

WOMEN IN SCIENCE: ARE PORTRAYALS ON  
PRIMETIME TELEVISION NEGATIVE, AND WHAT ARE  
THE EFFECTS OF EXPOSURE TO SUCH CONTENT?

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The undersigned, appointed by the dean of the Graduate School, have examined the thesis entitled

WOMEN IN SCIENCE: ARE PORTRAYALS ON  
PRIMETIME TELEVISION NEGATIVE, AND WHAT ARE  
THE EFFECTS OF EXPOSURE TO SUCH CONTENT?

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## Introduction

In the 2012 State of the Union address United States President Barack Obama recognized the ever-growing need to get more young people into science, technology, engineering and math (STEM) career fields, to help guarantee continued and future international leadership for the U.S. The truth is, this author believes, more girls are needed. As evidence, since 1993, the National Science Foundation (NSF) has made major financial investments for “real changes in the opportunities available for girls and women to participate in the study of science, technology, engineering and math” (National Science Foundation, ¶ 2, 2007). Yet, female STEM achievement data from 1995 to 2012 shows that women still lag behind men.

- In 1995, United States (U.S.) females earned less than 40% of science master’s degrees, and the Labor Department reported that U.S. women made up less than 10% of employed engineers and only 25% of the employed natural scientists (Steinke, 1998).
- Similarly, in the United Kingdom (UK), women made up only a small number of physics students – 20 % – and once employed in science fields, women found it difficult to reach positions of seniority (Hodgson, 2000).
- For the 10 year period, 2000-2009, the proportion of Science & Engineering bachelor's degrees awarded to women did not noticeably grow, and declined in computer sciences, engineering and mathematics (NSF, ch. 2, 2012).

- In 2008, females accounted for only 13% of the engineering workforce (NSF, ch. 3, 2012).
- During the academic year 2008-2009, females earned only 31% of the total higher education awards conferred in the fields of science, technology, engineering and mathematics (U.S. Department of Education, 2011), with colleges and universities seeing considerably fewer women enroll in advanced degree programs in computer sciences, economics, engineering and physical sciences (NSF, ch. 2, 2012).
- Females make up 50.8% of the U.S. adult population (U.S. Department of Commerce, 2011). Forty-seven percent of the U.S. workforce is female; and 52% of those employed in professional, management and related occupations are female (U.S. Bureau of Labor, 2014).
- Yet, in 2012, women made up only 17.7% of the chemical engineers, 15.1% of computer hardware engineers, 13.7% of civil engineers, 9% of electrical and electronics engineers, and 4.5% of the mechanical engineers employed in the U.S. (U.S. Bureau of Labor, 2014).

Why do women enter STEM fields at such lower rates than men? One could argue that women have had further to climb, in terms of access to education, to reach equality. For instance, wealthy Anglo men have had access to quality higher education since the mid-17<sup>th</sup> century. And throughout the 18<sup>th</sup> and 19<sup>th</sup> centuries more public colleges opened in the United States, offering greater opportunities to middle-class males. Possibly men dominated the science, math and engineering disciplines because women

were not allowed equal access to education until 1848 following the Women's Rights Convention in Seneca Falls, NY (The Women's Rights National Historical Park, 1994).

Once given access to education, women excelled – tripling enrollment in college between 1900 and 1920 from just over 2.5% to almost 8% of total higher education students. And contrary to common thought of the time, higher education did not damage a woman's ability to marry and raise children. In fact, the Association of Collegiate Alumnae<sup>1</sup> reported that women in college were found to be in better health due to exposure to athletics and involvement in physical activity (Lowe, 1989). Still, women were not encouraged to pursue scientific education. Magazines and newspapers, the prevalent mass media of the 1920s, quoted then-pop star Flapper Zelda Fitzgerald saying, “scientific careers call for 'hard work, intellectual pessimism, and loneliness,' and she would not want her daughter to choose such a life” (LaFollette, 1988, p. 266).

Taking a more current perspective is the report, *Why So Few? Women in Science, Technology, Engineering and Math* (American Association University Women [AAUW], 2010), which began to investigate why women have advanced in the education, business, law and medicine fields, but not in STEM. One of the co-authors, AAUW Senior Researcher Andresse St. Rose, Ed.D., spoke to a gathering of professional women in San Antonio, and said:

Social and environmental factors shape girls' achievements and interests in STEM fields. Up to middle school age, girls perform equal to or better than boys in math and science, but something happens after that point. Girls are threatened by the stereotype that math and science are only for boys. Because girls' performance improved with the threat removed, there is evidence that girls are just as capable as boys, and we must find ways to end the stereotype (personal communications, March 22, 2011).

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<sup>1</sup> ACA was the predecessor to today's American Association of University Women

Another recent article reported that American fourth graders scored above their global peers on academic testing (Perryman, 2012). But by eighth grade, though U.S. students were still ahead in science, they fell to just below average in math. And at the end of 12<sup>th</sup> grade, U.S. students were near the bottom scores in both math and science. Upon reading the news, this author questioned if the change in scores could be due to adolescence being a time when children are struggling with moral and identity development, as well as uncomfortable biological changes. But, if biology were the reason for the slip in academic achievement, wouldn't American students' knowledge of math and science still be on par with their peers around the globe instead of being noticeably different? Perryman (2012) suggests that teaching methods are to blame, stating that in America, curriculum focuses too much on "how to do" instead of emphasizing mathematical concepts for problem solving.

However, given the issues of gender stereotyping discussed by the AAUW, this author gives consideration to socialization factors and asks instead if American pop culture impacts science and math academic achievement. For instance, Hughes (1980) identified that children are acculturated by what they see, hear and learn at home, in school and through mass media. Also, Kaiser Family Foundation (2010) reports a significant increase in media usage once American children reach 11 years old – with documented increases for engagement with television, music, computer and video games.

Additionally, Long, Steinke, Applegate, Knight Lapinski, Johnson, & Ghosh (2010) applied Bandura's 1986 Social Cognitive Theory that recognizes the influence of media characters on people's learning of appropriate behaviors when they determined

that “children learn cultural patterns of behavior through repeated observations of actual models, such as parents and teachers, and symbolic models, such as those depicted in the media” (p. 358). Much more research would be necessary to identify a causal relationship, but this author questions if there might be a correlation between increased media usage and decreased test scores.

A review of existent literature found that mass media – news and entertainment genres, through print, film and broadcast mediums – has consistently downplayed women's achievements in science. In many instances, female scientists were positioned as unbecoming, unusual and/or anti-social. Other times, more attention was given to a female scientist's sexuality than to her accomplishments. And often, fewer women than men were shown in scientific roles, which implied women were insignificant. This was true in the early 20<sup>th</sup> century (Flicker, 2003; Kitzinger & Chimba, 2010; LaFollette, 1988; Lowe, 1989; Owens, 2011; Shachar, 2000; Steinke, 1998; Wagner & Caudill, 2003), and into the 21<sup>st</sup> century (Karciski, 2009; Hoopes, 2011; Long, Steinke, et al., 2010).

Yet, this author determined, research is missing into how women in science are portrayed on primetime entertainment television that reaches massive audiences. This finding suggests an area ripe for investigation. Noting how women in science are portrayed on popular broadcast programming is important because of “television's central role in our society (that) makes it the primary channel of the mainstream of our culture” (Gerbner, Gross, Morgan, Signorielli & Shanahan, 2002, p. 51). Moreover, as early as 1972, the National Science Foundation (NSF) recognized television's cultural influence and predicted the need to identify “the cultural lessons about science and scientists (being

shown) to millions of viewers who are not actively seeking science related information” (Dudo, Broussard, Shanahan, Scheufele, Morgan & Signorielli, 2011, p. 755-756).

Additionally, if “the more exposure a person has to television, the more that person’s perception of social realities will match what is presented on TV” (Harris, p. 270), then the media’s portrayal of women in science may affect the number of females who believe they can pursue studies and careers in STEM fields. Hence, this author believes it is important to investigate mass media’s portrayal of women in science, technology, engineering or mathematics, as it may play a role in socialization factors that affect females’ decisions to pursue such careers. Women in medical fields will be excluded from this study, as Dudo, Broussard, et al. (2011) suggest the recommendation from Gerbner et al., (1981) to separate medicine from science in studying how media portrays women in the STEM fields. This author questions if that is due to medicine being considered a helping field, or high in altruistic value, an area that females seem to gravitate toward (Weisgram & Bigler, 2006); but that is research for a different time.

Research into today’s popular<sup>2</sup> primetime television programs has revealed that two of the top five programs (Bibel, 2013) feature female lead characters who are working scientists:

1. *The Big Bang Theory*, a CBS comedy that airs Thursdays, 7-7:30 p.m. (CST), was the number one rated program for the week ending March 17, 2013, viewed by 15,901,000 individuals nationwide, with more than one-third of the audience (6,048,000) being between the ages of 18 and 49 years old (Bibel, 2013). Regular female scientist characters include:

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<sup>2</sup> Programs were deemed popular based on Nielsen ratings – *The Big Bang Theory* with 13.6 million weekly viewers (Porter, 2012), and *NCIS* with 17.2 million weekly viewers (Kissell, 2012).

- Amy Farrah Fowler who holds a Ph.D. and works in a laboratory as a neurobiologist.
- Bernadette Rostenkowski earned a Ph.D. in microbiology and works for a pharmaceutical company.

A personal scan of the program found that Amy displays awkward interactions with other characters; dresses in unflattering clothes, and wears minimal make up, which positions her as plain looking in comparison to other females on the program. Her portrayal illustrates Flicker's (2003) note that media sometimes positions women in science as manly. When Amy is shown working in science, she deals with the distasteful sides of science (e.g., monkeys throwing feces at her, dissecting gooey brains, etc.), in line with LaFollette's (1988) observation that media portrays scientific research as inappropriate for women. Additionally, Amy vocally longs for sex, which recalls remarks by Attenborough (2011) that science articles focused on the sexualization of female scientists, which was not the case for the treatment of male scientists.

Bernadette, the secondary female scientist character on *TBBT*, is portrayed as pretty and feminine, always wearing jewelry, make-up and fashionable clothes with matching shoes. Little attention is given to her science work; instead she is presented as the wife of Howard Wolowitz, an aerospace engineer and former NASA astronaut, and more attention is given to her concerns about their relationship and sexual activity. Her portrayal is in line with findings by Kitzinger & Chimba (2010), which noted news articles where women in science were primarily recognized for feminine traits not relevant to their scientific accomplishments, such as their ability to be a homemaker.

Bernadette's portrayal harkens to media from the early 20<sup>th</sup> century that indicated women should be concerned with their attractiveness to men (LaFollette, 1988 and Lowe, 1989).

One episode in particular – The contractual obligation implementation (Lorre, Kaplan, Holland, Molaro, Reynolds, Ferrari & Cendrowski, 2013) – seemed to poke fun at the idea of women in science by featuring the males on the show – Sheldon, Leonard and Howard, all of whom are scientists – talking to a class of female middle school students about careers in STEM. At the same time, the program's females – Amy, Bernadette and Penny, the one female who is not a scientist but is positioned as the dumb but good-looking and ditzy blonde – were shown playing hooky from work to get princess make-overs at Disneyland. As the episode begins to close, while still in the classroom, the men call the women on speakerphone, telling the students they'd probably like to hear from female scientists. Amy and Bernadette speak briefly on the phone about their science careers in biology, but as they are talking they are shown dressed as Snow White and Cinderella, respectfully. At the very end of the episode, Bernadette is shown surprising Howard dressed as Cinderella and offering herself to him as his sexual fantasy.

Also, occasionally appearing on the *TBBT* series are female scientists employed at the California Institute of Technology where the male characters work. The female co-workers are typically ridiculed by lead character Sheldon Cooper, who holds a Ph.D. in physics and believes that his intelligence is superior to everyone else.

2. *NCIS: Naval Criminal Investigative Service*, a CBS drama that airs Tuesdays, 7-8 p.m. (CST), was the number four rated program for the week ending March 17, 2013, viewed by 13,177,000 individuals nationwide, including 2,385,000 individuals age 18 to 49 years old (Bibel, 2013). The lead female scientist character includes:

- Abigail “Abby” Sciuto is a forensic scientist<sup>3</sup> on the NCIS major case response team. She is called a nerd with technology, her makeup and clothing are described as gothic; she sleeps in a coffin and drives a hearse (IMDb, n.d.; NCIS database, n.d.). Also, the team leader Special Agent Leroy Jethro Gibbs treats her like a daughter (IMDb, n.d.). Her portrayal is in line with Flicker’s (2003) observation that mass media portrays female scientists as unusual and in secondary or daughter-like roles.

3. Although not included on Bibel’s (2013) list of the top 25, *Bones*, a FOX drama that airs Mondays from 7 to 8 p.m. (CST), was determined to be a primetime television program, and it features a lead female character employed as a scientist. Audience demographics were not found, but program notes describe the character as follows:

- Dr. Temperance “Bones” Brennan, a forensic anthropologist employed at the Jeffersonian Institute in Washington D.C. She helps the FBI on criminal cases involving human remains that are too old for the agency’s standard examinations. She is described as “Brilliant, but socially inept” (IMDb, n.d.).

Based on information uncovered in the literature review and personal experience with current television programs, this author has drawn the following conclusions about the 2012-2013 primetime television season:

- Women in science tend to be portrayed negatively; not as mainstream or normal, but as unusual, anti-social or incompetent; and
- More emphasis is placed on their sexuality than on their accomplishments.

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<sup>3</sup> Forensic scientists assist in the judiciary process to determine facts of a legal investigation, or assist with public health and safety. Most are required to hold bachelor’s degrees, typically in science or a related discipline, and many have advanced degrees in biology, chemistry or mathematics (American Academy of Forensic Sciences, n.d.).

Given the many theories of television's impact on society, this research chose to consider more closely literature reviews conducted by Pajares, Prestin, Chen & Nabi (2009), which identified four cornerstones of Social Cognitive Theory: 1) human agency, 2) human capability, 3) vicarious learning and 4) self-efficacy. Authors noted a lack of research in the area of self-efficacy, or self-perceived capabilities. Recognizing that media research has two parts, content and effects, and considering Social Cognitive Theory, this thesis proposed an experiment to investigate the new question:

**RQ1:** Is there a relationship between exposure to entertainment TV's portrayal of women in science, which may be negative, and the self-efficacy of female college students, ages 18 to 24?

This thesis includes an in-depth literature review to give a historical overview of the mass media's portrayal of women in science, as well as a look at studies of social cognitive theory as a socialization model. Next, a quantitative research design tests the effects of exposure to negative content. Survey instruments utilized information from proven tools: The General Self-Efficacy Scale (Schwarzer & Jerusalem, 1995), Bandura's Self-Efficacy Scales (2005), and Arizona State University Virtual Counseling Center's STEM Career Self-Efficacy/Confidence Test (2007). The design was inspired by Leshner (2006), whose research into racial stereotyping used a content analysis with Entman's "substantial body of work" about television news' portrayals of minorities as a basis from which to "test the effects of the depictions on viewers" (p. 229).

## Literature Review

### Media Portrayals of Women in Science

Most individuals have never and will never meet a professional scientist. Nonetheless, for decades, people have passed judgments on science, typically based on information acquired from mass media (Flicker, 2003). In the first half of the 20th century, broadcast mediums were still in their infancy, so the majority of mass media was in print format. During that time, few women spoke or wrote about science, and almost none were presented as accomplished scientists, which communicated that “women were insignificant in the scientific research process” (LaFollette, 1988, p. 262):

There were no female authors or scientists on topics of mathematics, astronomy, archaeology or paleontology despite their work in those fields. Women tended to write on biological sciences, 1/5 of articles on social science (including anthropology) and almost 1/7 of psychology articles, though less on physics or chemistry. (Further) between 1910 and 1955, male scientists were 15 times more visible (LaFollette, 1988, p. 264).

Another study of magazine articles about women in science during the first half of the 20<sup>th</sup> century revealed that women were recognized for feminine traits that were not relevant to news of their scientific accomplishment, such as their ability to bake or be a homemaker (Kitzinger, J. & Chimba, M., 2010). Journalists also commented on the female scientists’ appearance or demeanor, rather than on their work; which differed from articles about males.

In line with that observation, content analyses of magazine and newspaper stories and biographies written about Marie Curie’s visit to the United States in May 1921 determined that mainstream press failed to present her as a real scientist, much less as the

accomplished physicist and chemist that she actually was (Owens 2011). Readers were reminded that the visit occurred less than one year after acceptance of the 19th amendment to the U.S. Constitution that gave American women the right to vote. This was also a time of strife in American history. Accordingly, in order to present Curie as non-threatening to traditional values, she was portrayed in popular media first as a mother, widow and mythic healer, before any mention of her scientific accomplishments.

Popular magazines reflected the societal times when women were expected to handle home, family and work responsibilities, and reported on science accomplishments by females “as if they were by accident” (LaFollette, 1988, p. 268). Owens (2011) corroborated the public sentiment by uncovering the quote of 1923 Nobel Prize-winning physicist and Director of the Norman Bridge Laboratory of Physics at the California Institute of Technology, Pasadena, Robert Millkian, who said, “while there would be the occasional Curie who was particularly gifted, in general, female faculty lowered the prestige of the department” (2011, p. 114).

In contrast, coverage of Marie Curie in *The Scientific Monthly* specialty press appeared as documentary material focused on her accomplishments as a scientist. But the niche publication was much less circulated than the popular *New York Times*.

A scan of the United States’ cultural history sees the movement of mass media communication from print to electronic technology. Motion picture theaters opened in 1896 to show feature-length films to mass audiences. In the 1940s, black & white television was introduced to transmit cinematography to mass audiences, and reaching them as individuals in their homes. The 1950s saw a rush to get a TV set into every U.S. household. In 1965, color was added to all network television signals, which led to

commercialization of content and ownership, and ultimately brought about evening soap operas and cable television in the 1980s (Bellis, 1996). And since the 1990s, with a plethora of channels to choose from, most U.S. homes each have two or more television sets (Elert, 2007).

Given that chronicle, it is no wonder that TV has become the leading source for information among Americans (Wagner & Caudill, 2003). Flicker (2003) theorized that for the past 50 years, film, cinema and television have publicized science and technology production and research, and thus contributed significantly to the “general public’s understanding of science” (p. 307). But before then, in 1972, the National Science Foundation (NSF) acknowledged the influence of television on the public, and began to collect information about how society views science. Taking it further, in 1985 the NSF agency partnered with media researcher George Gerbner to study entertainment media and identify “the cultural lessons about science and scientists (being shown) to millions of viewers who are not actively seeking science related information” (Dudo, et al., 2011, p. 755-756). The investigation determined that primetime entertainment programs – whether comedy or drama – did not often feature scientists. However, when they did appear, they typically were white males, and positioned as either good or mixed rather than depicted as evil scientists. But, Gerbner discovered, relative to doctors or law enforcement, scientists “were more likely to be shown as ‘strange’ characters whose fates in the dramatic world often pointed toward death or failure” (Dudo, et al., 2011, p. 755).

This author’s initial investigation into when television did begin to portray women in science found mostly instances of non-fiction niche programming that aired on educational television stations. For example, in 1995, PBS produced and aired a six-part

series entitled *Discovering Women*, which focused on female contributors to science who were leaders in their fields, including Geologist Marcia McNutt, who went on to become the U.S. Geological Survey's first female director (Steinke, 1998).

Also, the 1996 PBS six-part series *Breakthroughs: The Changing Face of Science* featured 20 successful women of color making advances in earth sciences, physics, technology and math fields, and disputed the stereotype of women not being fit for science (Hampton, 1996 and Steinke, 1998). And work by female scientists has been recurrent on the television science programs designed for middle-school students, *Bill Nye the Science Guy* and *Newton's Apple*, also PBS television show. Nevertheless, Steinke (1998) identified, generally, among educational science programs for school-age children, there were twice as many male scientists as there were female scientists; and of those who were female, 3/4 of them were positioned in secondary roles.

More recently, Wagner & Caudill (2003) reviewed and analyzed two other PBS eight-hour science series. In the first, *Evolution*, which began airing in September 2001, males received 153 minutes of airtime, compared to just 25 minutes for female scientists, which represented an approximate ratio of seven to one (7-to-1). Yet, on *The Shape of Life*, which first aired in April 2002, there was no evidence of gender-related differentiation (Wagner & Caudill, 2003). However, another study of television programs aimed at middle-school students identified that scientists were more often portrayed as male than female; although, education programs produced by the NSF were better balanced with regard to gender (Long, et al., 2010). And while male scientists were more often seen working independently, both genders displayed “feminine gender-

stereotyped behaviors of caring, dependent, and romantic, as well as the masculine attributes of dominance and athleticism” (Long, et al., 2010, p. 374).

Authors concluded:

By presenting scientists as more mainstream, these counter-stereotypical depictions may encourage adolescent girls, who wish to be popular (L. M. Brown & Gilligan, 1992; Orenstein, 1994), to think more positively about SET [sic] careers...this study also suggests that the stereotype of the ‘smart’ scientist is overriding the gender stereotype of the ‘dumb’ female” (Long, et al., 2010, p. 374).

Long, et al. (2010) recommended further investigation to determine whether substantially increasing the presence of female scientist characters would influence girls’ social learning about scientists, “particularly if those characters were portrayed as balancing work and family roles, and are shown caring for others” (p. 375-376).

Whereas, BBC Commissioning Editor for Science and Natural History Kim Shillinglaw took a firmer stance during Women’s History Month in March 2011 with her blog posting that read, “There are (still) too few women presenting science on TV!” (cited in Hoopes, 2011). In fact, another content analyses of science portrayals on television found that only three in ten scientists (less than 30 %) were women (Dudo, et al., 2011).

Long, Steinke, Applegate, et al. (2010) identified that educational programming is the typical genre available in classrooms and as such reaches only limited audiences, even when available for viewing at home. Dramatic programming is rarely if ever shown in school, but it does reach masses in their homes. To give an example of the differences:

- All of Public Broadcasting reaches almost 122 million people per month (170 Million Americans for Public Broadcasting, 2010).

- But, in just one week, according to Nielsen Ratings, the top 20 prime-time network television programs reached over 140 million viewers; and
- Just one episode of *The Big Bang Theory* reached over 13 million people (Porter, 2012).

Television has been said to be “the most powerful of all media...images portrayed through television, particularly when repeated week after week to millions of people, tend to have a lasting influence on public perception” (Haynes & Mickelson, 2000, as cited in Gibelman, 2004, p. 332). And, following decades of studying mass communications, researcher George Gerbner determined that television is “the common symbolic environment that interacts with most of the things we think and do” (Gerbner, 1998, p. 192). Therefore, “people do not consider the source of their information when making social reality judgments” (Gerbner, Gross, et al., 2002, p. 57). Described another way, “television’s central role in our society makes it the primary channel of the mainstream of our culture” (Gerbner, et al., 2002, p. 51).

Further, Gerbner, et al. (2002) recognized that children who were heavy viewers held the gender-role assumptions that females cook and men play sports. And another researcher, Kimball (1986), found that “children’s sex-role attitudes were less sex-typed than average in a town with no access to television, but became more stereotypical after introduction of television” (Harris, 2009, p. 76). This later research might help explain why from the 1950s into the 1980s, most children thought that only men were scientists (LaFollette, 1988).

Offering another example of how media exaggerates and distorts reality, Flicker (2003) identified that most fiction films from 1929 to 1997 portrayed a cliché male

scientist, who was obsessed with work, absent-minded and “uninterested in social trends and fads” (p. 309). And the female scientists were extremely attractive, thin and very young for her purported level of professional experience – in the movies, women’s bodies seem more important than their scientific brains. Additionally, female scientist characters were most often featured in science fiction films, which may promote that weird girls study science or science is weird for girls. Flicker (2003) also recognized sociological aspects of mass media:

(it has) a central function in the creation of opinions and myths. Film functions as more than a simple mirror, it also works as social memory and cultural metaphor. In contrast to purely linguistic media, film creates pictures that continue as social myths (p. 308).

Flicker’s research noted, “Female characters in feature films do not contribute to the buildup of negative myths surrounding the image of science” (2003, p. 316). Instead, they bring emotion, drama and suspense; but are positioned as incapable and without authority. A later study (Kitzinger & Chimba, 2010) substantiated that finding: from the 1960s to 1980s news media reported on the woman’s appearance, and marital and parental status, before her role in science; even newspaper coverage from January to June 2006 referred to a woman’s look twice as often as for men. In fact, “Male scientists are represented as the norm, whereas women are framed as somehow exceptional...even if it reflected the reality of gender inequality in the field, the typecast may have also helped to perpetuate it” (Kitzinger & Chimba, 2010, p. 621-622).

Karceski (2009) used the social construction of reality theory as her lens, and identified similar patterns when studying ten popular films from 1962 to 2005, whose

plot summaries met the criteria “that a female scientist character was part of the plot” (p. 48). The time period under study was chosen because of two real events:

- In 1962 pioneering biologist and environmental activist Rachel Carson published *Silent Spring*, which questioned agriculture science and governmental practices that negatively impacted our vulnerable planet. Despite chemical industry pressures, Carson continued to argue for policies to protect the eco-system and human health (Lear, 1998).
- In 2005, then-Harvard University President Larry Summers declared that women were inadequate in science, engineering and technology fields because of their “innate differences from men” (Karczeski, 2009, p. 43-44).

Given those dates and accounts, this author continues to wonder if much of anything in reality has changed for women in science. As expected, results from Karczeski (2009) also found female scientists being treated with disrespect, and women typecast as unstable and unsocial. The findings seem to corroborate the previous research by Flicker (2003):

Despite women in science gaining more equal treatment in films starting in the 1990s, they were still clearly subject to sexual stereotypes. And, the portrayal of women scientists that is oriented on their deficiencies contribute to the formation of myths about women scientists’ lack of competence and therefore also to women’s experience of social discrimination (p. 316 – 317).

Attenborough (2011) also studied the topic of sexualization, recognizing that male scientists Newton, Darwin, and Einstein were not considered sexy. But, he questioned, would journalists 30 years ago have even considered sexualization of a scientist? Probably not, but today, “sex is openly admitted into the sphere of public talk, has

become more visible and more mainstream, even sexualized representations of subjects that might once have been considered ‘non-sexual’ or even ‘a-sexual’ have proliferated in the mass media (Levy, 2005; McNair, 2002; McRobbie, 2004; Paul, 2005, as cited in Attenborough, 2011, p 660).

Most of the previous research, Attenborough (2011) discovered, focused on the sexualization of female scientists, with little reference to the sexuality of male scientists. In order to better understand how different genders were sexualized, he analyzed national UK newspaper articles that profiled male scientist Professor Brian Cox, described as pop-star-turned-physicist who was ‘pretty hot’, and female scientist Dr. Laura Grant, who regularly communicated science topics to the public, but was best recognized for appearing on *The Big Experiment*, a six-part prime-time television series for Discovery Channel that “aimed ‘to engage 19 uninterested teenagers with the wonders of science’” (Attenborough, 2011, p. 664).

Similar to previous media portrayals, his analysis determined that more attention was given to Grant’s status of being a woman than to her scientist position, whereas readers learned of “Cox’s intellect and/or academic status before his sex appeal” (Attenborough, 2011, p. 665). And “when female scientists are positioned as deficient, or are absent from view, myths form about their lack of competence, and women in science experience social discrimination” (Flicker, 2003, p. 316-317).

Media’s portrayal of women has been a topic of scrutiny for over 50 years. For example, Carilli and Campbell (2005) argued that if agenda setting is the theory that “the media shapes public opinion by telling people what to watch and how to experience what they witness, for women around the world, agenda setting has meant exclusion and

marginalization” (p. xiii). The authors go on to note that while women have actively participated in media, as reporters, scriptwriters, directors, producers and on-air talent, for all time, they have, for the most part, been kept out of the game. In fact, in the 1950s and 1960s, female reporters were not allowed on the balcony at the National Press Club. When they finally were allowed entry, they had to stay on the balcony and could not partake in the lunchtime refreshments offered to male journalists inside the club (Carilli & Campbell, 2005). That trend seemed to continue into the 1992-1993 primetime network television season when women, in general, “were more likely to be shown playing minor roles” (Elasmar, Hasegawa & Brain, 1999, p. 20).

In summary, though information on the subject is narrow, research was missing into what are the portrayals of female scientists on primetime television that reaches massive audiences, and possibly impacts and influences young adults.

### **Social Cognitive Theory**

When contemplating a sensible theory to use for studying mass media portrayals of women in science, consideration was given to Social Tokenism, Cultural Hegemony, Gender Schema, and Cultivation Theory. However, it was Bandura’s 1986 Social Cognitive Theory that specifically recognized the influence of media characters on the learning of appropriate behaviors. According to his theory, “children learn cultural patterns of behavior through repeated observations of actual models, such as parents and teachers, and symbolic models, such as those depicted in the media” (Long et al, 2010, p. 358). When investigating the theory, Smith (2002) found that adults also “learn from role models whose behavior they wish to emulate” (p. 30). And, Bussey and Bandura (1999) asserted:

the theory specifies how gender conceptions are constructed from the complex mix of experiences (to) guide gender-linked conduct throughout the life course. The theory integrates psychological and sociostructural determinants within a unified conceptual structure (Abstract).

When considering Social Learning Theory, Signorielli (1993) summarized it well:

Socialization is an ongoing process; we are socialized and re-socialized throughout the life cycle...[and] over the past 25 years...numerous studies have revealed that the mass media play a very important role in the socialization process for both children and adults (p. 230)” (as cited in Reichert, 2005, p. 105). Further, experimental research into gender-role stereotyping by Lafky, Duffy, Steinmaus & Berkowitz (1996) found that among high school students (n = 75), “Even brief exposure to an image affects audience perceptions of social reality immediately after exposure,” (p. 385). And Pajares et al. (2009) found that Social Cognitive Theory was often used to explain unintentional effects of media on people’s personal development, perceptions and behaviors.

However, it is common knowledge that every coin has two sides. And noted physicist and mathematician Sir Isaac Newton said that for every action there is a reaction. Therefore, it seems logical that there would be criticisms and limitations to Social Cognitive Theory. For instance, the Theory posits that learned behaviors come as a result of external factors and nominal thought is given to how emotions play a role in chosen behavior (Boston University School of Public Health, 2013). Also, no consideration is given to influences from biology or the subconscious mind, and the theory also excludes consideration of mental health issues (Middendorp, n.d.).

Nonetheless, Bandura (2001) emphasized:

The mass media, especially television, provide the best access to the public through their strong drawing power. Through the medium of

symbols, people transform information from transient experiences into cognitive models that serve as guides for reasoning and action. For this reason, television is increasingly used as the principle vehicle of justification. Research on the role of the mass media in the social construction of reality carries important social implications” (p. 279).

#### **Four Cornerstones of Social Cognitive Theory**

With their review of articles and mass media effects studies, Pajares, Prestin, Chen & Nabi (2009) observed that Social Cognitive Theory was often used to explain unintentional effects of media on people’s personal development, perceptions and behaviors. Their research identified four cornerstones of the theory:

1. Human agency: the capacity for self-development and an understanding that we live in collaborative environments;
2. Human capability: the capacity for self-reflection, forethought and intentionality;
3. Vicarious learning: the process of learning by observing others considered to be similar (e.g., “if she can do it, so can I!” or “if she cannot do it, neither can I”) and
4. Self-efficacy: the confidence in oneself to enact learned behaviors, whether knowledge is gained through mastery or vicarious experience.

Pajares et al. (2009) concluded that more research is needed to test messages for how they affect self-efficacy, which Bandura (2006) stressed is different from self-esteem or self-worth. Bandura (2006) also reasoned that “there is no all-purpose measure of perceived self-efficacy...(and) scales of perceived self-efficacy must be tailored to the particular domain of functioning that is the object of interest” (p. 307-308). Therefore, because the topic under investigation deals with women in STEM, tools were included in

the experimental design to measure both general self-efficacy and self-efficacy for STEM-related activities.

**Self-efficacy of middle school science students.** Researchers Weisgram and Bigler (2006) sampled female middle school students (n = 617) to learn about influences on their levels of interest in science. The girls were exposed to a daylong conference that included professional female scientists discussing their education and career paths, hands-on activities, and take-away information about careers in science.

Guided by the belief that “relations of altruistic values, egalitarianism, self-efficacy and utility values to girls’ occupational interest are interrelated” (Weisgram & Bigler, 2006, p. 330), researchers quantified the task-specific attitudes, which were also believed to be factors when young people plan their future occupations. For comparison purposes, girls attending the intervention program were randomly assigned to either group (a) that also heard about the altruistic values of science, or to group (b) that was told nothing about the altruistic values.

To measure the dependent variable *level of self-efficacy*, researchers Weisgram & Bigler (2006) experimented with the independent variable *exposure to an active science intervention program*. As a control, the same testing measures were administered within a day to a randomly selected group of students from the same classes as students who attended the intervention program; girls (n = 105) and boys (n = 690). None in the control group attended or received benefits of the intervention.

Following administration of measures compiled from Fennema–Sherman Mathematics Attitudes Scales (Fennema & Sherman, 1977, as cited in Weisgram & Bigler, 2006, p. 333), results pointed out that, for boys, “self-efficacy was unrelated to

interest in science; whereas among girls, self-efficacy was significantly and positively related to interest in science” (Weisgram and Bigler, 2006, p. 334). Additionally, as authors hypothesized, boys more than girls had increased confidence in their abilities to understand science.

Results also indicated, “girls who strongly prefer to work in a helping profession are unlikely to be especially interested in science because, relative to feminine sex-typed jobs (e.g., teacher, social worker), science careers are perceived as low in altruism” (Weisgram & Bigler, 2006, p. 338). Researchers concluded that to increase girls’ interest in science, there may be a need to emphasize the altruistic components of the occupation because it is sex-typed as masculine. One year later, authors conducted Study 2 using a pre-test/post-test with girls who attended a similar intervention program, and results replicated Study 1.

Authors noted that the intervention program allowed only female scientists to present, with event organizers thinking that they would lessen girls’ perception that science was masculine. Research instead pointed to the idea that “Same-sex models may, for example, promote feelings of similarity to the models among participants, which in turn, increases their effectiveness” (Weisgram & Bigler, 2006, p. 338).

**Career self-efficacy.** Regarding female students gravitating toward careers considered to be altruistic, Bandura (2002) identified:

...career interests and pursuits of women tend to be constricted by a sense of inefficacy for quantitative activities and skills necessary for occupations traditionally occupied by males. The gendered patterning of perceived occupational efficacy is similar in the United States and Japan (Betz & Hackett, 1983; Hackett, 1995; Lucas, Wanberg, & Zytowski, 1997; Matsui, Ikeda, & Ohnishi, 1989). Moreover, gendered socialization exerts a comparable impact cross-culturally even on judgments of personal

efficacy for the same activities performed in different contexts. Women both in the U.S. and Japan have a high sense of efficacy for quantitative activities embedded in stereotypically feminine activities, but low perceived self-efficacy when these same quantitative activities are embedded in scientific pursuits (Betz & Hackett, 1983; Junge & Dretzke, 1995; Matsui & Tsukamoto, 1991) (as cited in Bandura, 2002, p. 279).

In summary, the literature on media's portrayal of women in science includes studies of print journalism, film and educational television, as well as a longitudinal study of how women, in general, are portrayed on primetime television. Yet there was no study found regarding how women in science are portrayed on primetime television, which may influence decision-making by young people regarding viable career options.

Taking a cue from studies that identify the mass media's negative portrayal of women, on top of the documented lack of females in science, technology, engineering and mathematics (STEM) careers, this thesis chose to investigate the effects of mass media portrayals of women in science, which may be negative. Specific inquiry into portrayals on primetime television, studying program content and receivers is easy, but chances are slim that producers would participate in any academic research. They have been cited saying they write for entertainment purposes. For instance, Chuck Lorre, producer and writer of *The Big Bang Theory* and other popular television shows, was quoted saying, "I don't want criticism or praise" (Hertzfeld, ¶8 2013).

Therefore, rather than attempt to interview producers, this research studied the effects of exposure to television's portrayal of women in science by investigating the new question, "Is there a relationship between exposure to entertainment TV's portrayal of women in science, which may be negative, and the self-efficacy of female college students, ages 18 to 24?"

## **Variables Under Investigation**

Because available time for this research was limited, very brief video clips of positive and negative portrayals found within current primetime programming were used in an experiment. As reference, Lafky et al. (1996) identified that “even brief exposure to an image affects audience perceptions of social reality immediately after exposure” (p. 385). The independent or nominal variable *depiction of entertainment TV’s portrayals of women in science* was manipulated at two levels: Positive depictions and Negative depictions. The dependent or interval variable was *self-efficacy levels among female college students*.

Additionally, the concept of character liking suggests a positive valuation, which could return cognitive and/or affective reactions (Nabi and Krcmar, 2004). Given that Social Cognitive Theory recognizes the influence of media characters on people’s learning of appropriate behaviors, “Enjoyment or liking may be taken as an internal cue of positive reinforcement for the modeled behavior. Conversely, the lack of enjoyment may be read as a negative cue, and thus minimize the likelihood of modeling taking place (Nabi and Krcmar, 2004, p. 302-303). Therefore, character liking must be considered a moderator variable in the media effects research.

Based on the literature review, the following hypotheses were developed:

- H1:** Female participants who are exposed to the negative portrayals of female scientists will report less self-efficacy than those exposed to the positive portrayals.
- H2:** Character liking will be found to moderate self-efficacy such that effects will be stronger for those with higher levels of character liking.

## **Method**

The Weisgram and Bigler (2006) study tested for self-efficacy related to science among young females, which is important because their research discovered that among girls, self-efficacy was significantly and positively related to interest in science, but the same was not true for boys. However, the self-efficacy measured may have been influenced by mastery and vicarious experiences (Pajares, Prestin, et al., 2009), not media messaging, which is an area where the literature review revealed a need for testing. Therefore to address an identified need and better understand Social Cognitive Theory, this thesis deployed an experimental design for a new investigation into the question of how media messaging affects self-efficacy, based on modeling and vicarious learning.

### **Study Population and Sampling**

Though overall primetime television viewing is low among the 12 to 24 year old demographic, they do tune in to watch *The Big Bang Theory* (P. Senuta, research director for local CBS affiliate KENS 5-TV, personal communication, March 26, 2013).

Additionally, because women relate to women (Long, et al., 2010), to establish some research control and follow the modeling theme, the population under investigation was female college students between 18 and 24 years old who may also relate to the characters in the programs selected for the experiment. Further, because self-efficacy may be a factor in planning future occupations (Weisgram & Bigler, 2006), the new research sought to gain insight to the beliefs young adult women hold for themselves, which may have consequences for their own future and for society.

Though additional samples from various student populations must be tested for comparative data, to get started, this study used a convenience sample (Creswell, 2009)

from local institutions The University of Texas at San Antonio (UTSA) and San Antonio College (SAC), as well as from the University of Missouri and possibly from other U.S. colleges and universities because of recruitment posts on Facebook.

To establish a sample size for the experimental design, in keeping with the convenience sample method, the student population at UTSA was considered. The total number of UTSA female students, by age, was not determined; but for purposes of this investigation, based on the total population of 11,207 female students (The University of Texas at San Antonio Registrar, 2013), this researcher calculated that approximately 9,593 (85.6%) were between the ages of 17 and 29, and an estimated 80%, of those, approximately 7,674 would be between the ages of 18 and 24.

To determine an appropriate sample size, the population to study was set at 7,674, the confidence level set at 95%. Using The Survey System online Sample Size Calculator, an appropriate sample size was suggested at 117 (Creative Research Systems, 2015). Additionally, the alpha rate ( $\alpha$ ), or acceptable error rate, was set at .05 to indicate there was a “5% chance that results were due to chance rather than to the experiment” (Zint, n.d.). Another source used to set an appropriate sample size was “The t table – critical values” posted online by statistics mentor (2013), which suggested that the strongest sample size carried the degree of freedom (df) of infinity, and the second strongest df was 120. Therefore, the experimental design called for an appropriate sample size of 122, and the recruitment goal was set at 200 in order to reach an acceptable level of participation.

**Recruitment.** Before any humans were recruited or involved as participants in the experiment, an application was submitted to the University of Missouri Institutional

Review Board (MU IRB) in accordance with required documents and experimental instruments. The proposal package was approved August 13, 2013 for research to begin.

To recruit participants, permission had been granted in July 2013 by The University of Texas at San Antonio College (UTSA) of Engineering-Office of the Dean Coordinator for Engineering Outreach Brandy Alger. Additionally a waiver letter was received from the Institutional Review Board at UTSA indicating that appreciated the contact but did not need to approve the research project. Nonetheless, almost a year passed before the experimental design could be developed and recruitment efforts could begin. Therefore, to get a re-start, in the Spring semester 2014, Ms. Alger at UTSA was contacted with a request to renew the pledge of support to engage students, which was granted in June 2014. And, in order to prepare for anticipated recruitment challenges and cast a wider net for possible participants, permission to recruit students for experimental participation was sought and granted on July 15, 2014, by San Antonio College<sup>4</sup> Institutional Research Board and Dean of Performance Excellence Dr. David A. Wood, Jr. The MU IRB was also contacted to renew the research approval. An Annual Exempt Form was submitted and approved in July 2014.

With permissions granted and using MU IRB approved recruitment materials (see Appendix A and B for samples of recruitment materials) at the start of the Fall 2014 semester, UTSA and SAC faculty and staff sent e-mail invitations to qualifying students, to members of the UTSA Society of Women Engineers (SWE) student organization and to members of SAC's MESA (Math, Engineering, Science Achievement) Center.

Prospective participants were provided with study instructions, invited to watch videos

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<sup>4</sup> For reference, SAC's Fall 2014 female population totaled 12,450, and 53.4% of the student body – approximately 6,648 females – were between the ages of 18 and 24 (THECB, 2014).

and answer questions online. An incentive was included in the recruitment notices: upon completion of the questionnaire, the first 200 participants would get a gift card good for free food.

Approved fliers went up near computer labs, classrooms, libraries and student centers around the participating college and university campuses – more than 2,000 intended impressions were made. However, by mid-semester, Fall 2014, participation was slow, and this researcher asked University of Missouri to invite undergraduate female students and visited Professor Portales' English classes at SAC to read from fliers and invite female college students to participate.

By semester end, the Qualtrics (2014) data counter had recorded only 103 participants. Hence, to expand recruitment efforts, this researcher asked for and was granted MU IRB approval to advertise on Facebook during February 2015. The approved recruitment flier was revised with new dates and posted as an event on researcher's Facebook page. For ten days, and a few dollars, women in college between the ages of 18 and 24 were targeted with the message to consider participation. That same month, more recruitment fliers went out to college and university campuses, and presentations were made to Medical and Dental Assisting classes at SAC with Professors Stella Lovato and Carmen Santiago.

### **Data Collection**

The experimental design diagramed below addressed the new research question:

**RQ1:** Is there a relationship between exposure to entertainment TV's portrayal of women in science, which may be negative, and the self-efficacy of female college students, ages 18 to 24?

And tested the hypotheses:

**H1:** Female participants who are exposed to the negative portrayals of female scientists will report less self-efficacy than those exposed to the positive portrayals.

**H2:** Character liking will be found to moderate self-efficacy such that effects will be stronger for those with higher levels of character liking.

The null hypotheses ( $H_0$ ) specified that exposure to the negative portrayals would have no effect on self-efficacy levels, and that character liking would not serve as a moderator variable.

For a between-group comparison study, the independent or nominal variable *depiction of entertainment TV's portrayals of women in science* was manipulated at two levels: Positive depictions and Negative depictions. The dependent or interval variable was *self-efficacy levels among female college students*. The treatment, exposure to video content, was followed by the post-test measure labeled *Appraisal Inventory*, and results analyzed for between-group comparisons.

**Content Pre-selection.** In order for video content to be considered for use in the experiment, the featured female character had to be consistent with definitions from Long, Steinke, et al. (2010):

to be considered a scientist, a character (must) be human, appear on screen and speak, and meet one of the following criteria: (a) self-identify as a scientist or be identified by another character as a scientist, (b) wear a

laboratory coat, or (c) perform at least two of the following scientific activities: conduct an experiment, collect scientific samples for analysis, or discuss scientific phenomena (p. 365).

The literature review identified three primetime television programs with female scientist lead characters: *The Big Bang Theory*, *NCIS* and *Bones*. This researcher scanned online IMDB and YouTube databases for episodes from 2011, 2012 and 2013 searching for positive and negative portrayals of the main female scientist character acting in a scientific manner. No such instances of Abby on *NCIS* were found; therefore scenes from *The Big Bang Theory* and *Bones* were selected for use in the current experiment. Because the portrayals had to be so specific, the chosen clips were under 30-seconds in length capturing only relevant dialog.

In order to get a reliable index, during the Fall 2013 semester, five preselected YouTube videos were pre-tested with young women, ages 18 to 24, enrolled at UTSA who responded either to a call for volunteers sent during a Society for Women Engineers meeting, or to an email invitation sent from the university's engineering department (see Appendix C for sample invitation). Participants followed internet links to watch videos one by one, and after each were directed to completed a brief online Qualtrics (2013) survey to rate the woman in each video on appearance as a scientist, and to what extent would she be described as subordinate, a leader, attractive or unattractive. Using a common attitude measurement Likert scale, participants also rated character portrayals from 1 to 7 to indicate how negative, neutral or positive did they feel was the portrayal (see Appendix D for Content Pre-Selection Survey Instrument). After analysis, clips that rated strongest for negative and positive portrayals were selected for the experiment:

1. **Most negative** = *Big Bang Theory: Brain* (Lorre, Kaplan, Hernandez, Prady, Molaro, Holland & Cendrowski, 2011).

Description: female scientist makes friend sick by cutting tumor out of brain

- 12 respondents rated character as negative to absolutely negative
- Attributes: unusual, intelligent

2. **Most positive** = *Bones: ID remains* (Hanson, Reichs, Okoro & Southam, 2013).

Description: female and male scientists examine and discuss skeletal remains

- 16 respondents rated character as positive to absolutely positive
- Attributes: knowledgeable/experienced, leader/supervisory

Before the experiment was built, faculty advisors G. Leshner and C. Frisby (personal communications, July 2, 2014) suggested there may be a chance that the character Amy Farrah Fowler from the prime-time television comedy show *The Big Bang Theory* could be associated with a satirical program and thus be perceived negatively; and with her leadership role on the prime-time television dramatic series *Bones*, the character Dr. Temperance Brennan could be perceived positively. Therefore, to avoid confounds between the two conditions, a total of four video clips were necessary for manipulation within the experiment: a negative portrayal and a positive portrayal from each program.

Clips from *The Big Bang Theory* were readily available on YouTube; however, in June 2014 *Bones* video clips were unexpectedly no longer available, and the episode under consideration for experimental use had to be purchased from Amazon.com. To secure an index, this researcher repeatedly watched only one episode each of *The Big Bang Theory* and of *Bones* to identify appropriate portrayals. Ten total clips were selected for sampling: five clips from *The Big Bang Theory*, season 5 episode 16,

entitled, “The vacation solution,” which originally aired February 9, 2012, on the CBS television network (Lorre, Del Broccolo, Hernandez, Prady, Molaro, Ferrari & Cendrowski, 2012), and five clips from *Bones*, season 8 episode 18, entitled, “The survivor in the soap,” which originally aired March 4, 2013 on the FOX television network (Hanson, Reichs, Okoro & Southam, 2013).

In order to create the video clips, each program was watched along with a time code. This researcher subjectively chose segments that seemed to match the definition for a female scientist character, and hand wrote at what time code to cut. The clips were each under 30-seconds in length capturing dialog, and some as short as 6 seconds for only one sentence. The researcher then worked with art director/web designer Jacob H. Resendez, who used video production software to turn the clips into usable QuickTime Movie (.mov) files and saved on to a USB drive.

The clips were tested with a convenience sample of 20 female students, from 18 to 24 years old, selected from individuals inside the Student Center and Admissions Office at San Antonio College during the first week of classes, August 26, 2014. For pre-selection of content, participants were first told about the research and consent items (see Appendix E for Pre-Selection of Content II Invitation Script).

Those who agreed then watched videos one by one on the researcher’s laptop, and after each, completed the same survey instrument as used before, but on paper this time, indicating if the woman they saw in the video was a scientist; rate her on attractiveness, and to what extent would she be described as a subordinate or a leader. Character portrayals were again rated using a Likert scale to rate from 1 to 7, to determine how positive or negative was each portrayal – from absolutely negative to absolutely positive.

In sum, to identify a reliable index of four total clips, a total of 14 clips were pre-tested by 20 college/university women who ranged in age from 18 to 24. The figures in Table F1 represent the number of times each answer choice was selected. After analyzing the results, the clips that rated strongest for positive and negative portrayals were selected for the use in the experiment:

### **Most positive portrayals**

*Bones 1*: ID remains (none of the clips in second sample rated as positively)

- 25-sec. clip: Two scientists examining and discussing skeletal remains
- 16 respondents rated positive to absolutely positive

Attributes: knowledgeable/experienced, leader/supervisory

*The Big Bang Theory 1* = most positive

- 9-sec. clip: Amy and Sheldon compared to science pioneers Marie & Henry Curie
- 9 respondents rated positive to absolutely positive

Attributes: Knowledgeable/ experienced

### **Most negative portrayals**

*The Big Bang Theory 3* = most negative

- 5-sec. clip: Amy points to Sheldon's lack of biology experience
- 14 respondents rated as negative to absolutely negative
- Attributes: incompetent

*Bones 5* = most negative

- 24-sec. clip: Bones acts awkwardly when she learns about two coworkers dating
- 7 respondents rated negative to strongly negative
- Attributes: unusual

Once content was determined, to host the clips online for the design, videos were labeled for educational purposes and posted to a YouTube channel entitled MU Student at <https://www.youtube.com/channel/UCeWZZE5lBbNp7GOgFgRDGgQ/videos>. Next this researcher worked with Webhead, Inc. Multi-Media Graphic Designer Ellice Sanchez to develop an online survey tool utilizing the Qualtrics Survey Software (2014). The domain [www.studywomenscience.com](http://www.studywomenscience.com) was purchased and redirected to the survey site.

**Consent.** Recruitment materials were targeted to qualified participants, providing the [www.studywomenscience.com](http://www.studywomenscience.com) link and the password STEM. As each participant logged in, she/he was first greeted with this consent notice:

By participating in the online survey you understand:  
There will be no negative consequences associated with participation,  
No penalty for non-participation or early withdrawal,  
No participants will be identified by name,  
Individual answers will be kept strictly confidential, and

There will be no monetary compensation, but the first 200 participants who complete the questionnaire will receive a coupon good at a fast-food retailer near the college/university.  
Please email [dmmxw7@missouri.edu](mailto:dmmxw7@missouri.edu) if you have trouble with the survey and require assistance.

Through the online survey tool, the participant then agreed to the consent by clicking to participate, or selecting “not agree” to exit. Next came qualifier questions on gender and age to ensure participants were females between the ages of 18 and 24. Those who did not qualify were thanked and routed to exit.

**Procedures, Treatment, Post-test.** The Qualtrics computer system randomly assigned qualifying participants, who were females in college between the ages of 18 and 24, into one of two manipulations of the independent variable *depiction*: Positive or

Negative. Videos were labeled with abbreviations and numbers to minimize identifying marks: 1T and 2B were positive depictions, and 1B and 2T were negative depictions.

In order to gather reports of self-efficacy levels following treatment, participants completed an online Appraisal Inventory to measure their abilities to handle issues that college students may sometimes find challenging. Bandura (2006) advised the need for self-efficacy scales to carry face validity, and measure what they purport to measure. In this case, measure the personal belief in one's own power or ability to produce a desired effect, after exposure to media content. Therefore, the post-test included multiple questions from the proven General Self-Efficacy Scale (Schwarzer & Jerusalem, 1995) and Bandura's Self-Efficacy Scales (2005). To establish some validity with the measurement instrument, 15 items were selected for the current study. Each asked respondents to rate on a scale from 0 (not confident) to 100 (extremely confident) their perceived abilities to problem-solve, handle unexpected events, get assistance from teachers for school work or friends for social problems, live up to expectations, etc.

Because of the identified need to focus self-efficacy research on specific behaviors, and to continue validity of the measurement instruments, another 10 items were selected from the STEM Career Self-Efficacy/Confidence Test (Arizona Board of Regents, 2007). Permission to use the scale was granted by J. Horan, Professor Counseling & Counseling Psych Faculty Arizona State University Virtual Counseling Center (personal communication, July 9, 2013). The current study used two questions from each of five categories: 1) Life Sciences, 2) Physical Sciences, 3) Information Technology, 4) Engineering and 5) Mathematics. The items asked participants to rate on a scale from 0 (not confident) to 100 (extremely confident), their perceived ability to do

or get the training to do a STEM-related activity, such as solve an algebraic equation, develop more user-friendly machines or dissect an animal.

Such expansive scales, from 0 to 100, according to Bandura (2006) helped make the instrument more reliable – “scales that use only a few steps should be avoided because they are less sensitive and less reliable” (p. 312). The survey instrument was entitled “Appraisal Inventory” rather than “Test of Self-Efficacy” to follow advice from Bandura (2006) and reduce the chances that participants would feel they were being judged (see Appendix G: Survey Instrument: Association and Appraisal Inventories and Appendix H: Survey Instrument: Demographics and Viewing Habits).

A dependability check through SPSS showed the instruments were reliable and items did test for what they were intended; summary data shown in Tables 2 and 3 (see Appendix I6 and I7 for detailed tables).

Table 2 Reliability Statistics: General Self-Efficacy		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.905	.914	15

General Self-Efficacy was assessed by having all participants complete the Appraisal Inventory in which participants rated 15 items, each on a scale anchored by 0 = not at all confident and 100 = extremely confident. The Self-Efficacy Cronbach’s alpha for this scale was ( $\alpha = .91$ ).

Table 3		
Reliability Statistics: STEM Self-Efficacy		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.921	.921	10

STEM Self-Efficacy was assessed by having all participants complete the Appraisal Inventory in which participants rated 10 items, each on a scale anchored by 0 = not at all confident and 100 = extremely confident. The Self-Efficacy Cronbach's alpha for this scale was ( $\alpha = .92$ ).

Proposed measurement inventories were tested prior to the experiment in order to identify ambiguities, items that didn't differentiate between participants and/or items that need to be addressed for other reasons; as well as to verify the level of difficulty. The items were pre-tested in a focus group setting with seven female and two male members of The Society of Women Engineers UTSA student chapter during its regular meeting on September 23, 2013. Each participant was given a printed copy of the survey, asked to answer the questions and rate difficulty. Discussion and written responses indicated the survey was easy to understand and complete.

Also, because the extent to which participants in the experiment like or dislike the character could influence the strength of the relationship between the two variables of exposure and self-efficacy (Baron & Kenny, 1986) the post-test tool also included interval scales from 1 to 7 to measure how much participants liked or disliked the characters to examine if *character liking* would be a moderator variable.

And, in keeping with the recruitment offer to get free food from a fast-food retailer for participating, participants who completed the online survey were offered a \$5 Dunkin' Donuts electronic gift card<sup>5</sup> in exchange for a valid email address, which was required for coupon purchase. This researcher's credit card was debited with each transaction – 121 participants provided email addresses in order to receive the gift cards.

### **Data Analysis**

In total, the experiment was available online from August 28, 2014 through March 8, 2015. With the help of knowledgeable and patient support staff on the phone from Qualtrics-Missouri University (March 9-13, 2015), this researcher downloaded then manually sorted information using Excel software to observe responses from each of the two manipulation groups for a between-group study:

Group  $n_p$ : X-----O2

Group  $n_n$ : X-----O2

X = treatment, effects of which were measured

O = documented observation or measurement

(Creswell, 2009).

Using Excel functionality, longhand mathematics with a scientific calculator, and SPSS functionality, the mean scores and standard error of difference figures were calculated for each of the 25 measures of self-efficacy (15 regarding general and 10

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<sup>5</sup> Other studies that invited participation from young people saw greater recruitment success when an incentive was offered. For the current project, local retailers were asked for support, but none could offer an electronic coupon, much less a discount or donation. Dunkin' Donuts was the only online retailer that offered an electronic coupon at the nominal \$5 amount. This researcher recommends next time to save money and instead offer participants the chance to win one of 20 \$10 gift cards.

STEM-related.). To find a central tendency for use in the statistical analysis, an overall mean score was determined for each of the four data sets (two measures of self-efficacy by two manipulations).

A t-test was the statistical instrument used to address the relationship between the independent variable, exposure to media portrayals, and the dependent variable, self-efficacy. Some differentiations in self-efficacy levels were identified.

## Results

When results were viewed and participant records downloaded as Excel and PDF files from the Qualtrics Survey Software (2015) on the morning of March 9, 2015, data revealed a 22% drop out rate. Apparently 51 individuals began the process, but exited before treatment because they did not meet age/gender requirements or chose to exit for unknown reasons. A few more watched the videos but exited before answering questions.

In the final analysis, the experiment had a total sample size of 124 ( $N=124$ ) where 62 females in college who ranged in age from 18 to 24 were randomly exposed to the positive manipulation ( $n_p=62$ ); and another 62 females in college from age 18 to 24 were randomly exposed to the negative manipulation ( $n_n=62$ ). All participants answered questions about liking the female character and their abilities for general self-efficacy; but at the point where the science, technology, engineering and mathematics (STEM) self-efficacy questions started, one dropped from the positive manipulation group ( $n_p=61$ ) and two dropped from the negative manipulation group ( $n_n=60$ ), reducing the total sample to 121 ( $N=121$ ). The adjusted sample size was taken into consideration when statistics were calculated for each group.

Following the treatment, but before the self-efficacy measures, participants were asked “Based on the female scientist character you just saw, on a scale from 1 to 7, to what extent do you like or dislike her?” To examine the moderating role of character liking on self-efficacy between exposure to positive and negative videos, a character liking\* self-efficacy variable was computed and submitted to an independent samples t-test. And, to examine the moderating role of character liking on STEM self-efficacy

between positive and negative video treatment groups, a character liking\*STEM self-efficacy variable was computed and submitted to an independent samples t-test.

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means					95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
GeneralSelfefficacy	Equal variances assumed	.408	.524	.143	122	.886	.38909	2.71466	-4.98485	5.76304
	Equal variances not assumed			.143	119.035	.886	.38909	2.71466	-4.98619	5.76438
SelfEfficacySTEM	Equal variances assumed	.172	.679	.951	119	.343	4.67593	4.91496	-5.05618	14.40804
	Equal variances not assumed			.949	111.493	.344	4.67593	4.92494	-5.08269	14.43454
identselfesteem	Equal variances assumed	2.141	.146	-.800	122	.425	-14.65891	18.31874	-50.92269	21.60487
	Equal variances not assumed			-.800	120.092	.425	-14.65891	18.31874	-50.92846	21.61064
identselfesteemSTEM	Equal variances assumed	1.241	.267	-.968	122	.335	-97.10561	100.26452	-295.58924	101.37803
	Equal variances not assumed			-.968	120.754	.335	-97.10561	100.26452	-295.60976	101.39854

Figure 1: Independent Samples Test

Table 4					
Group Statistics for Character Liking as Moderator Variable					
	Condition	N	Mean	Std. Deviation	Std. Error Mean
General Self-Efficacy	0	62	77.9624	13.87078	1.76159
	1	62	77.5733	16.26355	2.06547
STEM Self-Efficacy	0	61	56.7443	23.53819	3.01376
	1	60	52.0683	30.17178	3.89516
Ident Self-Efficacy	0	62	216.0108	95.34951	12.10940
	1	62	230.6697	108.23215	13.74550
Ident STEM Self-Efficacy	0	62	706.5398	529.13841	67.20065
	1	62	803.6454	585.91548	74.41134

Condition Key:

0 = positive treatment

1 = negative treatment

## Statistical Analysis

**Character Liking.** It was expected that effects would be associated with the level of character liking given that liking a character may be a moderator variable that influences learned behaviors within the social cognitive theory framework (Nabi and Krcmar, 2004). The expectation was that effects would be stronger among people who liked the character.

However, data analysis revealed that character liking did not significantly moderate self-efficacy for positive video treatment ( $M = 216.01$ ,  $SD = 95.34$ ) or negative video treatment ( $M = 230.06$ ,  $SD = 108.23$ ), ( $t(122) = -8.00$ ,  $p = .146$ ). And, data analysis revealed that character liking did not significantly moderate STEM self-efficacy for positive video treatment ( $M = 706.53$ ,  $SD = 529.13$ ) or negative video treatment ( $M = 803.64$ ,  $SD = 585.91$ ), ( $t(122) = -968$ ,  $p = .335$ ).

**Self-efficacy.** Authors Schwarzer & Jerusalem (1995) suggest people cannot be categorized as high or low self-efficacious, and that rather than strive for a determining index or cut-off score, researchers would do well to consider mean differences and between-group distributions for a particular population. Thus, for a reliable between-group comparison to test the null hypothesis ( $H_0$ ), the statistical analysis calculated one- and two-tailed t-tests to measure respondents' self-efficacy levels (dependent variable), as it related to exposure (independent variable), manipulated two ways: positive and negative. An alpha level of .05 was used for all statistical tests.

A total of 25 items were utilized to measure reported levels of self-efficacy (dependent variable), separated by type of self-efficacy, general or STEM-related, which is in line with advice from Bandura (2006) that, "there is no all-purpose measure of

perceived self-efficacy...(and) scales of perceived self-efficacy must be tailored to the particular domain of functioning that is the object of interest” (p. 307-308).

Rather than provide too much detail in this report, to determine a central score for each section, general and STEM-related self-efficacy, items were averaged and totaled, then a mean score calculated for each of the two sections. Per the statistics mentor (2015) online t table, with a df above 120, the critical value of the test statistic was 1.658. Looking to find relationships between the two variables exposure and self-efficacy, results of the between-group comparisons are reflected in Table 5, which shows the mean, standard deviation and p value for each measure, by manipulation.

Table 5			
Positive/Negative Paired Samples <i>t</i> -tests for messages			
Type	Message	M(SD)	<i>p</i>
Self-Efficacy	Positive	77.96(13.87)	.524
	Negative	77.57 (16.26)	
STEM Self-Efficacy	Positive	56.74(23.53)	.679
	Negative	52.06(30.17)	

Independent Samples *t*-test did not reveal significant differences between positive and (M<sub>positive</sub> = 77.96 SD<sub>positive</sub> = 13.87) and negative video (M<sub>negative</sub> = 77.57 SD<sub>positive</sub> = 16.26) type on self efficacy ( $t(122) = .143, p = .524$ ). And Independent Samples *t*-test did not reveal significant differences between positive and (M<sub>positive</sub> = 56.74 SD<sub>positive</sub> = 23.53) and negative video (M<sub>negative</sub> = 52.06 SD<sub>positive</sub> = 30,17) type on STEM self efficacy ( $t(122) = .951, p = .679$ ).

## Discussion

**Interpretation.** This study was conducted to help fill an identified gap for more research into how media messages impact self-efficacy, which can influence young women's education and career decision. Results of the between-group comparison were non-significant, and no evidence was found to support the claim of a relationship between exposure to negative media portrayals and reports of lower self-efficacy.

However, when considering Bandura's notes (2006) to focus self-efficacy research on behaviors at issue, in this case, media portrayals were of women in science, there was something of interest found regarding self-efficacy for STEM-related activities. While respondents seemed equally likely to not likely to enroll in a STEM course in the next two years, illustrated in Figure 2, an overall review of the mean scores indicated that all participants, regardless of media manipulation, reported lower levels of self-efficacy for STEM-related activities.

On scale from 1 to 5, how likely are you to register for a science, technology, engineering or math class within the next two years?

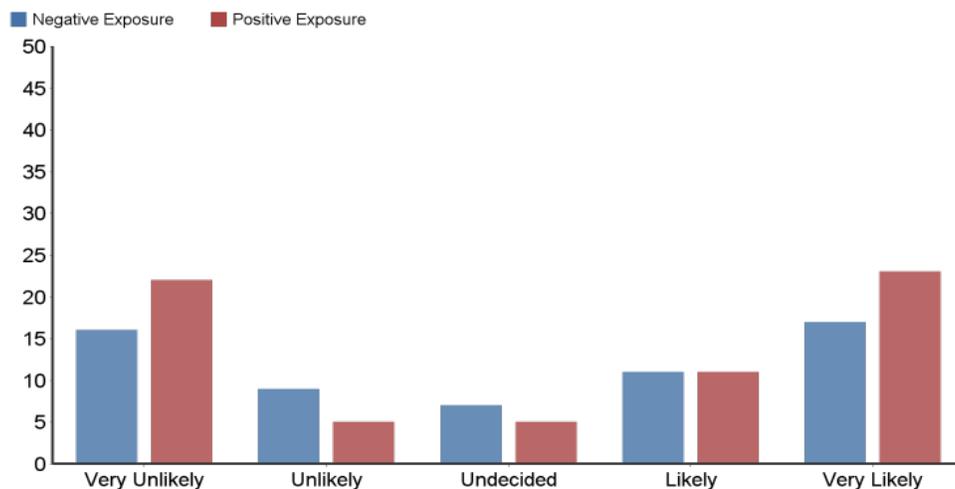


Figure 2: Potential for enrollment in STEM course

Coincidentally, high figures for the standard deviations demonstrate wide dispersals of perceived abilities for activities related to STEM, while measures of general self-efficacy demonstrated smaller standard deviations and individual scores more concentrated near the means. Also, a focused look at solely the mean scores, although statistically non-significant, shows that on 14 of 25 items, those exposed to negative content reported lower levels of self-efficacy than those exposed to positive content, including 9 of the 10 measures for STEM-related activities. The one STEM item that did not show a relationship between the variables was “confidence in my ability to do or get the resources to solve an algebraic equation (mathematics),” which is a task that most of the respondents, as young women in college, most likely have already accomplished (see Appendix Table I7.)

**Trends, patterns.** The concept of character liking suggests a positive valuation, which could return cognitive and/or affective reactions (Nabi and Krcmar, 2004). Given that Social Cognitive Theory recognizes the influence of media characters on people’s learning of appropriate behaviors, character liking was expected to be a moderator variable in this media effects study. Results showed otherwise, which was unexpected; however given the extremely brief exposure, not much time was allotted for participants to “get to know” the character, a possible factor associated with enjoyment of media, and could help explain the absence of a relationship between variables.

Alternatively, when looking for attitudinal patterns in the identified measurements of self-efficacy, although measurement items were scored collectively, the two individual items with the biggest mean differences were related to self-efficacy for information technology and engineering activities: a difference of 12.69 for *designing a technology*

system for distance learning and a difference of 11.84 for designing structures that can withstand heavy stresses (see Appendix Table I8.)

Those are two areas specifically discussed in AAUW’s timely report entitled *Solving the equation: the variable for women’s success in engineering and computing* (American Association of University Women, 2015), which identified engineering and computing as the STEM areas in which women have been slowest to advance. Consistent with the previous report, *Why so few? Women in science, technology, engineering, and mathematics* (Hill, St. Rose, 2010), stereotypes continue to be cited as variables that contribute to the problem. Common thought is that media contribute to stereotypes; hence, Social Cognitive Theory can be used to explain the influence of media influencing people’s learning of appropriate behaviors (Long et al, 2010, and Smith, 2002).

In addition, participants were asked about their media consumption. While there was a lack of time and resources for investigation, data that emerged could be helpful to remind messengers how young people consume media. As Figure 2 indicates, almost all watch television content in some form (n=108).

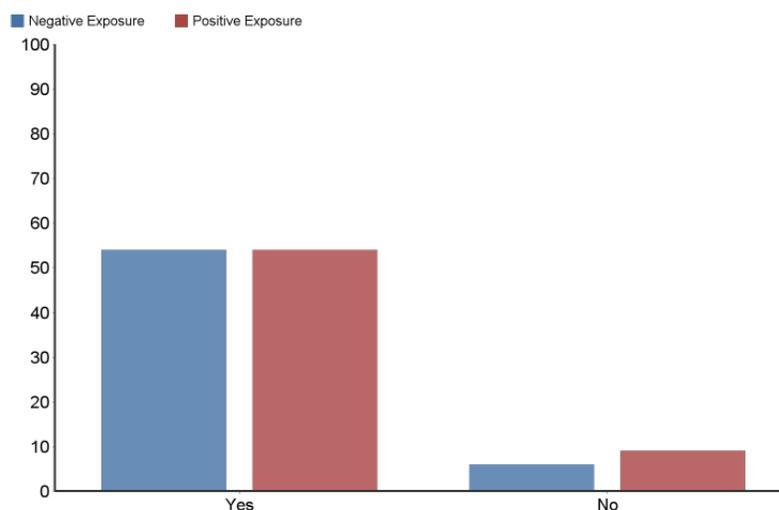


Figure 3: Young women watch television

Figure 4 approximates that 40% watch on traditional television sets, 40% on computers or laptops, and 20% on a mobile device.

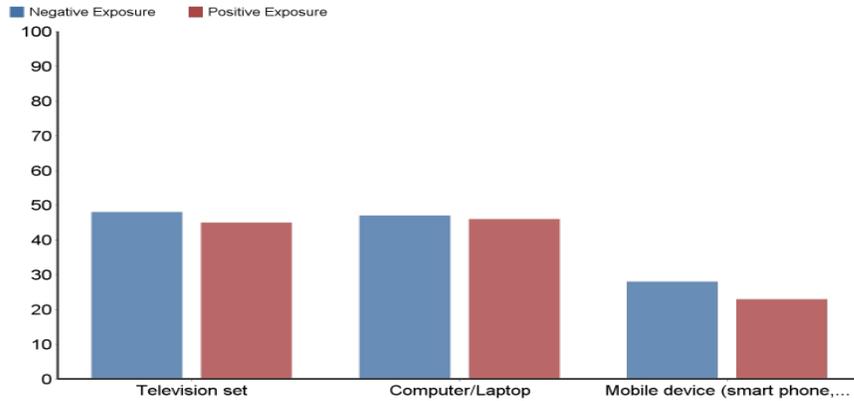


Figure 4: How they watch television

Also of note is the lack of educational programming viewed, in Figure 5.

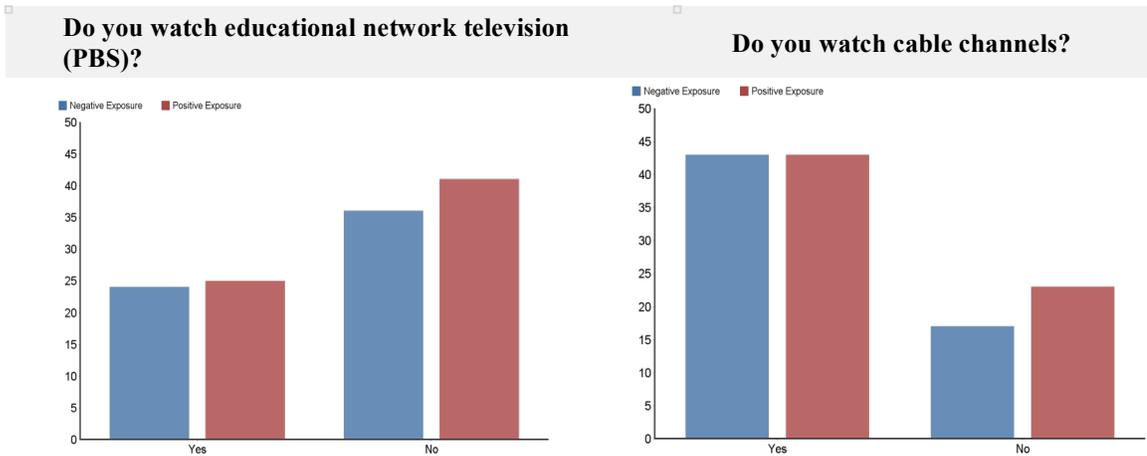


Figure 5: Young women don't watch educational television

And lastly, Figure 6 reflects some of the television ratings intelligence found in the literature review, that young people watch *The Big Bang Theory*:

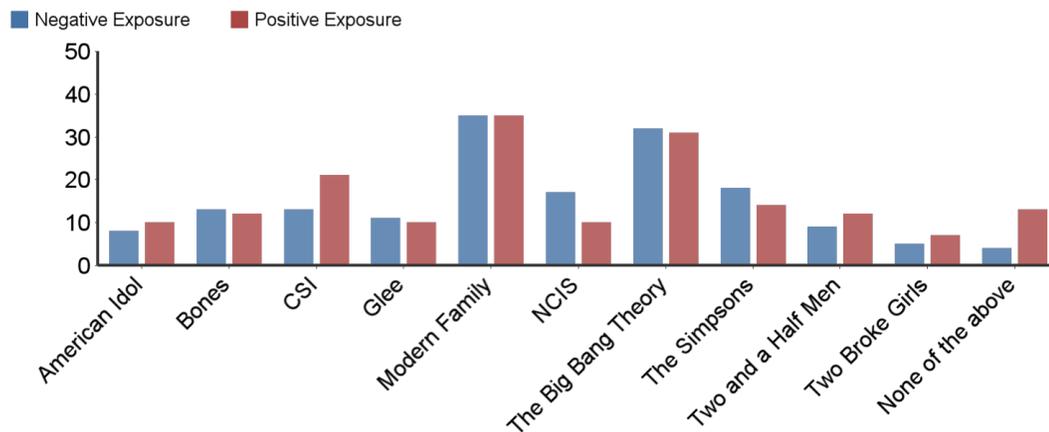


Figure 6: Popular television shows young women watch

**Implications.** The experimental design tested the new question of how media messaging affects self-efficacy, based on vicarious learning, for young women in college, many of whom tested herein may relate to the selected female media characters. As these young women may be looking for clues and advice to make decisions about their future careers, the media messages sent to them, as well as their effects, are worthy of study. Additionally, the data about media consumption can be helpful with creating media strategies to promote the benefits of STEM that are compelling to female audiences.

**Limitations.** Because conclusions were based on a sample population, and sample results may vary from sample to sample, there is a chance for type-I error. The statistical tests incorporated low significance level ( $\alpha=.05$ ), which may help “to keep the chance of type-1 error in check” (Rumsey, 2011, p. 226).

Participants, all females in college, ranged in age from 18 to 24; the majority being 21 years and younger. Figure 7 illustrates that age was fairly distributed between manipulations; however due to lack of time and resources, data was not studied to identify patterns or relationships.

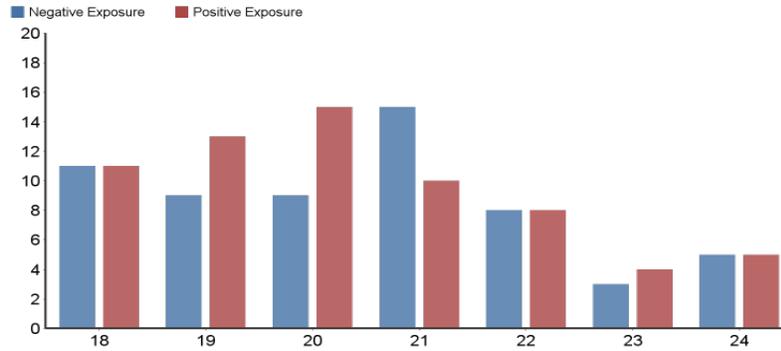


Figure 7: Age distribution

Also, due to a lack of evidence, no investigation was conducted to determine if results differed between undeclared and STEM majors: only five of 121 were undecided, whereas 41 reported they were majoring in a STEM field.

Further, sampling bias is a systematic error that can prejudice evaluation findings in some way and is a consistent error that arises due to the sample selection. The sample used in this study was found to be biased because it was not truly random, and some segments were more likely than others to be chosen. Careful thought was given to which segments were selected and how they differed. Nonetheless, one limitation in this study involves sampling bias, which might have affected the data collected and the level of accuracy represented in the positive and negative segments.

The study also did not isolate findings from external influences such as a previous home environment where television viewing was limited or constant. Nor did it control for variables of heavy or light television viewing; attention or enjoyment of media; cultural influences or opinions held about popular television programming; personality differences such as curiosity or serenity, determination or passivism; or conditions that may affect participants' emotional state of mind, such as a good or bad day at school, work or home. Also, more time is needed, but unavailable, to analyze the collected

demographic information for patterns related to age, ethnicity, education, major and career paths, as well as household income, the education of parents, family situations, television and social media consumption or news gathering habits – all possible mitigating factors.

In summary, results cannot be generalized to all college students, nor to at-large audiences, because of the small convenience sample, use of the selected purposive clips and the brief one-time exposure. And, Rumsey (2011) reminds us, Internet surveys that ask for respondents to click for participation are biased, “research shows that people who respond to surveys tend to have stronger opinions than those that don’t respond” (Rumsey, p. 255). Plus the website-based mechanism used to gather data lacked rigorous controls by relying on prospective respondents to voluntarily accept the invitation to participate, as well as accurately self-report.

Moreover, internal validity was weak because the media content used in the experiment was preselected using objective and subjective judgments, which could have introduced researcher bias. Additionally, the Likert scale is a common method for measuring attitudes, however, using it as a linear measurement was not the most reliable method for the pre-selection process. Video clips were pre-selected with answer choices from absolute to absolute, with neutral being an option. A more reliable index would compare two index scores to get absolute values, using a Likert scale for each treatment in order to register from not at all to very, for example:

How negative was the character?

- 7 – Very Negative
- 5 – Negative
- 3 – Somewhat
- 1 - Not at all

How positive was the character?

- 7 – Very Positive
- 5 - Positive
- 3 - Somewhat
- 1 - Not at all

## Conclusion

The ultimate goal of this research is to get more women involved in science, technology, engineering and math fields – educationally and in career. One strategy to investigate why females shy away from STEM is to study what are the media images and messages of women in science, and how do they affect the perception of personal abilities and socially acceptable behaviors, given television’s “high impact and rapid message delivery (Andreasen, 1995)” (as cited in Gibelman, 2004, p.331), and its role in “reinforcing or challenging gender segregation and inequalities...(and helping) to define people's sense of taken-for-granted normality lists” (Eldridge et al., 1997).

An extensive literature review found that for the most part, popular media negatively portray women in science, both fictitiously and in the news. And with television being a “popular outlet for shaping and informing public perception” (Bourke, Major & Harris, 2009, p. 55), it may also be an important source of ‘role models’ for potential scientists (Phillips and Imhoff, 1997: 35)” (as cited in Kitzinger & Chimba, 2010, p. 609). Hence, one opinion is that media perpetuate the stereotype that science is not for girls, which might offer clues for solutions and was the route of this thesis. Research into the literature also determined a lack of information into media’s portrayal of women in science during primetime television, the most popular time for viewing, and how media messages impact self-efficacy.

This research project confirmed that the population in question engaged with television media, and explored the new question: is there a relationship between exposure

to entertainment TV's portrayal of women in science, which may be negative, and the self-efficacy of female college students, ages 18 to 24?

### **Key findings**

The non-significant results were unexpected. However, a closer review of the Social Cognitive Theory literature finds Bandura recognized first that it was children who were learning cultural patterns of behavior with exposure to media. Maybe by the time females reach college age, their perceived abilities have been determined, and by college age, media has little effect. The fact that all participants rated themselves lower on self-efficacy for STEM-related activities, regardless of the exposure to media, may be the result of media messaging they received at younger ages.

### **Recommendations**

Self-efficacy is a judgment of capability; a perception that comes from mastery and vicarious experience (active learning), as well as from modeling and vicarious learning (passive learning). It stands to reason, then, if there are not opportunities for hands-on learning or the exchange of knowledge and experience from role models, media will be the teachers. And if prevalent images are not compelling about women going into science and engineering, how will females receive inspiration to pursue scientific careers? Does constant messaging on popular television perpetuate a culture that sees science is not for girls, which results in college-age females being less inclined to enter STEM fields? The questions and ideas for solutions can go on and on. Despite the non-significant results of this study, something this inquiry did discover is that more women working in STEM fields are needed to be mentors and real-life models to young people (Weisgram & Bigler, 2006, and AAUW, 2015), which could help combat media

stereotypes and be an intervention strategy that promotes hands-on mastery over vicarious modeling.

### **Future research**

If “the more exposure a person has to television, the more that person’s perception of social realities will match what is presented on TV” (Harris, p. 270), then the media’s portrayal of women in science may affect the number of females who believe they can pursue studies and careers in STEM fields.

Females may report low levels of self-efficacy for STEM-related activities before they reach college, which may not improve without intervention; therefore, more exploration is needed to understand females’ self-efficacy for STEM. One route is to build upon the study by Weisgram and Bigler (2006) by exposing elementary, middle school and high school age populations to hands-on activities and personal interactions with women employed as scientists, technologists, engineers and mathematicians, as well as strategic media programming. Before and after survey instruments can be used to measure self-efficacy and the effects of the various communication methods.

Another research project could examine science programming and related messages aimed at each of the different age groups. Also, experiments could be designed to investigate self-efficacy levels of students before and after exposure to educational stimuli on the topic of women in STEM. For instance, between-group studies could find relationships between level of self-efficacy and teaching method, manipulated in one of two ways: with in-person interactive role models (in line with mastery behavior, a way to boost self-efficacy) and virtually through video or computer (in line with modeling behavior, another way to boost self-efficacy). Students in selected school classrooms

could be sampled, with one set receiving weekly video messages from women who excel in science, technology, engineering and math college courses and careers, while another set hears from guest speakers who are women excelling in STEM college courses and careers. Students would be surveyed for self-efficacy levels at the beginning, middle and end of the school year for pre- and post-test, as well as between-group comparisons. Results by age group and gender could be compared, as well as a longitudinal study could follow females through many grades to more closely inspect if and how perceptions change with age, school culture and media consumption.

At the same time, there are documented problems with media effects research, for example, “a pro-effects view presumes the public to be a gullible mass, cultural dopes, vulnerable to an ideological hypodermic needle, and as if television was being proposed as the sole cause of a range of social behaviours” (Livingstone, 1996, p. 2). Further, studying media effects is not the only way to address the reasons for women lagging in STEM fields, as captured by Brownlow, Smith & Ellis (2002) when investigating if college students negatively view college females who enroll in science programs:

Research has revealed several possible factors that contribute to the tendency of women to shun (STEM) fields, including different cognitive styles (Harris and Carlton, 1993), problems with spatial skills crucial to science success (Coleman and Gotch, 1998), science anxiety (Mallow, 1994), diminished efficacy beliefs regarding science coupled with a tendency to be negatively affected by sex-role consistent expectations (Acker and Oatley, 1993; Brown and Josephs, 1999), non-supportive school experiences (Trankina, 1993), and a lack of role models (Smith, 1992). It is likely that all of these sources – along with a view that science is unfeminine and female scientists are unappealing – work in concert to discourage women from pursuing science (p. 135).

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## Appendix A

### Recruitment Email

INVITATION TO QUALIFYING STUDENTS (to be sent at start of Fall 2014 semester)

Dear college student,

By watching a video and answering some questions about mass media portrayals of women scientists, and perceptions held by female college students, you could get a free lunch\*.

It will take less than 30 minutes. No participants will be identified by name and individual answers will be kept strictly confidential. Survey must be completed before end of day, October 3, 2014.

Participation is voluntary. There will be no negative consequences associated with participation, and no penalty for non-participation or early withdrawal. Once the study is complete, participants will receive aggregated results of the study, which also may be used to help colleges and universities shape initiatives that encourage more women into high-demand career fields.

Thank you for your participation in this research study that is being done to satisfy requirements for a Master of Arts degree in Journalism-Strategic Communications from the University of Missouri. The graduate thesis is entitled, "Women in science: are portrayals on primetime television negative, and what are the effects of exposure to such content?"

LINK TO SURVEY: [www.studywomenscience.com](http://www.studywomenscience.com)

PASSWORD: STEM

Please feel free to reply with questions.

Deborah M. Martin

dmmxw7@missouri.edu

University of Missouri Graduate Student – Journalism/Strategic Communications

\* All participants will each receive a coupon good for food or drink from a local Dunkin' Donuts or Starbuck's retail outlet. There will be no monetary compensation, but coupon will be provided upon completion of the online survey.

Appendix B

Recruitment Flier

**Inviting college women ages 18 to 24  
Watch videos, answer questions, get free food\***

Research into mass media  
portrayals of women scientists, and  
perceptions held by female college students  
can help more women  
get into high-demand career fields!

**It will take less than 30 minutes.**  
No participants will be identified by name and  
individual answers will be kept strictly confidential.

**SURVEY: [www.studywomenscience.com](http://www.studywomenscience.com)  
password: STEM**

**Check it out now!  
Survey closes October 3.**

\* Participation is voluntary. Participants receive a \$5 coupon  
good for food or drink from a local retailer.  
No monetary compensation, but coupon will be provided upon  
completion of the online survey.

The graduate thesis is entitled,  
"Women in science: are portrayals on primetime television negative,  
and what are the effects of exposure to such content?"

Deborah M. Martin, [dmmxw7@missouri.edu](mailto:dmmxw7@missouri.edu)  
University of Missouri Graduate Student - Strategic Communications

## Appendix C

### Content Pre-Selection Recruitment Email

September 2013

Dear UTSA student,

Thank you for your volunteer assistance to rate the following videos for mass media research into television's portrayal of women in science. Your answers will be anonymous. There are five video clips that you are asked to view, and rate via the survey link provided for each. See links at the bottom of this letter.

Please complete the surveys before end of day September 30, 2013.

Again, thank you for your participation in this research study that is being done to satisfy requirements for a Master of Arts degree in Journalism-Strategic Communications from the University of Missouri. The graduate thesis is entitled, "Women in science: are portrayals on primetime television negative, and what are the effects of exposure to such content?"

Your participation helps to further research and investigation into mass media and popular culture. By participating in the survey, respondents agree to the following:

- There will be no negative consequences associated with participation,
- No penalty for non-participation or early withdrawal,
- No participants will be identified by name,
- Individual answers will be kept strictly confidential, and
- Participation is voluntary and there will be no monetary compensation.
- After the survey closes, aggregate results will be sent to project participants.

Feel free to reply or call with questions.

Many thanks,

Deborah M. Martin  
[dmmxw7@missouri.edu](mailto:dmmxw7@missouri.edu)  
(210) 216-6493

### **VIDEOS AND SURVEYS**

1. Big Bang Theory: Women in STEM

[http://www.youtube.com/watch?v=QDdrnacKumg&feature=player\\_detailpage](http://www.youtube.com/watch?v=QDdrnacKumg&feature=player_detailpage)

Survey: [https://qtrial.qualtrics.com/SE/?SID=SV\\_di2ksTGGjOfDEKp](https://qtrial.qualtrics.com/SE/?SID=SV_di2ksTGGjOfDEKp)

2. Bones ID Remains

<http://www.youtube.com/watch?v=zn0BDcnjuzE>

Survey: [https://qtrial.qualtrics.com/SE/?SID=SV\\_di2ksTGGjOfDEKp](https://qtrial.qualtrics.com/SE/?SID=SV_di2ksTGGjOfDEKp)

3. Big Bang Theory: Experimental monkey

<http://www.youtube.com/watch?v=53iTJT77zPM>

Survey: [https://qtrial.qualtrics.com/SE/?SID=SV\\_di2ksTGGjOfDEKp](https://qtrial.qualtrics.com/SE/?SID=SV_di2ksTGGjOfDEKp)

4. Bones: Investigate

<http://www.youtube.com/watch?v=bo3EcVOBakk>

Survey: [https://qtrial.qualtrics.com/SE/?SID=SV\\_di2ksTGGjOfDEKp](https://qtrial.qualtrics.com/SE/?SID=SV_di2ksTGGjOfDEKp)

5. Big Bang Theory Brain

<http://www.youtube.com/watch?v=KewHyYFNlcg>

Survey: [https://qtrial.qualtrics.com/SE/?SID=SV\\_di2ksTGGjOfDEKp](https://qtrial.qualtrics.com/SE/?SID=SV_di2ksTGGjOfDEKp)

## Appendix D

### Content Pre-Selection Survey Instrument

Content Identification Survey      \_\_\_ Female    \_\_\_ Male    \_\_\_ Age

**1. Please select the women in science video clip you just viewed.**

**The following questions will be regarding the clip you just viewed.**

- Big Bang Theory: STEM
- Big Bang Theory: Monkey
- Big Bang Theory: Brain
- Bones: Remains
- Bones: Investigation

**2. Female lead character(s) in the scene you just saw was a scientist (wears a lab coat, is shown working in a scientific setting, is recognized or self-identifies as a scientist)**

- Agree     Disagree

**3. Which of the following attributes describe the female scientist character(s) you just observed? (select all that apply)**

- |  |                                      |
|--|--------------------------------------|
| <input type="checkbox"/> Knowledgeable / experienced | <input type="checkbox"/> Unusual     |
| <input type="checkbox"/> Leader/supervisory          | <input type="checkbox"/> Sexy        |
| <input type="checkbox"/> Incompetent                 | <input type="checkbox"/> Seductress  |
| <input type="checkbox"/> Subordinate                 | <input type="checkbox"/> Intelligent |

**4. Based on the female scientist character(s) you just saw, on a scale from 1 to 7, to what extent was the model negative or positive?**

- 1 – absolutely negative
- 2 – strongly negative
- 3 – negative
- 4 – neutral
- 5 – positive
- 6 – strongly positive
- 7 – absolutely positive

**5. Based on the female scientist character you just saw, on a scale from 1 to 7, to what extent do you like or dislike her?**

- 1 – absolutely like
- 2 – strongly like
- 3 – like
- 4 – neutral
- 5 – dislike
- 6 – strongly dislike
- 7 – absolutely dislike

Content Pre-Selection Survey II \_\_\_\_\_ Female \_\_\_\_\_ Male \_\_\_\_\_ Age

**1. Please select the women in science video clip you just viewed.**

**The following questions will be regarding the clip you just viewed.**

- |  |                                  |
|--|----------------------------------|
| <input type="checkbox"/> Big Bang Theory 1 | <input type="checkbox"/> Bones I |
| <input type="checkbox"/> Big Bang Theory 2 | <input type="checkbox"/> Bones 2 |
| <input type="checkbox"/> Big Bang Theory 3 | <input type="checkbox"/> Bones 3 |
| <input type="checkbox"/> Big Bang Theory 4 | <input type="checkbox"/> Bones 4 |
| <input type="checkbox"/> Big Bang Theory 5 | <input type="checkbox"/> Bones 5 |

**2. Female lead character(s) in the scene you just saw was a scientist (wears a lab coat, is shown working in a scientific setting, is recognized or self-identifies as a scientist)**

Agree  Disagree

**3. Which of the following attributes describe the female scientist character(s) you just observed? (select all that apply)**

- Knowledgeable / experienced
- Unusual
- Leader/supervisory
- Sexy
- Incompetent
- Seductress
- Subordinate
- Intelligent

**4. Based on the female scientist character(s) you just saw, on a scale from 1 to 7, to what extent was the model negative or positive?**

- 1 – absolutely negative
- 2 – strongly negative
- 3 – negative
- 4 – neutral
- 5 – positive
- 6 – strongly positive
- 7 – absolutely positive

**5. Based on the female scientist character you just saw, on a scale from 1 to 7, to what extent do you like or dislike her?**

- 1 – absolutely like
- 2 – strongly like
- 3 – like
- 4 – neutral
- 5 – dislike
- 6 – strongly dislike
- 7 – absolutely dislike

## Appendix E

### Pre-Selection of Content II Invitation (Script)

#### **Project #: 1208309 Review #: 128055**

To identify content for use in the experiment, ten more video clips, or scenes, with female scientist characters from *The Big Bang Theory* and *Bones*, have been selected to fit negative or positive depictions. To get a reliable index, videos will be pre-tested by 20 college/university women who are in the same age range (18 to 24).

Rather than sending email invitations, personal interviews will occur at San Antonio College and/or University of Texas at San Antonio with students hanging out in the student center, in line for registration, and/or in science computer labs. To begin, I will ask if they have 10 or 15 minutes to volunteer to rate 10 short, short video clips for mass media research into television's portrayal of women in science. I ask if they are between the ages of 18 and 24, and if so, for participating, I will offer a free movie ticket, courtesy of Santikos Theatres.

To those who say no, I will say thank you. To those who say yes, they will volunteer, I will say, Thank you for your participation in this research study that is being done to satisfy requirements for a Master of Arts degree in Journalism-Strategic Communications from the University of Missouri. The graduate thesis is entitled, "Women in science: are portrayals on primetime television negative, and what are the effects of exposure to such content?"

Your answers will be kept anonymous. The clips will be, one-by-one on my laptop. You are asked to view, and rate on the paper surveys – one page per video, total 10 pages.

Your participation helps to further research and investigation into mass media and popular culture. By participating in the survey, participants agree to the following:

- There will be no negative consequences associated with participation,
- No penalty for non-participation or early withdrawal,
- No participants will be identified by name,
- Individual answers will be kept strictly confidential, and
- Participation is voluntary and there will be no monetary compensation.
- After the survey closes, aggregate results will be sent to project participants.

Ready to get started?

Deborah M. Martin  
[dmmxw7@missouri.edu](mailto:dmmxw7@missouri.edu), (210) 216-6493

Appendix F

Table F1				
Results: Video clip pre-selection				
Negative Ratings				
Clip	Negative	Strongly neg	Absolutely neg	Total Negative
<b>TBBT3</b>	7	5	2	14
TBBTbrains	7	4	1	12
TBBT5	7	2	1	10
TBBT4	8	1	0	9
TBBT monkey	6	3	0	9
TBBT2	5	3	0	8
TBBTstem	7	0	1	8
<b>Bones5</b>	5	2	0	7
TBBT1	4	2	0	6
Bones2	5	0	0	5
Bones3	3	0	0	3
Bones4	3	0	0	3
Bones1	0	0	0	0
Bonesid	0	0	0	0

Positive Ratings					
Clip	Positive	Strongly pos	Absolutely pos	Total Positive	
<b>Bonesid</b>		<b>5</b>	<b>8</b>	<b>3</b>	<b>16</b>
Bones1		8	2	1	11
Bones3		5	4	1	10
<b>TBBT1</b>		<b>5</b>	<b>3</b>	<b>1</b>	<b>9</b>
Bones4		5	2	2	9
Bones2		5	2	0	7
TBBT4		4	2	0	6
TBBTstem		5	1	0	6
TBBT monkey		2	1	2	5
TBBT2		4	1	0	5
TBBT5		3	1	0	4
Bones5		3	0	1	4
TBBT3		3	0	0	3
TBBTbrains		1	0	2	3

Neutral ratings	
Clip	Neutral
Bones1	9
Bones5	9
Bones4	8
Bones2	8
Bones3	7
TBBT2	7
TBBTstem	6
TBBT monkey	6
TBBT5	6
TBBT1	5
TBBT4	5
TBBTbrains	5
Bonesid	4
TBBT3	3

## Appendix G

### Survey Instrument: Association & Appraisal Inventories

Dear participant,

Thank you for your involvement. By participating in the online survey you understand:

- There will be no negative consequences associated with participation,
- No penalty for non-participation or early withdrawal,
- No participants will be identified by name,
- Individual answers will be kept strictly confidential, and
- There will be no monetary compensation, but all participants will receive a coupon good at a fast-food retailer near the college/university.

Q1.

Based on the female scientist character you just saw, on a scale from 1 to 7, to what extent do you like or dislike her?

- 1 – absolutely like
- 2 – strongly like
- 3 – like
- 4 – neutral
- 5 – dislike
- 6 – strongly dislike
- 7 – absolutely dislike

### Appraisal Inventory

0-----10-----20-----30-----40-----50-----60-----70-----80-----90-----100

**Not**                      **Slightly**                      **Confident**                      **Very**                      **Extremely**  
**Confident**                      **Confident**                                           **Confident**                      **Confident**

This feedback form is meant to help us learn more about what things that can be challenging for students. Using the above scale with values 0 to 100, please type in the number to indicate how confident you are in your abilities regarding each of the following items. Remember, no participants will be identified by name, and individual answers will be kept strictly confidential.

Thank you for your participation.

\_\_\_ I can solve difficult problems if I try hard enough.

\_\_\_ I can usually handle whatever comes my way.

\_\_\_ I can remain calm when facing difficulties because I can rely on my coping abilities.

- \_\_\_ I am confident that I could deal efficiently with unexpected events.
- \_\_\_ If someone opposes me, I can find the means and ways to get what I want.
- \_\_\_ I can get teachers to help me when I get stuck on schoolwork.
- \_\_\_ I can get another student to help me when I get stuck on schoolwork.
- \_\_\_ It is easy for me to stick to my aims and accomplish my goals.
- \_\_\_ I can get a friend to help me when I have social problems.
- \_\_\_ I can finish my homework assignments by deadlines.
- \_\_\_ I can get myself to study even when there are other interesting things.
- \_\_\_ I can get myself to class on time and with proper materials.
- \_\_\_ I can control my temper.
- \_\_\_ I can live up to what I expect of myself.
- \_\_\_ I can live up to what my peers expect of me.

STEM Appraisal Inventory

This feedback form is meant to help us learn more about what things interest science and engineering students.

0-----10-----20-----30-----40-----50-----60-----70-----80-----90-----100

<b>Not Confident</b>	<b>Slightly Confident</b>	<b>Confident</b>	<b>Very Confident</b>	<b>Extremely Confident</b>
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Regarding the specific science-related tasks below, using the above scale with values 0 to 100, please type in the number to indicate how confident you are **in your abilities to do or to get the training to do** each of the following items. Again, no participants will be identified by name, and individual answers will be kept strictly confidential. Thank you for your participation.

- \_\_\_\_\_ Solve an algebraic equation
- \_\_\_\_\_ Develop more user-friendly machines
- \_\_\_\_\_ Study the movement of planets

- \_\_\_\_\_ Design structures that can withstand heavy stresses
- \_\_\_\_\_ Study the nature of quantum physics
- \_\_\_\_\_ Dissect an animal
- \_\_\_\_\_ Measure the speed of electrons
- \_\_\_\_\_ Modify an equipment design to reduce sound level
- \_\_\_\_\_ Calculate the probability of winning a contest
- \_\_\_\_\_ Design a technology system for distance learning

## Appendix H

### Survey Instrument: Demographic & Viewing Habits

Age: \_\_\_\_\_  
Gender: \_\_\_\_\_  
Ethnicity: \_\_\_\_\_  
Level of education: \_\_\_\_\_  
Major: \_\_\_\_\_

If you are undecided, on scale from 1 to 5, how likely are you to register for a science, technology, engineering or math class within the next two years?

- 1 – very likely
- 2 – somewhat likely
- 3 – undecided
- 4 – not likely
- 5 – definitely will not

I am interested in learning more about (check all that apply):

- \_\_\_\_ Astronomy
- \_\_\_\_ Biology
- \_\_\_\_ Chemistry
- \_\_\_\_ Computers
- \_\_\_\_ Engineering
- \_\_\_\_ Geology
- \_\_\_\_ Math
- \_\_\_\_ Plant science
- \_\_\_\_ Physics
- \_\_\_\_ Social Science
- \_\_\_\_ All of the above
- \_\_\_\_ None of the above

Do you watch any of the following programs? (check all that apply)

- \_\_\_\_ American Idol
- \_\_\_\_ Bones
- \_\_\_\_ CSI
- \_\_\_\_ Glee
- \_\_\_\_ Modern Family
- \_\_\_\_ NCIS
- \_\_\_\_ The Big Bang Theory
- \_\_\_\_ The Simpsons
- \_\_\_\_ Two and a Half Men
- \_\_\_\_ Two Broke Girls
- \_\_\_\_ All of the above
- \_\_\_\_ None of the above

Do you watch educational network television (PBS)?

Yes

No

If you watch cable channels, what are your top three favorite programs?

1

2

3

I don't watch cable channels

If you watch reality television, what are your top three favorite programs?

1

2

3

I don't watch cable channels

Does your household:

Subscribe to Cable television (Time Warner Cable, Grande Communications, etc.)

Subscribe to Satellite television (DIRECTV, DishTV, etc.)

Subscribe to fiber optic or digital television (AT&T Uverse, Verizon FiOS TV)

Neither – we get local broadcast television

Neither – we watch television via computer

My household does not watch television

What device do you use to watch television programs? (cancel all that apply)

Television set

Computer/Laptop

Mobile device (smart phone, tablet, etc.)

I don't watch television

If you watch television on a device other than standard set, do you

watch complete television program

watch only TV clips via You Tube or similar web site/app

this question does not apply to me

On average, how many hours per day do you watch television?

0-2 hours

2-4 hours

5+ hours

I don't watch television

From where do you get your news information? (check all that apply)

Newspaper

- Radio News
- Television News
- local or network news
- cable news
- Internet news sites (give an example: \_\_\_\_\_)
- App on my mobile device (give an example: \_\_\_\_\_)
- Facebook
- Friends/family
- I don't keep up with news

From where do you learn about science (select all that apply)

- Traditional news sources (give an example: \_\_\_\_\_)
- Television programming (give an example: \_\_\_\_\_)
- Internet science sites (give an example: \_\_\_\_\_)
- Facebook
- Friends/family
- School
- I don't learn about science

Thank you for your participation.

## Appendix I

Table I6

SPSS Item Statistics: General Self-Efficacy

	Mean	Std. Deviation	N
Q13_1	83.08	16.525	126
Q13_2	82.68	15.504	126
Q13_3	72.42	21.782	126
Q13_4	75.40	16.970	126
Q13_5	72.90	21.121	126
Q13_6	77.14	27.752	126
Q13_7	75.06	31.716	126
Q13_8	77.39	19.844	126
Q13_9	82.20	19.891	126
Q13_10	85.90	18.395	126
Q13_11	70.09	23.351	126
Q13_12	87.05	19.109	126
Q13_13	81.79	20.654	126
Q13_14	81.17	18.961	126
Q13_15	76.52	25.598	126

Table 17

SPSS Item Statistics: STEM Self-Efficacy

	Mean	Std. Deviation	N
Q15_1	74.02	26.789	126
Q15_2	54.99	33.743	126
Q15_3	62.50	30.424	126
Q15_4	54.12	34.341	126
Q15_5	41.26	38.215	126
Q15_6	60.16	40.650	126
Q15_7	42.43	38.488	126
Q15_8	45.90	35.724	126
Q15_9	69.19	33.238	126
Q15_10	46.86	40.386	126

## Appendix J

Self-efficacy measure	Manipulation		Difference
	Positive (n <sub>p</sub> =67)	Negative (n <sub>n</sub> =62)	
Design a technology system for distance learning (information technology)	52.92	40.23	12.69
Design structures that can withstand heavy stresses (engineering)	59.42	47.58	11.84
Calculate the probability of winning a contest (mathematics)	73.56	64.23	9.33
Modify an equipment design to reduce sound level (engineering)	49.5	42.2	7.39
Develop more user-friendly machines (information technology)	58.71	51.39	7.32
Measure the speed of electrons (life sciences)	45.02	38.84	6.18
If someone opposes me, I can find the means and ways to get what I want.	75.31	69.4	5.91
Study the movement of planets (physical sciences)	63.06	59.32	3.74
I can solve difficult problems if I try hard enough.	84.5	80.84	3.66
I can usually handle whatever comes my way.	83.76	80.31	3.45
Study the nature of quantum physics (physical sciences)	41.8	38.45	3.35

Dissect an animal (life sciences)	61.32	59.13	2.19
It is easy for me to stick to my aims and accomplish my goals.	78.24	76.31	1.93
I can get another student to help me when I get stuck on schoolwork.	75.9	74.21	1.69
Solve an algebraic equation (mathematics)	73.97	74.17	-0.2
I can get teachers to help me when I get stuck on schoolwork.	76.97	77.19	-0.22
I can live up to what I expect of myself.	80.78	81.35	-0.57
I am confident that I could deal efficiently with unexpected events.	74.97	75.63	-0.66
I can get myself to study even when there are other interesting things.	69.61	70.44	-0.83
I can remain calm when facing difficulties because I can rely on my coping abilities.	71.59	72.82	-1.23
I can get a friend to help me when I have social problems.	81.3	82.73	-1.43
I can finish my homework assignments by deadlines.	84.91	86.58	-1.67
I can control my temper.	79.82	83.19	-3.37
I can live up to what my peers expect of me.	74.78	78.55	-4.07
I can get myself to class on time and with proper materials.	83.4	90.42	-7.02