2009

"Engineer Your Life" Evaluation Report for Year 2: Executive Summary

Prepared by:

Veridian inSight, LLC,

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Contacts

For questions or more information about the **EYL initiative**, please contact:

Thea Sahr

Associate Director,

Educational Outreach

WGBH

One Guest Street

Boston, MA 02135

617.300.3770

thea_sahr@wgbh.org

For questions or more information about the **evaluation study**, please contact:

Christine Andrews Paulsen, Ph.D.

Owner and Principal Scientist

Veridian inSight, LLC

PO Box 694

Concord, MA 01742

978.369.3519

cpaulsen@veridianinsight.com

Note: Dr. Paulsen was the study director at American Institutes for Research for the work performed in Year 1 of the project.

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About the Study

Background

According to the Bureau of Labor Statistics, four of the thirty fastest growing occupations through the year 2014 will be in engineering-related fields, resulting in 386,000 new job openings.[1] However, many students are graduating from high school with insufficient skills to pursue engineering.[2] Furthermore, males vastly outnumber females in undergraduate engineering programs. For example, in 2002, only 20% of engineering undergraduate degrees were completed by females[3] and in 2005, 52,936 males graduated college with an engineering degree, while only 13,197 females did the same.[4]

Therefore, in an effort to prepare female high school students for a college curriculum and achieve gender parity in the engineering industry, WGBH has developed an initiative entitled, *Engineer Your Life* (EYL). The initiative is targeted toward female high school students, career counselors, and professional engineers. It is designed to: 1) increase these target audiences' understanding of engineering, 2) inspire young women to explore engineering as a career option and 3) help counselors and engineers encourage young women to investigate engineering opportunities.

Study Design

One component of this initiative involves collecting survey and other types of data to both track changes in attitudes and knowledge over time as well as to evaluate the impact of the EYL initiative. To achieve these goals, American Institutes for Research (AIR) and Veridian inSight (VI) have collected several types of data to inform WGBH's efforts. In Year 1 (2007 – 2008) American Institutes for Research (AIR) collected baseline survey data to inform the development of the EYL initiative and set the foundation to measure its effectiveness over time. In 2009, Veridian inSight (VI) collected Year 2 survey and interview data. Table 1 summarizes the type and frequency of data collection for the evaluation.

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[1] Weill, S.I. (2008). High schools focus on engineering. *Industrial Engineer*, Vol. 40*(1)*, 16.

[2] Ibid.

[3] National Science Board. (2006). Science and Engineering Indicators.

[4] National Science Foundation. (2008). Accessed on 5/13/08 at: http://www.nsf.gov/statistics/wmpd/underdeg.htm

Table 1: EYL Evaluation Data

Type of Data	Year 1 (2008)	Year 2 (2009)	Year 3 (2010)
Survey of career counselors	X	X	X
Survey of engineers	X	X	X
Survey of college-bound, female high-school students	X	X	X
Interviews with EYL partners		X	X

The study was designed to capture data over a period of three years from the three main cohorts of interest: professional engineers, career counselors, and college-bound females. The study was not designed to be a longitudinal study of the same individuals over time. Rather, the surveys will capture data from unique members of each cohort over time.

These data provide a "snapshot" of attitudes, knowledge and beliefs among key audiences at three points in time: before the EYL initiative was launched, the year of its launch, and one year after EYL was launched.[5]

Study Participants

To date, the study sample has included counselors, teachers, engineers, and college-bound female students from all regions of the United States and a small sample from Canada. The total number of participants is summarized in Table 2 below.[6] We should note that the samples are independent from Year 1 to Year 2; in other words, we only included individuals in Year 2 who had *not* responded to the survey in Year 1.

[5] The full report contains a discussion of study limitations and how they were addressed.

[6] More information about the study participants is available in the full report.

Table 2: Number of Study Participants

Role	Year 1 Frequency & Percentage	Year 2 Frequency & Percentage
Counselor Survey		
Counselor only	147 (100.0%)	101 (59.1%)
Counselor and teacher	0 (0.0%)	43 (25.1%)
Teacher only	0 (0.0%)	27 (15.8%)
Engineer Survey		
Engineers	401 (100%)	411 (100%)
Student Survey		
College-bound, female students	1,824 (100%)	707 (100%)
Partner Interviews		
EYL partners	N/A	10 (100%)

We recruited survey respondents through contacts at relevant organizations and associations. Individuals who received the recruitment advertisements circulated the information via listserv postings, electronic bulletin boards, word-of-mouth, flyers and emails to all of their members. The organizations included national engineering, counselor and teacher associations, and national organizations for girls and young women. We also invited individuals who previously visited WGBH at college fairs and visited the EYL website. We targeted college-bound, female high school students by posting advertisements on social networking websites and various teen / student online forums. We also targeted counselors and engineers by posting advertisements on professional networking websites.

Study Findings

Since 2008, more of the college-bound high school females surveyed are viewing engineering jobs as wide-ranging, creative, and impactful on society—and more of them are interested in engineering careers. [7]

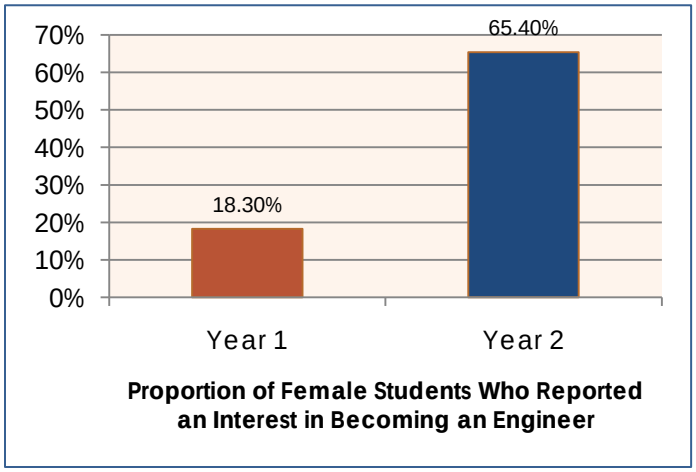
College-bound, high-school females have grown more interested in engineering as a career choice.

We asked college-bound high school females what kinds of careers they envisioned for themselves in the future and the kinds of work they expected to do as adults. In Year 1 of our survey, the top five career choices among college-bound high school females were:

- Doctor (40.3%),
- Teacher (39.8%),
- Psychologist (34.8%),
- Scientist (31.3%), and
- Business person (30.6%).

In Year 2 of our survey, the top five career choices among the same population were:

- *Engineer (65.4%),*
- Scientist (35.1%),
- Doctor (28.4%),
- Teacher (22.9%), and
- Business person (21.9%).



In Year 1, only 22.7% of the student respondents reported that they were "very likely" or "likely" to take an engineering class in college. In Year 2, 64.7% of students reported they would take an engineering class.

In Year 1, only 10.6% of respondents reported that they were "very likely" or "likely" to pursue a career in engineering. By Year 2, that proportion jumped to 52.4% of students.

More Year 2 counselors (63.1%) also reported that engineering careers were "very appealing" or "appealing" to their students than Year 1 counselors (39.7%).

We found that engineering was significantly more likely to be chosen in Year 2, even when controlling for age, grade, urbanicity, whether the student's school was an all-girls' school, weekly Internet usage, and exposure to EYL materials; even the Year 2 students who were unfamiliar with EYL were more interested in engineering as a career than were students in Year 1. **These findings add to the accumulating evidence from other recent studies which point**

[7] Throughout this document we use the terms "college-bound, high school females", "academically-prepared girls" and "students" interchangeably. We make distinctions when necessary.

to a growing level of interest nationally among young women with respect to field of engineering. For example, a recent report by Junior Achievement USA echoes the findings reported here. The 2009 study surveyed a national sample of teens and found that "engineer" tied with "doctor" for teens' first career choice.[8]

Girls who were familiar with EYL were significantly *more likely* to report that they wanted to be engineers (78.8%) than girls who were unfamiliar with EYL (57.3%)

However, we have evidence that our survey findings may be due to more than just a rising wave of interest among girls nationally. **We found a significant relationship between exposure to EYL and girls' interest in engineering.** When we examined the Year 2 students more closely, we found that although many students in Year 2 were interested in engineering (many more than Year 1), students who reported that they were familiar with EYL were significantly *more likely* to report that they wanted to be engineers (78.8%) than students in Year 2 who were unfamiliar with EYL (57.3%).[9]

This finding points to a significant relationship between EYL exposure and student interest in engineering. Either EYL is sparking girls' interest in the field *or* EYL is providing a needed resource for girls who are already interested in the field.

Girls who visit the EYL website report becoming more interested in engineering and feeling inspired to pursue engineering in college.

Most of the students who viewed the website indicated that the website helped them learn about engineering (95.3%). Most students also indicated that the website made them become more interested in engineering as a career (87.9%) and inspired them to take an engineering class in college (75.5%).

Girls reported that the EYL website made them more interested in engineering (87.9%) and were inspired to take an engineering class in college (75.5%).

Students' favorite aspects of the site were: learning about different engineering jobs, the stories about women engineers, and getting information on how to become an engineer.

In addition, many students indicated that the website helped them understand what they should do if they wanted to become engineers (79.2%). Most also reported that they would recommend the website to their friends (91.5%).

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[8] Junior Achievement USA (January 29, 2009). Poll shows less interest in "business person" careers. Retrieved on September 16, 2009 from http://www.ja.org/about/releases/about_newsitem526.asp. The study included a national sample of male and female teens and did not restrict the sample to college-bound students as we did in our study, so the proportion of teens interested in engineering is lower than the proportion found in our study (16%).

[9] More than 26% of the Year 2 sample of students (n = 165) reported that they were familiar with EYL.

College-bound, high school females want careers where they can use math and science, and they have become more interested in using engineering, too.

We asked students to chose school subjects that they would like to use in their future careers. In Year 1, writing (60.6%), math (57.2%), and science (56.5%) were listed as the most common school subjects that students wanted to use in their future jobs. In Year 2, the top three subject choices were math (74.9%), science (70.5%), and engineering (56.2%). Mirroring earlier findings about engineering careers, we found that students who were familiar with EYL were significantly *more likely* to report that they wanted to use math, science, and engineering in their future jobs than students who were unfamiliar with EYL.

The top five desirable job-related characteristics reported by students in both Year 1 and Year 2 were:

- I want to have fun
- I want to have time for family and friends as well as work
- I want to be successful
- I want to contribute to society / make a difference in people's lives
- I want to think creatively

Across both years, students who reported that they want to think creatively in their careers were also significantly *more likely* to report that they were interested in becoming engineers than students who did not want a career where they could think creatively.

Students may not realize that some of the jobs they are interested in doing *actually* are engineering-related.

We asked students to express their level of interest in a variety of different specific engineering jobs, without disclosing to them that the jobs were engineering-related. These included:

- Creating special effects for the movies
- Helping build schools that can withstand earthquakes
- Teaching communities to make their drinking water safe
- Designing life saving medical devices for patients with heart disease
- Developing a user-friendly blogging software
- Inventing a more powerful superglue

Students may be interested in engineering – without even realizing it.

Roughly half of the students in both Year 1 and Year 2 said they would be "very interested" or "interested" in designing life saving medical devices for patients with heart disease (52.1% and 56.5%, respectively) and in teaching communities to make their drinking water safe (43.9% and 54.8%, respectively). **In fact, students who were familiar with EYL were significantly more interested in these types of engineering jobs than other Year 2 students.**

So, how can it be that Year 1students are interested in doing these jobs, yet so few of these same students reported an interest in engineering as a career? Rather than contradicting the earlier finding that Year 1 students were less interested in engineering careers, there is evidence that many Year 1 students were simply *unaware* that jobs like these were actually examples of engineering jobs.

In fact, our survey of counselors revealed that only half of the counselors believed that their students were "very aware" or "aware" of engineering career opportunities. In addition, in Years 1 and 2, eighty-three percent (83%) of engineers reported that the most common barrier that prevented women from entering the field was young women's lack of familiarity with the engineering industry.

Engineers reported that the most important information that students should have about engineering are *examples of engineering projects* so that they can learn about the jobs available to them in the field.

These finding were echoed in a separate, recent study conducted by the American Society for Quality. Their recent national survey of US teens (including those who were not planning to go to college) found that kids, in fact, didn't know much about engineering (44%) and, likely as a result, were not interested in pursuing it.[10]

Students who realize that engineering is wide-ranging are more likely to want to pursue it.

Students cited many skills they believed were important to becoming a successful engineer. The majority of students reported that math, science, computer, machinery and problem solving skills were important, while people and public speaking skills were cited less frequently.

However, we found that students who recognized a more wide-ranging set of skills as important to engineering were significantly *more likely* to report interest in pursuing engineering than students who did not recognize such wide-ranging skills, such as:

- Good writing skills
- Good public speaking skills
- Good problem solving skills
- Good people skills
- Imagination and creativity
- Ability in math

[10] American Society for Quality (January 8, 2009). Kids Saying No to Engineering. Retrieved on September 16, 2009 from http://www.manufacturing.net/News-Survey-Kids-Saying-No-To-Engineering.aspx?menuid=36

EYL appears to be helping students to understand that engineering encompasses a wide range of skills.

Over time, it appears that many students are becoming more familiar with the skills needed to become engineers. For example, students in Year 2 were significantly *more likely* than students in Year 1 to believe that engineers needed the following skills:

- Good problem solving skills
- Ability in math
- Ability in science
- Imagination and creativity
- Good people skills
- Good writing skills
- Good public speaking skills
- Ability to work in groups

It appears that EYL is helping students to understand that a wide range of skills is necessary to becoming a successful engineer, beyond the stereotypical view that math and science skills are the most important ones.

Furthermore, students who were familiar with EYL were significantly *more likely* than those students who were unfamiliar with EYL to believe that the following skills were important to engineers:

- Imagination and creativity
- Good people skills
- Good writing skills
- Good public speaking skills

We also asked students to tell us the job roles they associate with engineering careers. Year 2 students were significantly *more likely* than Year 1 students to report that engineers…

- Use their math and science skills (90.8% in Year 2 versus 85.9% in Year 1)*
- Design and build solutions to problems (87.7% versus 11.9%)
- Design equipment (78.8% versus 72.2%)
- Think creatively (82.9% versus 68.6%)*
- Manage projects (79.9% versus 74.0%)
- Invent things (78.1% versus 37.3%)*
- Make a difference in people's lives (77.2% versus 58.6%)*
- Sometimes work with other professions (76.8% versus 70.7%)*
- Work as part of a team (76.4% versus 67.2%)*
- Have a lot of choices in the industry (73.7% versus 64.0%)*
- Use English and writing skills (29.1% versus 18.3%)*
- Travel around the world (39% versus 23%)

For most of these job roles (those marked with an asterisk), we found that students who were familiar with EYL were significantly *more likely* to associate non-stereotypical job roles with engineers than students who were unfamiliar with EYL. Thus, we observed an increased

awareness among students from Year 1 to Year 2 that is strongly related to student familiarity with EYL.

EYL is helping students to become more informed about the type of preparation required for an engineering career.

In Year 1, 39% of students believed that a master's degree was necessary for a career in engineering. In Year 2, only 27.6% of students believed that a master's degree was necessary for an engineering career and were *more likely* than students in Year 1 to suggest that a broader educational background is important in order to become an engineer. This suggests that students have developed an understanding that a master's degree isn't necessary to pursue an engineering career and that a more diverse background of educational experience and skills is desirable.

Most of the students who viewed the website indicated that the website helped them learn about engineering…many students indicated that the website helped them understand what they should do if they wanted to become engineers.

For example, we asked the student respondents which subjects engineers might study in college. The majority of students were aware that engineering, physics, math, general science and chemistry were typical course requirements.

While fewer than half of the students across both years were aware of the need for a more diverse portfolio, including English, social studies, psychology and public speaking opportunities such as debate and theater, students in Year 2 were significantly *more likely* than students in Year 1 to recognize the importance of the non-science subjects.

When we controlled for whether students had expressed an interest in engineering, we found that students who were interested in an engineering career were significantly *more likely* to recognize the importance of studying subjects like English, psychology, foreign languages, debate, and nutrition than students who were not interested in engineering.

Students, especially those familiar with EYL, have become more aware of the importance of non-science subjects like English and debate to the field of engineering.

The more active students are in extra-curricular activities, the more likely they are to report having an interest in engineering.

In both years, there was a positive correlation between the number of extra-curricular activities in which students participated and their reported intentions to take an engineering class in college. The more activities students participated in, the more likely they were to report intentions to take an engineering class in college.

There was also a positive correlation between the number of extra-curricular activities students participated in and their reported intentions to pursue an engineering career. The more activities students participated in, the more likely they were to report intentions to pursue an engineering career.

Students who participated in

- Community service activities
- National Honor Society
- Sports teams

…were most likely to show an interest in engineering.

We found significant differences between student respondents who had participated in certain extracurricular activities and those who had not participated with respect to their intentions to pursue an engineering career. Students who reported participating in community service activities, National Honor Society, and sports teams were *more likely* to report intentions to pursue a career in engineering than those who had not participated in the same activities.

In addition, students who participated in engineering-related activities (Mathletes and science fair) were also *more likely* to report an intention to pursue engineering than students who did not participate in engineering-related activities.

Students are perceived to be more aware of and more interested in engineering at schools where they are exposed to engineering programs and activities.

Not surprisingly, counselors who worked at schools that offered multiple engineering activities and programs were significantly more likely to report that their students were aware of engineering career opportunities and found them more appealing than counselors who worked at schools that did not offer engineering activities and programs.

Parents carry substantial influence in helping students choose engineering.

Many students (roughly half) relied on their parents for career advice. This finding is echoed in other recent studies which have found that girls' career choices are heavily influenced by their parents.[11,12] In fact, in Year 1, 75.3% of the counselors reported that their students' parents were encouraged by the school to be involved in their child's career plans. By Year 2, that proportion increased to 79.7%. In both years, we found that the more parents were encouraged to be involved in their children's career plans by the schools, the more counselors perceived the

[11] Dietrich, J. & Kracke, B. (2009). Career-Specific Parental Behaviors in Adolescents' Development. Journal of Vocational Behavior, 75*(2)*, 109-119.

[12] Flouri, E. & Hawkes, D. (2009). British Journal of Educational Psychology, 78*(3)*, 411-433.

students to be aware of engineering career opportunities and the more appealing engineering career opportunities were perceived to be to students.

EYL is Helping Engineers and Counselors Encourage Young Women to Choose Engineering

EYL may be filling an information gap for counselors at schools with few engineering resources.

Of the 175 counselors and teachers in the sample, 49 (28.0%) reported that they had heard about EYL before receiving an invitation to participate in the survey. Those who had heard about EYL reported hearing about it from various sources. The most common sources of information about EYL included: colleagues, the NACAC listserv, finding the EYL website, and receiving EYL materials in the mail.

86% of the counselors who used EYL resources are from schools that offer few engineering classes or activities.

Interestingly, counselors who had previously heard of EYL were far more likely to be from schools that did *not* offer specific engineering classes *nor* did their schools offer engineering in their science curricula. For example, of the counselors who indicated they were familiar with EYL, 86% of them were from schools that did not offer specific engineering classes. Thus, it appears that counselors in such schools may be more actively seeking out information on engineering from external sources than counselors in schools that already offer such courses.

Moreover, counselors who reported they had heard of EYL were more likely to be from schools that did not offer engineering classes. Thus, it appears that the EYL resources are perceived by counselors in schools without their own engineering resources to be able to fill an important gap in engineering resources.

Counselors are using EYL resources to help educate students about the engineering field.

I found inspiration and role models in the stories for young girls who think that only nerds and ugly women are engineers.

Counselors who used EYL resources were more likely to report that "young women are not aware of what engineers do" than counselors who did not use EYL resources. Thus, it appears they are using the EYL resources to address this information gap. All who reported that they had used EYL resources previously also reported that the resources were "useful" or "very useful." We asked all the counselors in the study to report which EYL materials they thought they *might*

use when advising their students in the future. The most common responses were the EYL website, the brochure, and the poster. Some counselors reported:

> *Being from Michigan, my girls often associate engineering with the automotive industry. The site was useful in opening their minds to the other possibilities.*
> *…the Looking at Programs section was extremely helpful because it directed me toward other sites where I could search for schools by specific types of engineering degrees offered. This helped me to find an appropriate school for a student interested in bioengineering and biomedical engineering.*

The EYL website has helped counselors learn more about engineering and how to prepare young women to pursue it.

99% of counselors who were familiar with EYL reported that they learned something about engineering using the EYL website.

Most of the counselors (96%) also reported that the website did a good job of helping them understand what they should do to prepare high school girls to become engineers (e.g., what classes to take and how to prepare for college).

99% of counselors who were familiar with EYL reported that they learned something about engineering using the website.

96% of counselors reported that the website did a good job of showing what life and work are like for different engineers.

All the counselors reported that the website helps to teach kids about engineering, that it helps kids understand that an engineering career is achievable, and that it does a successful job of introducing high school girls to young women engineers.

All counselors reported that they would visit the website again and recommend the website to others, including other counselors and students.

EYL appears to be encouraging engineers to share with students the wide-ranging nature of their field.

Twenty-six of the engineers indicated that they had previously used EYL resources. Engineers reported using the following resources most frequently: EYL postcard, the EYL website, and an EYL poster. All engineers reported that the resources they used were useful or very useful.

Engineers who had used EYL resources were *more likely* than engineers who had not used EYL resources to report that they would encourage young women *and men* interested in engineering to visit engineering websites for more information about the field, to explore a range of classes, including social sciences and history, and to consider various English classes, including language arts, debate, and journalism.

Engineers report that the EYL website portrays engineering in a realistic, understandable, and educational way.

All of the engineers who had used the website reported that the website did a good job of showing what life and work were like for engineers.

Most engineers (88%) reported that the website helped them to feel more comfortable helping to prepare high school girls for becoming engineers.

Almost all of the engineers (97%) reported that the website helped kids learn about engineering and that it did a successful job of introducing high school girls to female engineers.

> All of the engineers reported that the EYL website helped kids understand that an engineering career is achievable.

All of the engineers reported that the website helped kids understand that an engineering career is achievable.

All of the engineers indicated that they would recommend the website to a student who is interested in learning more about engineering. Most engineers (97%) reported that they would recommend the website to their colleagues.

Some comments added by engineers included:

> *I love the positive image of engineers (specific engineers with faces) really making a difference (specific differences with pictures/videos)! I also really like the easy to access descriptions of the various types of engineering.*
>
> *I think it is great that there is a website encouraging young girls to become engineers.*
>
> *The teachers and counselors that I have worked with are especially excited about the stories and videos!*
>
> *The videos help younger children understand what an engineer does.*

Barriers Still Exist to Young Women Entering Engineering

Career counselors perceive educational and non-educational barriers to women entering the field of engineering.

The majority of the counselors (roughly 90%) in both years of data collection reported that they perceived both educational and non-educational barriers to entry for women into the profession. Roughly one-tenth of counselors reported there were no barriers at all for women to enter the field of engineering.

Most counselors (82.3% in Year 1 and 84% in Year 2) reported that educational factors were a barrier to entry into the field of engineering for women, especially the lack of engineering classes and program offerings in many schools.

According to counselors, boys are still more encouraged to try engineering than girls.

More than half of the counselors reported that there were several non-educational barriers to women entering the field of engineering, including a lack of female role models, women being unaware of what engineers do, the masculine image associated with engineering, and aversion to working in a male-dominated environment.

More than two-thirds of the counselor respondents "strongly disagreed" or "disagreed" with the statement that boys are better at math and science than girls. However, almost one-tenth of the respondents "strongly agreed" or "agreed" that boys are better at math and science than girls.

More than one-third of the counselors "strongly agreed" or "agreed" that boys were generally more encouraged to pursue engineering than girls.

Regardless of suitability and encouragement to pursue engineering, most respondents were "very confident" or "confident" that women can succeed in an engineering high school curriculum, an engineering college curriculum, and in engineering careers.

Nationwide, only a small proportion of schools offer engineering activities or classes.

According to counselors and students, fewer than one-third of the schools represented in our sample offered engineering activities or mentors to students, including clubs, Women in Engineering Day, guest speakers or career fair representatives. Furthermore, between one-quarter and one-half the schools in the Year 1 sample offered engineering classes or curriculum components, while fewer than one-quarter of the schools in the Year 2 sample offered these courses.

- More suburban schools offered engineering extracurricular activities and clubs than their urban and rural counterparts.
- More Southern schools offered engineering programs and activities than schools in other regions of the country.
- More public schools offered engineering programs and activities than other types of schools.

Schools that were least likely to offer engineering programs and activities tended to be charter schools, rural schools, and schools in the Midwest region of the country.

As discussed earlier, counselors who worked at schools that offered multiple engineering activities and programs were significantly more likely to report that their students were aware of engineering career opportunities and found them more appealing than counselors who worked at schools that did not offer engineering activities and programs.

Engineers report that today's students should learn about engineering *before* they reach high school.

Although most engineers reportedly decided to become engineers while in high school, they argued that today's students should be encouraged to pursue engineering at an even younger age. The majority of engineers reported that current students should be encouraged to pursue a career in engineering in junior high or in elementary school, rather than waiting until high school.

Engineers perceive barriers to women entering the field of engineering.

In Years 1 and 2, eighty-three percent (83%) of engineers reported that there were barriers that prevented women from entering into engineering. The most commonly reported barrier was young women's lack of familiarity with the engineering industry.

According to engineers, the biggest barrier to women entering engineering is lack of knowledge of the field.

Other key barriers included: a lack of visible role models, the perception of having to work in a male-dominated environment and being the "lone female," and the masculine image of engineering. In fact, we asked the engineers whether they had any male or female engineers as role models when they were in school or starting their career. Only 14.5% of Year 1 respondents and 21.9% of Year 2 respondents reportedly had a female engineer as a role model. Meanwhile, 66% of respondents in Years 1 and 2 reported that they had a male engineer as a role model.

Engineers did not perceive that the following factors were barriers to women becoming engineers: a lack of flexibility, the need to excel in math and science, and lack of teamwork—often having to work alone.

Engineers who were familiar with EYL prior to completing the survey were significantly more likely to believe that there were barriers to women entering the engineering profession than engineers who were unfamiliar with EYL. Engineers who were familiar with EYL were also significantly more likely to believe that young women were unaware of what engineers do than engineers who were unfamiliar with EYL. They were also more likely to believe that there is a lack of visible role models for young women than engineers who were unfamiliar with EYL.

There is a perceived lack of gender equality in engineering.

In both years, only slightly more than half of engineers in our sample reported that females were accepted as equals by their peers in the field of engineering. Many respondents cited perceived gender inequality as a barrier to women entering the engineering industry. For example:

Thirty-one percent (31%) of respondents in Years 1 and 2 indicated that engineering is not a female-friendly profession.

> 31% of engineers reported that engineering is not a female-friendly profession.

More than half of the respondents (53.7% in Year 1, 53.5% in Year 2) reported that the "masculine" image of engineering was a barrier to women entering into engineering as a career.

More than half of the respondents (57.9% in Year 1 and 54.0% in Year 2) reported that "working in a male-dominated environment / being the lone female" is an entry barrier for women.

In fact, approximately 12% of students in Years 1 and 2 indicated that someone in their lives had specifically discouraged them from pursuing engineering as a career choice. In Year 1, the main reason was that the adult perceived the student to be disinterested in it. But, in Year 2, one of the main reasons that they had been discouraged was that "engineers are all men."

Despite this, in both years, over 99% of the students agreed that women can succeed in an engineering career.

Engineers report that some of the widely held stereotypes about engineering are, in fact, true.

Across both years, the most common stereotypes that engineers perceived to be true included: (1) engineers must excel at math and science, (2) engineers are promoted less if they are female, and (3) engineers are "nerdy." The stereotypes that engineers were least likely to believe were: (1) that engineers lack communication skills, (2) that they lack social skills, and (3) that they are boring. There were no differences in beliefs among engineers who had previously used EYL resources.

EYL coalition members are enthusiastic and eager to do more work together.

Coalition members believe that the message the EYL initiative sends to young women has successfully challenged engineering stereotypes.

Several members we interviewed commented that the "look and feel" and language used on the EYL website and promotional materials effectively challenged stereotypical images of engineers. Two members specifically mentioned the similarities between the messaging of the initiative and the messaging recommendations from the National Academy of Engineering's "Changing the Conversation" study group report. Some members commented that the videos and profiles of engineers on the website, and the personal stories and imagery used within the promotional materials, resonated with high school women and encouraged them to question their perceptions of engineering careers. Many members commented that EYL resonated with high school women largely because the content appeared to be clearly researched, market-based, contemporary, and professionally designed. Some members commented:

> Many members commented that EYL resonates with high school women largely because the content appears to be clearly researched, market-based, contemporary, and professionally designed.

> *It's well designed and engaging for girls.* —National Girls Collaborative Project

> *These girls (on the website) look cool. They don't look nerdy, which is what the girls were expecting to see… The individual stories…(they're) jazzed up. Clearly marketed to the right age group…* —Texas A&M

> *'Outside the box' video (on site) has helped kids think about engineering.* —NACAC Member, Covenant Christian Academy

> *They (profiles on website) look more and act more like students today.* —IBM

> *I think the messaging piece (EYL does well)…It shows that different light of how diverse engineering is. I don't know of any other website that really does that good of job of it. This has such great messages through all of it.* —WEPAN

EYL coalition members report varying degrees of how they used the EYL resources.

Members generally reported using the resources in one of three ways. They either:

- Used the materials directly with students.
- Modified the materials with their own company and organizational images and logos to recruit students to enroll in their university engineering departments or to engage students in their own specific organizational goals.
- Distributed the EYL materials to affiliate organizations and schools, and reported a casual knowledge of the specific content included within the EYL materials.

Some members that worked directly with students or modified the materials to better match their own university or organizational brand said:

> *We took the EYL postcards and modified them and put pictures of our own students in there. We have made giant posters using the (templates) from EYL featuring our own students. We actually use that internally to help communication with our own students (and promote) the vision for engineering and that engineers…have rich and varied lives…* —University of Colorado-Boulder

> *We're true believers…we just redid a website for civil engineering for a somewhat younger cohort (www.ASCEville.org). We leapt off the page of EYL…the outcome looks pretty different but the messaging looks quite the same…* —ASCE

> *We sort of looked at what happens at the EYL career fairs…we designed some materials that take the exact look of the EYL posters, only they feature civil engineers…* —ASCE

> *I worked with the science teachers about how to present the information…I did presentations in the biology classes and talk with students about (EYL) and the opportunities.* —NACAC Member, Fossil Ridge High School

> *We take the material…and push it out there to girls…We also grab material off of (EYL website) and stick it in our PowerPoints.* —WEPAN

> *We help with the process of dissemination.* —ITEA

> *Our outreach is to after school programs (not directly to students) and STEM organizations…we don't serve girls directly.* —National Girls Collaborative Project

> *Our recruitment programs are designed to improve our mix, so diversity and women are a big part of who we're trying to attract into the college of engineering...our outreach is to teachers, not students.* —Texas A&M

Coalition members are satisfied with the active and visible role the EYL initiative has played in promoting the goals of their organizations.

Most members commented that EYL resources enhanced or supplemented their organizational goals of reaching out to high school women and challenging engineering stereotypes. Some members said:

> *…I was looking into how we might create materials (to recruit young women to consider engineering degrees). When I saw (that) these materials…were such good quality I couldn't imagine why I would recreate this.* —Texas A&M

> *IBM has been involved with Engineers Week and the National Engineering Foundation for years….It was the natural next step…because of the focus on girls and trying to encourage girls to consider careers in technology.* —IBM

> *There really wasn't anything else out there for those high school girls that was cool and hip and talked about engineering in the same language that we use to talk to our*

students… It gives us some great talking points that help shift that mindset or any preconceived notions that students might have about what engineering is about...

—WEPAN

EYL is the perfect fit for us because the EYL resources are well designed, research based, engaging for girls…all of our programs and collaboratives (consortium of organizations that serve girls in engagement with STEM) around the states are excited to get (resources) from us...we have lots of people who ask us to send out resources. We don't do that for everybody. We want to be sure the resources we send are research based.

—National Girls Collaborative Project

…we actually use EYL as a verb here (in our outreach materials). 'Have you EYL'd it?' we say. 'Have you put it through the EYL filter?' —University of Colorado-Boulder

EYL sort of evolved over time…it started with a research grant from NSF that really gave us the tools to learn more about why girls that were academically prepared weren't choosing engineering…that gave us a tool that we could use to go back to inform engineers and change their thinking about how they approach outreach to girls, in particular, but to all students. It opened (engineers') eyes to the sense that maybe it's not enough to just have a passionate commitment to get kids interested in engineering…

—ASCE

General feedback about the EYL initiative was overwhelmingly positive. Some members commented:

Anytime you have a program like this it helps people understand (what engineering is). —ITEA

Whenever we (bring) all the EYL stuff with us to any of our events, we never bring anything back. They fly off the tables. —National Girls Collaborative Project

I would often talk with (my students) about engineering, but their hesitation was really apparent…They didn't seem themselves in those roles….when I went to the workshop at the national conference I learned that I didn't promote (engineering) to students who really showed characteristics that fit that type of a career. I didn't know as much about it as I thought I did… —NACAC Member, Fossil Ridge High School

Coalition members do not yet have data to assess the overall impact of EYL on academically-prepared young women.

Most members measured the impact of their organization's involvement with the initiative based on the "anecdotal" enthusiasm they observed from teachers, program leaders, and students.

One member that used the materials directly with students reported that the EYL resources had great impact with high school females in one-on-one settings. She also observed impact with middle school students in small group settings. She judged the overall impact of the EYL resources based on student enthusiasm for the videos and individual stories on the website.

Another member that used the materials directly with students said:

> *…what I saw were students connecting (engineering) with ideas (of) being able to travel, earn money, have flexibility, (and) to be creative. Because I was in an all-girls school, we talked about their strengths as problem solvers in groups…I saw them really connect…* —NACAC Member, Fossil Ridge High School

Other members commented on how they measured anecdotal impact:

> *We measure our impact based on program people telling us (that) it's working…we don't touch girls directly.* —National Girls Collaborative Project

> *I think the materials are really good (based on) what my marketing group says …the feedback from the teachers is very positive. I've had them e-mail me and ask for more…I always find it difficult to give quantitative data for an outreach program.* —Texas A&M

> *…I'm starting to see more anecdotal evidence…the anecdotal feedback we're getting is really positive…were getting really good feedback from people who have been exposed to this…I've seen evidence of positive reaction within the community.* —ASCE

Some members indicated that they would like to have a clear way of evaluating the impact the resources had on the young women to whom they have reached out.

> *In retrospect, the thing I didn't do that I would do in the future is that I didn't do any type of evaluation with them…* —NACAC Member, Fossil Ridge High School

> *I would love to know more about the impact of EYL...it would be really interesting to hear back from EYL (about its impact)…* —National Girls Collaborative

Some coalition members are interested in combining outreach efforts and networking with other coalition members.

Many members indicated that the EYL initiative is "one of many" programs designed to involve young women in engineering. Some suggested that since coalition members have similar goals, combining outreach and strategic efforts would help the EYL initiative achieve its broader goal of challenging young women to rethink their perception of engineering, take engineering courses, and consider engineering careers.

Some members recommended making it more clear on the EYL website how to connect to other members that are actively involved with promoting the EYL initiative, perhaps through an online forum or portal-like application. Members expressed a desire to combine efforts with other coalition members to find better ways to reach out to young women through EYL, learn about creative ways to use the EYL resources collectively, access updated materials, and share new ideas. Another member recommended that members present a "What EYL has done for you" presentation at conferences.

A couple of members commented:

> *If we can get more people understanding how to talk these high school girls and show them these role models and these cool things you can do with this degree, the better off we all are…if we can all speak that same language.* —WEPAN

> *One area we can do a better job at is reaching some of the companies and corporations in our sector.* —ASCE

Coalition members reach out to other organizations and partnerships about the initiative.

Many members reported that their level of satisfaction with the resources has resulted in telling other individuals and organizations about the initiative. These organizations included:

- American Association for University Women
- WEPAN
- Society of Women Engineers
- Purdue University
- National Girls Collaborative
- Texas Girls Collaborative
- Texas Regional Collaborative
- Girl Scouts Network
- TechBridge (California)
- SciGirls Initiative
- Computer Science Teachers Association
- Local high schools

All of the EYL coalition members expect to stay involved with the EYL initiative and some hope to become even more involved.

Some members expected that WGBH would contact them about any updates in materials and resources either through the website or newsletter. Other members offered the following recommendations to enhance the initiative:

> *…I would love, of course, to see more women profiled or a new batch of the women profiled. More is always wonderful. I love the top ten reasons to be an engineer. I don't know if there are other (versions) of that to use as selling points for girls.* —WEPAN

> *We're going change as they change…we don't know what we'll be doing a year from now, but we expect it to be cooler and more edgy.* —University of Colorado-Boulder

One member implied that the initiative should stress to members that they can modify and revise EYL resources so that they more readily resonate with specific brand and outreach goals of different organizations:

… it's unrealistic that we're going to check our corporate objectives at the door…you have to have a way to motivate those engineers. It helps them be personally invested and empowered in the concept (of EYL)…you have to let them put their logo on it and feature their engineers. The key is to get them to embrace the messaging and embrace the resources, and letting them customize it is really one way to do that. —ASCE

Conclusion

This study found evidence that there may finally be a shift occurring among college-bound, high school females in the United States—towards a greater level of interest in the field of engineering. This is perhaps not surprising, given that there are dozens—if not hundreds—of engineering programs, afterschool activities, STEM efforts, and technology curricula in place across the country. This study provides evidence that these efforts to get girls excited about careers in the field of engineering, including EYL, may finally be starting to take hold.

In fact, we found that academically-prepared girls expressed a definite interest in using math and science in their future careers and that they expressed significant interest in doing the kinds of work that engineers do. Students were even more interested in engineering when they had a fuller understanding of the kinds of skills that are required to be a successful engineer—skills that are not traditionally associated with the field, such as writing and people skills, imagination and creativity. This deeper understanding is one of the changes that EYL strives to produce.

So, what role has EYL played in this shift?

Our study also found evidence that the *Engineer Your Life* initiative has had a significant and positive impact on members of its target population who have used EYL, in several meaningful areas. Consider the following:

- Girls who were familiar with EYL were significantly *more likely* to report that they wanted to be engineers (78.8%) than girls who were unfamiliar with EYL (57.3%).

- Students who were familiar with EYL were significantly *more likely* than those students who were unfamiliar with EYL to believe that the following skills were important to engineers:

    - Imagination and creativity
    - Good people skills
    - Good writing skills
    - Good public speaking skills

- Students who were familiar with EYL were significantly *more likely* to associate non-stereotypical job roles with engineers than students who were unfamiliar with EYL.

- Most of the students who viewed the website indicated that the website helped them learn about engineering (95.3%). Many students also indicated that the website made them

become more interested in engineering as a career (87.9%) and inspired them to take an engineering class in college (75.5%).

- Students who visited the EYL website had a greater understanding of how to prepare for an engineering career than those who did not.

- In addition, many students indicated that the website helped them understand what they should do if they wanted to become engineers (79.2%). Most also reported that they would recommend the website to their friends (91.5%).

- Counselors familiar with EYL were far more likely to be from schools that did *not* offer specific engineering classes *nor* did their schools offer engineering in their science curricula. Thus, it appears that counselors in such schools may be more actively seeking out information on engineering from external sources than counselors in schools that already offer such courses.

- Counselors reported that they were using EYL resources to help educate students about the engineering field.

- 99% of counselors who were familiar with EYL reported that they learned something about engineering using the EYL website.

- Most of the counselors (96%) also reported that the EYL website did a good job of helping them understand what they should do to prepare high school girls to become engineers (e.g., what classes to take and how to prepare for college).

- 96% of counselors who used the website reported that EYL did a good job of showing what life and work are like for different engineers.

- All the counselors who used it reported that the EYL website helped to teach kids about engineering, that it helped kids understand that an engineering career was achievable, and that it did a successful job of introducing high school girls to young women engineers.

- All counselors who used it reported that they would visit the EYL website again and recommend the website to others, including other counselors and students.

- Engineers who had used EYL resources were *more likely* than engineers who had not used EYL resources to report that they would encourage young women *and men* interested in engineering to visit engineering websites for more information about the field, to explore a range of classes, including social sciences and history, and to consider various English classes, including language arts, debate, and journalism.

- All of the engineers who had used the EYL website reported that the website did a good job of showing what life and work were like for engineers.

- Most engineers (88%) who used it reported that the EYL website helped them to feel more comfortable helping to prepare high school girls for becoming engineers.

- Almost all of the engineers (97%) who used it reported that the EYL website helped kids learn about engineering and that it did a successful job of introducing high school girls to female engineers.

- All of the engineers who used it reported that the EYL website helped kids understand that an engineering career is achievable.

- All of the engineers who used it indicated that they would recommend the EYL website to a student who is interested in learning more about engineering. Most engineers (97%) reported that they would recommend the website to their colleagues.

- EYL coalition members believe that the message the EYL initiative sends to young women has successfully challenged engineering stereotypes.

- Coalition members are satisfied with the active and visible role the EYL initiative has played in promoting the goals of their organizations.

- Coalition members have reached out to other member organizations to collaborate and are interested in doing more.

Despite these positive findings and students' growing interest in engineering, much work still remains to be done. According to the counselors and the engineers in our survey, there are still significant barriers to women entering the field of engineering:

- Boys are still more likely to be encouraged to pursue engineering than girls in some schools.

- Some schools do not offer engineering programs or activities.

- Many students still do not have an accurate understanding of what engineering is.

- Engineering is still perceived by some to be a male-dominated profession that is not female-friendly.

- Male engineering graduates still vastly outnumber female engineering graduates.

Our study indicated several ways in which EYL may be able to continue addressing these problems.

- EYL should attempt to reach out to schools that specifically *do not* offer engineering programs or activities.

- EYL should attempt to reach out to non-engineering-related student groups such as National Honor Society, community service groups and sports organizations.
- EYL should consider reaching out to middle schools and elementary schools.

- EYL should continue to engage more engineers in outreach activities.

- EYL should continue creating awareness of the academic preparation (school subjects and degrees) needed for a career in engineering, and emphasize the importance of non-science subjects.

- EYL should continue emphasizing to students that engineering is a rewarding career choice which offers the opportunity to make a difference in the world, design solutions to problems, use their creative skills *and* have fun.

- EYL should continue emphasizing the different types of projects on which engineers work.

- EYL should continue encouraging students to participate in career exploration days, shadow an engineer, or find a mentor.

- EYL should explore ways to help coalition members network with each other.

In Year 3 (2010), we will survey a cohort of college-bound, high school females, counselors, and engineers to see whether the possible trends identified in this study are continuing.