Perception that STEM helps the community rather than being self-interested;
- Perception that STEM is family-flexible;
- Personally knowing someone in STEM;
- Having someone to look up to in STEM;
- Having teachers that encourage them to pursue STEM;
- Having friends that encourage them to pursue STEM; and
- Having family members that encourage them to pursue STEM.

The following item significantly decreased positive attitudes toward STEM:

- Perception that women face sexism in STEM.

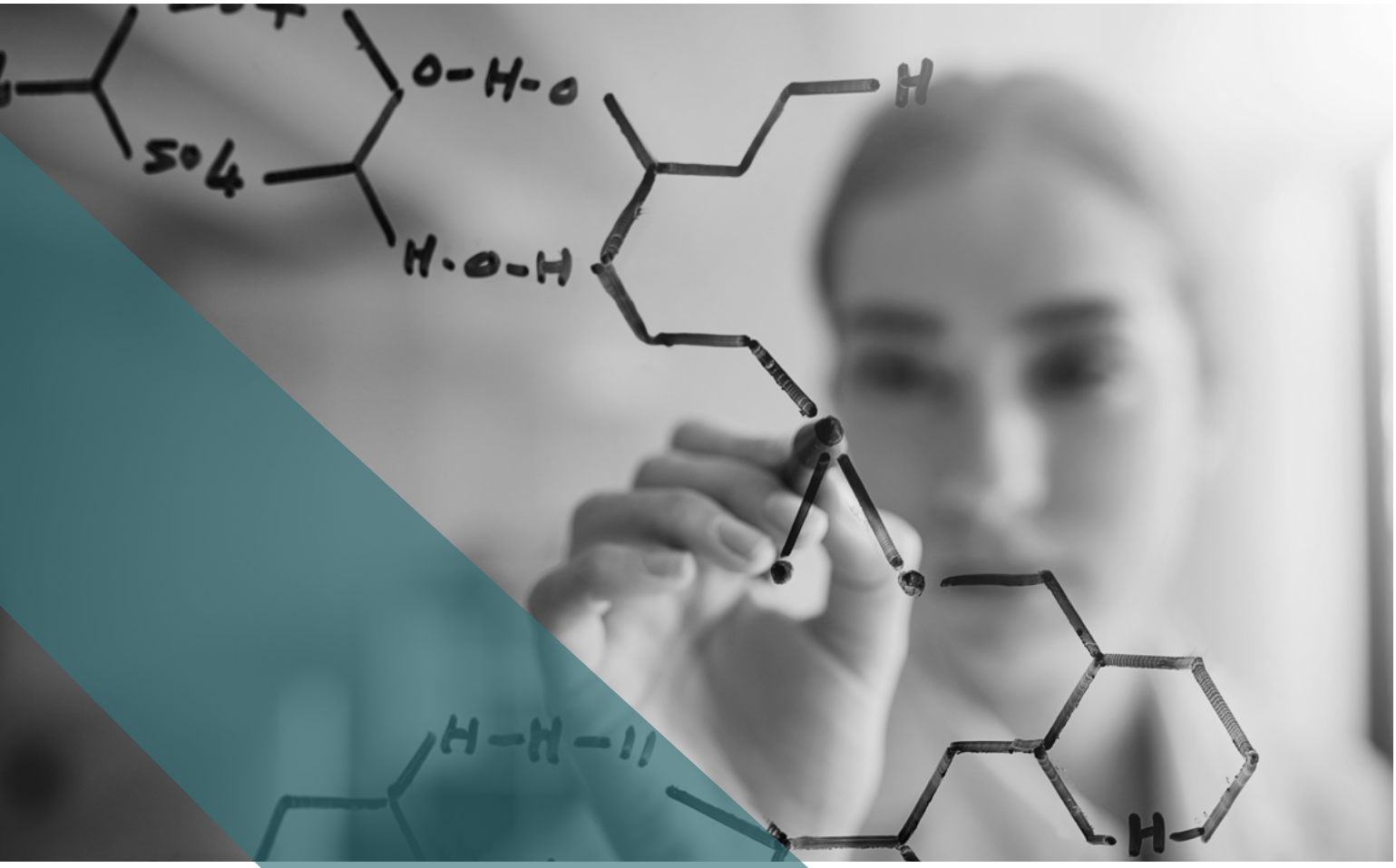
Intention to go into STEM
The following items significantly increased the intention of girls/women to go into STEM:

- Perception that STEM helps the community rather than being self-interested;
- Perception that STEM is family-flexible;
- Personally knowing someone in STEM;
- Having someone to look up to in STEM;
- Having teachers that encourage them to pursue STEM;
- Having friends that encourage them to pursue STEM; and
- Having family members that encourage them to pursue STEM.

The following items significantly decreased intention to go into STEM for girls/women:

- Perception that STEM is solo rather than collaborative work; and
- Perception that women face sexism in STEM.

This analysis shows that many of the variables that previous studies hypothesized may influence the attitudes and intentions of girls/women about STEM are accurate. Perceptions that STEM is collaborative and family-flexible improved both attitudes toward and intentions to go into STEM. Other important factors that encourage girls/women to pursue STEM are role models and support from teachers, friends, and family. Having these types of support improved both attitudes toward STEM and intention to go into a STEM major/occupation. Perceptions that STEM is sexist discourages girls/women from pursuing a STEM major/career.



MAJOR FINDINGS

In this part of the report, we summarize our major findings from our longitudinal content analysis and our nationally representative survey of girls/women on STEM.

CONTENT ANALYSIS FINDINGS

Our content analysis addressed the primary question of whether entertainment media primarily reinforces or interrupts portrayals and stereotypes of gender and STEM that serve to discourage girls/women from going into STEM professions. We found mixed results, that entertainment media both projects and disrupts damaging gender messages about STEM. We analyzed media aimed at a broad audience as well as children's media and found that representations of STEM characters were similar. The statistics here are based on STEM characters in content for all ages.

Negative Media Messages about STEM

The most profoundly negative message entertainment media sends about gender in STEM is that STEM professions are for white men, and this has not improved in the past decade. Our analysis finds that men were over-represented as STEM characters, especially white men, and this gender gap was more pronounced in film than television and streaming content. When girls/women viewed media content, and especially girls of color, they rarely saw themselves as STEM characters on the big and little screen. Girls/women also learned that white men matter more because they were more likely to be featured as STEM protagonists than women, especially women of color.

In the past decade, entertainment media also reinforced rather than corrected gender gaps in STEM fields by showing far fewer women STEM characters as natural scientists, engineers, or computer scientists than men STEM characters. Women were mostly portrayed as medical doctors or in a related life sciences field, a gender bias that likely partially explains why so many women prefer medicine/life sciences in the real world.

Entertainment media also sends a discouraging message to girls/women that they will have to sacrifice their personal and family life if they go into a STEM profession. Although men and women STEM characters were equally likely to be shown sacrificing their personal life, due to culturally prescribed gender roles, this affects young women differently because they are raised to place more value on having a family.

Positive Media Messages about STEM

Perhaps the most positive finding of this study is that women characters are just as likely to be portrayed as leaders in a STEM profession as men characters. This shows that, despite a massive leadership gap in STEM in the real world, entertainment media producers can choose to show a more equitable, ideal gender balance in the worlds they create. The one caveat of this finding is that the percentage of women STEM leaders trended down in the last decade.

Another positive finding is that entertainment media portrays women STEM characters as positively or more positively than men STEM characters when it comes to competence in their profession, intelligence, and personal empowerment. In a similar vein, men and women STEM characters were equally likely to be shown as facing adversity. These are quite positive indicators that content producers for film, television, and streaming platforms wrote their men and women STEM characters as possessing similar traits and abilities.

Another positive finding is that entertainment media mostly presents STEM work as collaborative. As noted in previous research, while men and women alike value collaborative work over mostly solo work, women are especially inclined to prioritize collaboration. As our survey findings show, a sizable number of girls/women perceived STEM as being solo rather than collaborative work, but this inaccurate idea is not coming from entertainment media.

Our last positive finding from the content analysis is that entertainment media showed STEM work as mostly serving the community and helping others rather than being driven by self-interest. This is especially the case for STEM work performed by women characters. As previous research indicates, most people prefer careers that are driven by helping others, but this is especially true for women. Media portrayals of STEM as mostly community-serving therefore encourage girls and young women to go into STEM professions.

SURVEY FINDINGS

We organize our major findings from the survey analysis into two sections: Important factors to girls' and women's pursuit of STEM, and attitudes and intentions toward STEM.

Important Factors in Pursuing STEM

When it comes to media influence, the data is unequivocal. Virtually all girls and women in our sample thought it was important to see girls/women in STEM in film and television shows, and popular STEM characters have influenced many to pursue a STEM major/career.

Other important factors that encouraged girls/women to pursue STEM are the presence of role models and support from teachers, friends, and family. Having these types of support improves both attitudes toward STEM and intention to go into a STEM major/field.

Attitudes and Intentions Toward STEM

Our survey analysis found that girls in middle school and high school, and women in college, hold moderately positive attitudes toward STEM. They rated technology and science more positively than engineering and math. Students classified as "other" in terms of race (which includes Asian-Americans) had more favorable attitudes toward STEM than White, Black, or Latinx students.

When it comes to intention to pursue a STEM major/career, one-third of girls/women said they have considered it. Intention to go into STEM did not vary by age group, but it did vary by race. Girls/women classified as "other" in terms of race reported the highest STEM intention rates, while Black girls/women reported the lowest STEM intention rates.

We found a distinct pattern that interest in STEM fields is higher during middle school than at any other point, and is lowest in high school. Not only does interest drop during high school, but negative attitudes toward STEM increase at this time. Although interest in STEM does bounce back somewhat in college, women in college reported higher insecurity about sexism and gender-specific challenges in STEM occupations.

A vast majority of girls/women perceived of STEM work as collaborative (rather than solo) and community-serving (rather than self-interested), which is a positive finding given that girls/women place a high priority on these aspects of their work life. Just under half of girls/women perceive of STEM work as family-flexible, which may discourage them from pursuing this career path.

RECOMMENDATIONS

Based on previous research, coupled with our findings, we propose the following interventions to increase the participation of girls and women in STEM majors and careers:

- Improve media representations of STEM characters when it comes to gender and race. This study demonstrates that media is influential in shaping attitudes toward STEM, but content producers continue to disproportionately represent STEM characters as white men, especially leading characters. Special attention should be paid to increase the representation of women and people of color as STEM characters, and to improve the ways women STEM characters are portrayed.

- Cultivate girls' interest in math and science from an early age through media role models, parents, educators, and mentors. Having supportive mentors, teachers, friends, and family members improves girls' interest in and intention to pursue STEM.

- Implement early childhood interventions to combat stereotypes about science as a masculine pursuit, and cultural misperceptions that girls and women have a lower aptitude for STEM.

- Retain women in STEM through equitable hiring, pay, and promotion practices, and by addressing workplace bias (gender discrimination and sexual harassment) as well as implementing flexible work-family policies.

APPENDIX A: SAMPLE WEIGHTING

The total sample for this survey is comprised of different components, as such, the weighting process was carried out in several steps. In the first step, design weights for the parent sample from which eligible girls/women 11 to 18 have been identified were computed to reflect parent's selection probabilities. Subsequently, an adjustment was added to reflect the selection of one eligible woman per household by multiplying parent design weights by the number of eligible girls/women enumerated in each household. In order to minimize undue variability in the final weights, we limited this adjustment to a maximum factor of 2.

The resulting weights were then post-stratified to the geodemographic benchmarks of women 11 to 18 who attend middle school, high school, or are full-time college with no Bachelor's degree. The needed benchmarks, which were secured from the 2016 October Supplement of the Current Population Survey (CPS), were indexed by age, race-ethnicity, region, metro status, and grade classification of middle school, high school, and college. In the second step, design weights for the sample of women 18 to 24 with no Bachelor's degree were computed to reflect their respective selection probabilities. Analogously, the resulting design weights were post-stratified to the geodemographic benchmarks of women 18 to 24 who attend high school or are full-time college students with no Bachelor's degree as indexed above.

In the third step, the computed weights for all KnowledgePanel respondents from the above two sample components were combined in proportions of their respective effective sample sizes. In doing so, adjustments were applied to retain the correct proportions of students who attend middle school, high school, or those full-time in college with no Bachelor's degree. Next, the resulting weights were post-stratified to the geodemographic distributions eligible girls/women 11 to 24 as indexed above. In the fourth step, respondents from nonprobability panels were assigned a design weight of 1 and then post-stratified to the corresponding geodemographic distributions of girls/women eligible for this survey. These distributions for women 18 to 24 who are full-time college students with no Bachelor's degree were indexed by age, race-ethnicity, region, metro status, and grade classification of high school and college. Furthermore, the weighting adjustments for these respondents were to include a special calibration to correct for the higher propensity of opt-in respondents to spend time on the Internet, watch TV, express opinions online, as well as early adoption of new products and services. The needed calibration benchmarks for these corrections were obtained from the corresponding respondents from KnowledgePanel.

In the final step, the above interim weights for all respondents of this survey were combined in proportions of their respective effective sample sizes. In doing so, adjustments were applied to retain the correct proportions of students who attend middle school, high school, or those full-time in college with no Bachelor's degree. Next, the resulting weights were post-stratified to the geodemographic and calibration distributions of eligible girls/women 11 to 24 as indexed above. These adjustments were carried out separately for eligible girls/women attending middle school, high school, or those attending full-time college students with no Bachelor's degree.

APPENDIX B: STEM OCCUPATION LIST

STEM OCCUPATION CATEGORY	PERCENTAGE OF CHARACTERS (n=1,007)
PHYSICIANS AND SURGEONS	42.8%
FORENSIC SCIENCE TECHNICIANS	8.6%
ENGINEERS (GENERAL)	7.2%
PHYSICISTS	3.6%
REGISTERED NURSES	3.4%
COMPUTER PROGRAMMER	2.4%
PHYSICAL SCIENTISTS (GENERAL)	2.2%
ATMOSPHERIC AND SPACE SCIENTISTS	1.7%
OPERATIONS RESEARCH ANALYST	1.5%
COMPUTER OCCUPATIONS	1.5%
LIFE SCIENCES (GENERAL)	1.5%
VETERINARIANS	1.4%
EMTS AND PARAMEDICS	1.4%
PHARMACISTS	1.4%
BIOLOGICAL SCIENTISTS	1.3%
ZOOLOGISTS AND WILDLIFE BIOLOGISTS	1.2%
AEROSPACE ENGINEERING AND OPERATIONS TECHNICIANS	1.2%
COMPUTER AND INFORMATION RESEARCH SCIENTISTS	1.0%
INFORMATION SECURITY ANALYST	1.0%
OTHER STEM PROFESSIONS	14.9%

We classified STEM characters based on a 2014 Bureau of Labor Statistics report that included a total of 146 STEM-related occupations. Here, we report only the 18 categories which applied to at least 1% of the characters in our sample.[76]

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70. Streaming shows include both original content and content aired from television networks.
71. Responses to most questions do not add up to 100% for a variety of reasons for surveys and content analysis. First, for surveys, some respondents may choose not to answer the question. Secondly, some respondents may have answered "other" to the question because the response categories did not fit their situation (e.g., gender non-conforming individuals would report "other," not "male" or "female"). For content analysis, the percentages may not total 100% because the character may not fit the standard categories (e.g., an extraterrestrial character who does not have an identifiable race would be classified as "other").
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