



Gender Stereotypes: Historical comparison of female students' beliefs on career, marriage, and children (1935 versus 2019 populations)

Dr. Suzanne Zurn-Birkhimer, Purdue University-Main Campus, West Lafayette (College of Engineering)

Dr. Suzanne Zurn-Birkhimer is Associate Director of the Women in Engineering Program and Associate Professor (by courtesy) in the Department of Earth, Atmospheric, and Planetary Sciences at Purdue University. Dr. Zurn-Birkhimer conducts research and leads retention activities including administration of the undergraduate and graduate mentoring programs and the teaching of the Women in Engineering seminar courses. For the past decade, Dr. Zurn-Birkhimer's research has focused on broadening participation of women and underrepresented group in STEM fields. Recently, she has been investigating the intersection of education and career path with cultural identity and is developing strategies to inform programming and policies that facilitate recruitment and retention of underrepresented populations in academia. In 2012 Dr. Zurn-Birkhimer was presented with an Outstanding Alumni Award from the Department of Earth, Atmospheric, and Planetary Sciences and in 2019 the College of Science Distinguished Alumni Award at Purdue University. Dr. Zurn-Birkhimer earned her B.S. in Mathematics from the University of Minnesota, and an M.S. and Ph.D. in Atmospheric Science from Purdue University.

Ing. Mayari Illarij Serrano Anazco, Purdue University at West Lafayette

MAYARI SERRANO is currently a graduate research assistant in the College of Engineering at Purdue University. She earned her B.S. degree in Biotechnology Engineering from the Army Polytechnic School, Quito, Ecuador. She completed her M.S. in Computer and Information Technology at Purdue University. Mayari is currently a PhD student at Purdue University and is working in for the Women in Engineering Program. Her interests include foster STEM enthusiasm, and technology innovation.

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Introduction

Women who work in engineering face numerous academic and professional barriers^{1,2}. Smith and Gayles² enumerated several attitudinal barriers such as the perception of incompatibility with feminine attitudes and the role of women in the family. Similarly, in engineering, as in all STEM fields, women are held to masculine guidelines^{1,2}.

Elizabeth Bragg was, in 1876, the first woman in the United States (U.S.) to be awarded an engineering degree which she earned in civil engineering³. She never worked as an engineer, rather she was a stay-at-home wife and mother³. Likewise, the careers of other female pioneers in engineering, namely Bertha Lamme and Marion Sara Parker, commonly ended after marriage³. Fortunately, the campaign for women's suffrage and World War I created more work opportunities outside the household for women⁴ and starting in the 1920s Amelia Earhart, world renowned aviatrix, unwillingly became a role model for women of all ages⁴. In 1932, Earhart became the first female aviator to fly solo across the Atlantic Ocean and, in 1935, the first person to fly solo across the Pacific Ocean. But her impact did not stop there, as she was also a best-selling author writing not only about her time flying but as a strong advocate for women's rights. She felt that women should learn to live on their own by supporting themselves, pursuing education, and planning their own adventures⁵. She used the admiration of the public to spark discussion about femininity, equal opportunity regardless of gender, woman's rights, and equality⁴.

Edward Elliott, President of Purdue University, was impressed by Earhart and realized she would be the perfect role model for the female students his institution. After much discussion and several visits to the institution, Earhart, in 1935, joined the staff as a Counselor in Careers for Women and technical advisor in the Department of Aeronautics. Before officially starting, Earhart created and distributed a survey to measure female students' interest in pursuing a career and how they would balance that pursuit with their personal lives⁴. Radical ideas for the time. It wasn't until the 1970s that both the number of women enrolling in universities and the age at which women married substantially increased⁶.

Even today, females are confronted with gender stereotypes at an early age⁷. Furnham et al.⁸ reported that fathers estimate that their sons have higher spatial intelligence and mathematical ability than their daughters. Boys and girls in elementary school already possess cultural stereotypes about their math ability, stereotypes that negatively portray girls' mathematical skills⁹.

Cheryan et al.¹⁰ also found that girls underestimate their own abilities in STEM fields which follows them to tertiary education.

Recent data shows that in 2018, woman represented 46.8% of the labor force in the United States (U.S.)¹¹. Women in the U.S. are a vital portion of the country's workforce, regardless of their marital status and the number of children they have, however, in married couple households, the division of housework and the willingness to focus on one spouses demanding career typically benefit the men¹². As such, men dominate the high paying professions². Unfortunately, bias towards women in male-dominated fields is still predominant² and the workplace structure in the U.S. leads many women to choose between career and family¹². Also, Kelly and Grant¹³ found that working women in the U.S. are penalized in salary because of motherhood. Additionally, Wolfinger et al.¹² concluded that marriage and having children under six years old had a negative independent effect on the likelihood of obtaining a ladder-rank position for women.

STEM professionals represent about four percent of the U.S. labor force and this small fraction of the labor force is needed to sustain the current rate of booming economic innovation and productivity¹⁴. However, women are still underrepresented in the majority of the STEM areas¹⁵ noted by the fact that women enter engineering fields at lower rates than men and leave the profession at higher rates^{2,16}. In fact, the engineering workforce faces perhaps the greatest disparity as it is made up of only 15% women¹⁷. Also, Hill et al.¹⁴ mentions that from a pool of 6000 engineers, surveyed by the Society of Women Engineers, 25% of the women and 10% of the men did not work at all or did not work in engineering.

The percentage of women in undergraduate engineering programs remains low at 20%². However, in 2017, the number of engineering degrees awarded to women achieved a 10-year high, with 21.3% of bachelor's, 25.7% master's, and 23.5% of doctoral degrees awarded to women¹⁸. The path toward equality has not been easy, and women still have a long way to go. Meaningful change will require the collective efforts of all genders.

The under-representation of women in STEM fields has been identified as one of the principal factor contributing towards insufficient workforce in the fields¹⁹. Research in gender stereotyping shows that women are constantly exposed to unfavorable messages about their ability to succeed in these areas⁷. The survey that Amelia Earhart developed, *Questionnaire for Women Students, 1934-1935*, along with her speech covering the results provides a unique opportunity to glance into the past to see the thoughts and opinions of the few women students at Purdue University. This paper compares females students' beliefs on career, marriage, and children in a time period where women's representation in STEM fields was nearly null (1935) with those of current female engineering students (2019). Furthermore, this paper examines current gender stereotyping.

Methods

Research Question

The research questions that guided this study were:

- What beliefs on career, marriage, and children are similar between populations of female students in 1935 and 2019?

- What is the proportion of female engineering students in the 2019 sample that encountered gender bias?

Questionnaire for Women Students

The questionnaire was developed and implemented at Purdue University by Amelia Earhart and Dr. O’Shea in 1935. The results were disclosed by Amelia Earhart in her speech entitled “Education and Careers” given at the University’s Conference on Women’s Work and Opportunities in 1935. These documents are part of the George Palmer Putnam Collection of Amelia Earhart Papers held at the Purdue University Libraries. The original questionnaire contained ten (10) multiple-choice questions on career and education topics and four (4) multiple-choice demographic questions. Demographic questions included academic standing, age, earnings, and college expenses. Questions referring to education and career choices are detailed in Table 1. In 2019, the researchers added to the survey a set of exploratory questions around gender bias and stereotyping (refer to Table 2).

Data Collection

The 1935 and 2019 data were examined and compared by the research team. The first data collection was in 1935 by Amelia Earhart at Purdue University, and the second data collection was at the same institution in 2019 by the Women in Engineering Program (WIEP). The 1935 data were collected using paper copies of the questionnaire and the 2019 data collected via Qualtrics, an on-line surveying tool.

Participants

The Earhart data set was collected in 1935 prior to the Conference on Women’s Work and Opportunities held at Purdue University⁴. Details about the sample size used were not found in the written reports and demographic data were not available. The 2019 data were collected from female engineering students that took part in a mentoring program at Purdue University. A total of 414 students completed the survey. The majority of participants were freshman with 235 (56.76%), followed by 84 (20.29%) sophomores, 43 (10.39%) juniors, 36 (8.70%) seniors, and 16 (3.86%) graduate students. Seven of the graduate students were pursuing a master’s degree, eight were pursuing a doctoral degree, and one unknown. All freshmen students were in a First-Year Engineering (FYE) program. The majority of upper-class students were in mechanical, electrical and computer, or chemical engineering (Table 3 contains the list of schools/divisions and the sample distribution). The White/Caucasian ethnicity was predominant in the sample, with 261 participants representing 63.04% of the sample self-selecting this choice. The other ethnicities represented in the sample were Asian which constituted 23.67% (98 participants); Hispanic/Latino with 5.31% (22); Multiracial with 3.38% (14); African American with 2.90% (12); and other/prefer not to answer with 1.69% (7). In the sample, 356 (85.99%) were domestic and 14.01% (58) were international students, representing 24 countries.

Table 1: Questionnaire for Women Students, 1934-1935²⁰

Number	Question
1	Are you planning to seek employment after you leave college? <i>Yes, No, Undecided as yet</i>
2	If you are planning to work, what is your reason for doing so? <i>(a) Economic necessity, (b) The family expects it, (c) To attain personal independence, (d) To secure luxuries that could not otherwise be had, (e) To have something to do, (f) To achieve professional success (to have the mental stimulus of accomplishing something), (g) Other reasons</i>
3	Have you decided what work you want to do or at least in what general field of work you wish to be? <i>Yes, Some idea but not definitely decided, No</i>
4	How did you choose your career? <i>(a) Liking for the field, (b) A brother or a sister or another close relative engaged in the same work, (c) The family decided it, (d) Liked a former teacher in the field, (e) An idea that "it was a good field for a woman", (f) "Could not think of anything else to do", (g) Other reasons</i>
5	If you were the wage earner and your husband ran the home, would you consider his work financially equivalent to yours? <i>Yes, No</i>
6	Do you plan to continue working after marriage? <i>Yes, No</i>
7	Do you consider it advisable for women in general to continue working after marriage? <i>Yes, No</i>
7 - Yes	What are your reasons for your opinion? - If "yes": <i>(1) The husband and wife will have a more interesting comradeship, (2) It gives the woman more personal independence and self respect, (3) A woman needs continuous activity in her life exactly as a man does, (4) Other reasons</i>
7 - No	What are your reasons for your opinion? - If "no": <i>(1) Working would interfere disastrously with a woman's administering her home, (2) A man would be hurt and ashamed to have his wife earning money, (3) The husband and wife would soon grow uncongenial and grow apart, (4) There cannot be two heads to a household. The man should be the head of the house, (5) Other reasons</i>
8	Would you consider it feasible for married woman in general to continue working when there were very young children in the family? <i>Yes, No</i>
9	When all the children were over sixteen? <i>Yes, No</i>
10	What do you think a married man's part in the running of the household should be? <i>(a) He should not have to have anything to do with it, (b) He should do a few simple things – such as keeping his own bureau in order, (c) He should do all he have [sic] time for, (d) He should have real interest in the running of the household no matter how much or how little he actually takes part, (e) If the wife is employed, both husband and wife should take an equal part in the active running of the household</i>

Table 2: Additional questions for 2019 sample

Number	Question
11	A woman faces more challenges in the workplace than a man. <i>Yes, No</i> ²¹
12	Have you ever been faced with a gender stereotype or bias? <i>Yes, No</i> ²¹
12 Yes	How did you deal with the gender stereotype or bias you faced? ²¹
13	Do you think that dealing with gender stereotype or bias should be addressed by university programs? <i>Yes - how:, No</i>

Table 3: Engineering School/Division of the 2019 sample

School/Division	N	Percentage Equivalent
Aeronautics and Astronautics	11	2.66%
Agricultural and Biological Engineering	18	4.35 %
Biomedical Engineering	18	4.35%
Civil Engineering	13	3.14%
Chemical Engineering	24	5.80%
Construction Engineering and Management	2	0.48%
Electrical and Computer Engineering	27	6.52%
Environmental and Ecological Engineering	6	1.45%
First-Year Engineering	235	56.76%
Industrial Engineering	19	4.59%
Interdisciplinary and Multidisciplinary Engineering	6	1.45%
Mechanical Engineering	24	5.80%
Materials Engineering	10	2.42%
Nuclear Engineering	1	0.24%

Data Analysis

A comparison of the populations was made by contrasting relative frequencies, where data are available.

Results and comparison

Full results of the 1935 data collection are not available. Results reported in this research were found in the 1935 “Careers and Education” speech given by Amelia Earhart. For the 2019 data collection, 83.57% (346) of the participants reported that had earned money while 16.45% of the participants reported never earning money. An overwhelming 98.31% plan to seek employment after finishing college. Only one participant is not planning to work after college, and 6 remained undecided. The most popular reason to seek work after college was: *To achieve professional success (to have the mental stimulus of accomplishing something)*. Table 4 presents the distribution of responses for this question noting that participants were able to choose multiple reasons. This question was answered almost identically 85 years ago when 92% of participants planned to work after leaving college while 7% remained undecided. The most noted reason for seeking work after college by the 1935 cohort was *To achieve professional success (to have the mental stimulus of accomplishing something)* followed by *To attain personal independence*, and thirdly *Economic*

*Necessity*²⁰.

Table 4: Responses to Question 2: Reasons for Seeking Work after College From 2019 Population

Major	N	Percentage Equivalent
Economic necessity	279	17.60%
The family expects it	140	8.83%
To attain personal independence	340	21.45%
To secure luxuries that could not otherwise be had	238	15.02%
To have something to do	198	12.49%
To achieve professional success (to have the mental stimulus of accomplishing something)	378	23.85%
Other	12	0.76%

In 2019, 47.47% of all participants stated that they had decided on a general field of work, 49.16% had some idea of what they wanted to do, and 3.37% had not yet decided. Similarly, the 1935 sample saw that 54% of participants had already decided what they wanted to do, 36% had some idea, and 6% stated that they were undecided²⁰. Earhart also stated that 40% of the freshman in her sample had decided on their general field of work²⁰. Similarly, in the 2019 sample, 40.68% of freshmen had decided on their general field of work. Table 5 presents the percentage, by academic level, of undecided for both samples. The percentages are similar for freshmen, sophomores, and juniors, however, the percentage of seniors undecided in the 2019 sample is far greater than the percentage in the 1935 sample.

In the 2019 sample, 67.73% of participants indicated that they selected engineering as a career because of a *liking of the field*. The remaining 32.27% are divided as follows: 12.94% *A brother or a sister or another close relative engaged in the same work*, 6.56% *Liked a former teacher in the field*, 4.08% *Could not think of anything else to do*, 3.72% *Other*, 3.37% *An idea that “it was a good field for a woman”*, and 1.60% because *the family decided it*. In the 1935 sample, 80% of the participants selected their field of study because of liking of it²⁰. It is important to keep in mind that the participants’ field of study in the 1935 sample was not collected.

Concerning the question “*If you were the wage earner and your husband ran the home, would you consider his work financially equivalent to yours?*”, 59.04% of the 2019 sample considered the work equivalent while 40.96% did not. Similarly in the 1935 sample, 67% of the participants stated

Table 5: Percentage, by Academic Level, of “Undecided” for Question 3 “*Have you decided what work you want to do or at least in what general field of work you wish to be?*” for 1935 and 2019 samples

Academic level	1935	2019
Freshman	52%	54.66%
Sophomore	40%	50%
Junior	30%	37.21%
Seniors	5%	36.11%

that they would consider it equivalent and 33% would not²⁰. In the 2019 sample only one student stated that they did not plan to keep working after getting married. On the other hand, in the 1935 sample, only 21% planned to continue working after marriage while 79% did not plan on working after marriage²⁰. When asked if they consider it advisable for women, in general, to continue working after marriage, 13% of the 1935 participants and 99.5% of the 2019 participants responded positively²⁰.

A vast majority of the 2019 participants (91.57%) stated that having young children would not interfere with their ability to continue working. On the other hand, 8.43% (35) would not consider it feasible to keep working. However, when children are over sixteen only 1.20% (4) stated that work would not be feasible, and 98.80 % (410) believe that working would be reasonable. In the 1935 sample only 2% would consider working while taking care of small children²⁰. That number increased to 39% when the children were 16 or older²⁰. Earhart stated that freshman and sophomores answered this question more conservatively than juniors and seniors²⁰.

Regarding the role of the married men *in the running of the household*, 87.71% of the 2019 sample stated that if the wife works, both husband and wife should have equal parts in the running of the household. 9.88% responded that *the man should have real interest regardless of the amount of participation he has* while 2.17% considered that *the man should do as much as he has time for* and 0.24% believed that *he should do a few simple things*. Similarly, in the 1935 sample, the most cited participant response was that husband and wife should take equal parts in the running of the household²⁰.

Exploratory Questions Responses in the 2019 Survey

When asked about workplace challenges, 96.14% of the 2019 sample believe that women face more challenges than men and 81.93% of participants indicated that they had faced gender stereotyping or bias. By the time this survey was applied, 82.63% of the freshmen, 79.76% of sophomores, 81.40% of juniors, 86.11% of seniors, and 75% of the graduate students had already faced gender bias. Finally, 91.81% believed that gender stereotyping coping strategies should be addressed by university programs.

Discussion

As a counselor, in 1935, Earhart learned that most female engineering students dropped out of the program by their junior year, citing unwelcoming attitudes from the male students and professors⁴. Earhart wished to break down the barriers that separated the female students from their male peers⁴. Not all male professors welcomed Earhart's efforts as they believed that the male students struggled enough finding jobs without having to compete with the female students⁴. Watson⁴ suggested that Earhart demonstrated that even though participants' attitudes towards their careers were changing, for the time, their attitudes towards marriage and children had not shifted. When contrasting the 1935 and 2019 populations, we observed that beliefs towards career and men's involvement in the household follow the same trends, while beliefs about children and marriage shifted significantly.

The two populations responded similarly for Question 1, 2, 3, 4, 5, and 10. Questions 1, 2, 3, and 4 asked about career expectations while 5 and 10 referred to beliefs around marriage and children.

For Question 1 “*Are you planning to seek employment after you leave college?*” 92% of the 1935 and 98.31% of the 2019 populations answered positively. For Question 2 “*If you are planning to work, what is your reason for doing so?*” the most popular response for both population was *To achieve professional success (to have the mental stimulus of accomplishing something)*. Responses to Question 3 “*Have you decided what work you want to do or at least in what general field of work you wish to be?*” answers were similar overall, however, the samples of seniors behaved differently. Only 5% of seniors in the 1935 population were unsure while 36% of the seniors in the 2019 population stated that they were unsure. Also, in both populations, the majority of students signaled that they selected their career because of liking of the field (Question 4). For Question 5 “*If you were the wage earner and your husband ran the home, would you consider his work financially equivalent to yours?*” 67% of the 1935 population believed that it was equivalent, while in 2019 this proportion decreased to 59.04%. Finally, both populations stated that married men should have equal part in the running of the house (Question 10).

On the other hand, a drastic shift in the responses to Questions 6, 7, 8, and 9 is noted. In the 2019 sample, 99.76% of participants plan to keep working after marriage (Question 6), while only 21% of participants in the 1935 sample planned to continue working. Similarly, 99.51% of the 2019 sample consider it advisable to continue working after marriage, while in 1935 only 13% considered it advisable (Question 7). In 1935 only 2% of the participants considered it feasible to continue working while having young children, this changes dramatically in 2019 where 99.57% consider it feasible (Question 8). This trend continues when asked about having children over sixteen years old, as 98.80% of the 2019 sample and 39% of 1935 sample consider it feasible to work (Question 9).

In 1935, the role of the wife was to manage the home, take care of the children and educate them, while the husband was the bread winner²². In the 2000s, wife and husband are seen as partners²². Historical events have likely shaped woman’s current beliefs on work and family; in 1963, Congress passed the Equal Pay Act, in 1964, Title VII of the Civil Rights Act passed prohibiting discrimination based on sex, in 1964, the Equal Employment Opportunity Commission was created, in 1965, contraception for married couples was legalized, in 1972, sex discrimination in federally funded programs was prohibited by Title IX, in 1975, women can no longer be exclude from jury duty, in 1978, discrimination against pregnant women is banned, and in 2013, women can be placed in military combat roles²³. Additionally, research shows that since the 1980s, men living with children are more involved in the children’s life²⁴.

The additional data collected from the 2019 population showed that most of the participants (81.93%) had faced gender bias. Gender bias in STEM could contribute to women’s lack of persistence in these fields of study. Smith and Gayles² stated that the main differences between women who decide to persist in STEM and women who leave are their academic and work environments. Smith and Gayles² also noted that all the participants in their study reported underestimation or demeaning attitudes towards their engineering knowledge by their male peers. Participants in our study disclosed several strategies they employ to deal with bias. The most prevalent were to ignore the comments and to work harder.

As a strategy to boost enrollment and persistence of female students in engineering, the Woman in Engineering Program (WIEP), established in 1969, strives to provide encouragement, strategies, and professional development to current students. As detailed in this paper, bias against women in

male-dominated fields is not new. To address this, alumnae regularly visit campus to share their experiences and tips for success. Additionally, mentoring programs for undergraduate and graduate students have been created. It is also important to note that WIEP hosts outreach programs for girls and boys in kindergarten through 10th grade with a goal of breaking barriers for girls as early as possible.

Limitations

The populations from 1935 and 2019 are different as Earhart gathered data from women across campus and did not collect information on their majors, while the 2019 population was exclusively female engineering students. Earhart did not disclose the little information about the sample demographics that she did collect, making it impossible to mimic the sample. Availability of data from the 1935 collection was limited and incomplete. The results of Earhart data collection were presented as part of her speech on “Education and Careers” given at Purdue University and to our knowledge no other records of this data exist.

Future work

Research in career, marriage, and children of men and women in STEM may represent a viable path towards equality in these fields. It is necessary to create an assessment that will allow us to draw valid and reliable results. Additionally, the new assessment should include male participants and the responses allow for same sex partners. Based on the information collected about gender bias, WIEP will consider implementing workshops to educate participants on what to do if encountered with these issues in the academic and workplace settings, thus creating a more supportive academic environment for female students.

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