MEDIA IMAGES OF WOMEN ENGINEERS AND SCIENTISTS AND ADOLESCENT GIRLS' CONCEPTIONS OF FUTURE ROLES

Jocelyn Steinke[1]

Abstract –Media images of engineers and scientists reinforce cultural stereotypes about the role of women in American society and in the engineering, scientific, and technical professions. These images can have a negative impact on adolescent girls who are making career plans at a time marked by waning self-confidence and a heightened awareness of cultural norms of femininity. An analysis of images of women engineers and scientists in popular films shows how these images reinforce cultural representations of gender and science and explores the potential impact on adolescent girls' conceptions of gender roles and their occupational aspirations. This paper makes recommendations on how intervention programs can be enhanced through a greater understanding of the cultural representations of gender in the everyday lives of adolescent girls.

Index Terms – Adolescent girls, cultural representations, gender and science, images of women engineers and scientists.

INTRODUCTION

The mass media convey and reinforce cultural expectations about the lives and roles of women by providing "images for interpreting the world" [1]. Growing up in a media-rich environment, girls see many images that convey information about "appropriate" and "inappropriate" roles for women. By the time girls reach adolescence, when most girls begin to develop individual identities and prepare for future roles, they have seen countless images that tell them who they are, who they should be, and who they can be.

A recent study of the most popular media used by adolescent girls found that the mass media play a "dual role" [2] in identity formation by presenting contradictory images of women. While some media images portray women as strong, positive characters, showing them as independent, intelligent, honest, direct, and capable of solving their own problems, others reinforce traditional stereotypes of women by focusing more on the appearance and relationships than the careers of female characters[1].

Many media images reinforce cultural representations of gender that teach girls to value traditional feminine attributes and roles. These images depict women as expressive, communal, physically weak, helpless, dependent, emotional, and giving [3]. In addition, these images are more likely to show women as homemakers, and if they work outside the home, in traditional jobs for women, such as secretarial and teaching positions, and jobs that involve caring for other people and their possessions, such as nursing, flight attendant positions, and domestic work [3]. These images along with and other socializing agents encourage girls to conform to feminine stereotypes. The 1998 National Council for Research on Women report explains how girls growing up in male-dominated cultures are socialized: "[M]any girls face enormous pressure to judge their self-worth based on narrow standards of physical attractiveness; to put boys and men ahead of themselves; and to conform to very narrow notions of femininity which promote passivity, compliance, and self-sacrifice, while discouraging strength, autonomy, and entitlement to pursue one's own desire" [4].

Adolescence is a challenging time of change for many girls as they begin to assert their independence and to make plans for the future [5]. During adolescence, girls become increasingly more aware of cultural expectations of women, and many adolescent girls become preoccupied with fitting in; being popular, thin, and attractive; and finding romance [6]-[8]. Psychologist Carol Gilligan, author of *In a Different Voice*, explains the loss of self-confidence that girls experience during adolescence: "Girls' initiation into womanhood has often meant an initiation into a kind of selflessness, which is associated with care and connection but also with a loss of psychological vitality and courage" [9]. In American society, adolescence represents an unfortunate convergence of events for girls during a pivotal period of identity formation: Adolescent girls begin making plans for the future, including career plans, at a time marked by waning self-confidence and a heightened awareness of cultural norms of femininity.

The mass media are important sources of information about gender roles and future roles as adolescent girls develop what Researchers Ann Patrice Ruvolo and Hazel Rose Markus describe as the "possible selves" [10] that represent who they "could become, would like to become, and are afraid of becoming" [10]. Researcher Nancy Signorielli describes the potential influence of the mass media during identity formation: "Media's portrayals contribute to girls' perceptions, helping them define what it

means to be a girl and later a woman. Adolescent girls form ideas about their own lives by observing how girls and women in the media look and behave, their motivations and their goals, what they do with their time and with their lives" [2].

Media portrayals that emphasize cultural norms of femininity and traditional roles for women do little to encourage adolescent girls in engineering, science, and technology. Despite recent increases in participation, women make up only 19.4 percent of the engineering, science, and technology workforce, and women from all underrepresented minorities make up an even smaller percentage of the workforce in these areas [11]. Women make up only 9.1 percent of the workforce in engineering, 21.9 percent of the workforce in the physical sciences, 27.3 percent of the workforce in computer science, and 36.2 percent of the workforce in the life sciences [11]. Statistics show that in 1996, women earned only 17.9 percent of all bachelor's degrees, 17.1 percent of all master's degrees, and 12.3 percent of all doctoral degrees in engineering [12]. A 1997 study of Advanced Placement examinations indicates a smaller percentage of women than men took the exam in calculus, computer science, chemistry, and physics [13].

Numerous intervention programs have emerged as part of a nationwide initiative to remove barriers that contribute to the gender gap in engineering, science, and technology. Schools, colleges and universities, non-profit organizations, scientific societies, government agencies, industry, museums, and others have spearheaded a variety of programs for girls, providing them with opportunities to learn in all-girl environments [14], conduct hands-on experiments [14]-[15], meet female engineers and scientists and learn about career opportunities [16], and email and chat with women engineers and scientists [17]-[19].

Creating "warmer climates" and more supportive environments in homes, schools, workplaces, and elsewhere clearly is, and should remain, a high priority in efforts to increase the participation of girls and women in engineering, science, and technology. These programs also need to be informed by an understanding of the cultural representations of gender in the everyday lives of adolescent girls that promote biased assumptions about the role of women in American society and can lead to gender biased attitudes about the role of women in engineering, scientific, and technological professions. A greater understanding is especially needed of the mediated images of women engineers and scientists that girls see if girls are truly going to benefit from existing efforts to create "warmer climates" in these professions.

CULTURAL REPRESENTATIONS OF GENDER AND SCIENCE

Tracing the ways in which cultural factors contribute to the gender gap in engineering, science, and technology is a difficult endeavor because cultural influences are typically long-term, changing, subtle, and indirect. Various socialization agents in American culture convey assumptions about the "appropriate" and "inappropriate" roles for women through cultural representations of gender. The books, toys, television programs, videotapes, music, photographs, and clothing that are a part of young children's everyday lives all carry cultural representations of gender that teach children specific gender roles. Children as young as age two first learn gender roles by labeling certain characteristics and behaviors as masculine or feminine [20]-[21]. Observations of preschool-aged girls reveal that young girls conform to adult feminine behavior when playing, [22] and interviews with preschool-aged girls show that girls are more likely to select careers traditionally associated with their gender [23]. Numerous studies indicate that older girls make decisions about what to think, what to say, and how to act based on their knowledge of social definitions of gender [24]-[26]. The extent to which girls at all ages exhibit gender-stereotyped behavior varies, however, depending upon their exposure to gender-related information, the nature of that information, and their ability to interpret that information [27].

Cultural representations of gender and science tend to promote a "masculine image of science" [28] by focusing on the "masculine" characteristics, such as aggressiveness and analytical skills [29]-[32], needed to succeed in these professions and by emphasizing the conflict between the dedication and long hours required of the profession and family responsibilities [30],[33]. Consequently, girls exposed to cultural representations that present engineering and science as masculine are likely to label these occupations as masculine, thus automatically excluding themselves from educational and professional opportunities. Multiple studies have shown that many girls do indeed hold a "masculine image of science" [28] and tend to think most engineers and scientists are male [34]-[35].

MEDIA IMAGES OF WOMEN ENGINEERS AND SCIENTISTS

Historically, images of male engineers and scientists dominate the mass media in the United States. In a comparison of the percentage of men and women in occupations in the U.S. work force and the percentage in prime-time network television drama in the 1980s, Researcher Nancy Signorielli noted three male scientists for every female scientist [36]. An analysis of scientists profiled in the *Science Times* section of *The New York Times* found only two of the 11 profiled scientists to be females [37]. A study of scientists on Saturday-morning children's television programs in the 1990s found that these shows featured twice as many adult male scientists as female scientists [38].

When women engineers and scientists do appear in the mass media, these images often perpetuate cultural myths

that reinforce the idea that science is an inappropriate career for most "ordinary" women, depicting women scientists as both "atypical scientists and atypical women" [39]-[40]. Media portrayals of women engineers and scientists typically reinforce cultural stereotypes through images that downplay the expertise of women engineers and scientists [38]-[43], focus on the conflicts faced by women engineers and scientists in balancing the demands of their professional and personal lives [39]-[41], present women engineers and scientists as lacking the masculine traits and skills needed to conduct scientific research [39], and portray women engineers and scientists as potential distractions to their male colleagues [40].

IMAGES OF ENGINEERS AND SCIENTISTS IN FILMS: PRELIMINARY FINDINGS

A list of 126 popular films that featured engineers and scientists from 1984-2001 were selected for this analysis. These films were selected using key word searches of movie reviews indexed in the *Reader's Guide to Periodical Literature* and plot summaries indexed in Microsoft's *Cinemania* CD ROM and the Internet Movie Database (http://www.imdb). Various combinations of the following keywords were used: movie, film, scientist, woman scientist, woman engineer, engineer, physicist, space scientist, biologist, chemist, geologist, and researcher. Every attempt to provide as comprehensive a list as possible was made, but this sample does not represent all films that feature engineers and scientists because of limitations of the sampling procedure.

Textual analysis provides a way to assess, in rich detail, portrayals of female engineers and scientists in popular films. Based on previous research on media images of women scientists [38], [44]-[47], the author identified several themes to use as a framework for this analysis. Table 1 outlines the themes used to analyze the images and texts of these films. Examples of these themes from the preliminary findings of the textual analysis are presented below.

TABLE 1
THEMES OF MEDIA IMAGES

Downplaying the Expertise of Women Engineers and Scientists
Emphasizing the Appearance of Women Engineers and Scientists
Stressing the Conflicts of Balancing Professional and Personal Lives
• Conflicts with Romantic Relationships
• Conflicts with Family/Childcare Responsibilities
Focusing on the Lack of Ability and Skills
Showing Women Engineers and Scientists as Distractions

One theme noted in the images and texts of films that portray women engineers and scientists involves downplaying the expertise of these women. In a number of films, including *Contact*, *Batman and Robin*, *Junior,* and *Body Chemistry*, the expertise of the women engineers and scientists is overshadowed or questioned by male colleagues who take away research funding or laboratory space, take credit for scientific accomplishments, or speak on behalf of women engineers and scientists. In some cases, other male professionals, besides male engineers and scientists, downplay or question the expertise of women engineers and scientists. In *Volcano*, for example, Geologist Amy Barnes sarcastically relates to another female colleague how a male emergency management official doubts her ability to gather samples underground. She gives her interpretation of what he has said to her: "It's too dangerous. It's man's work and you're just little girlies."

The focus on the appearance of women engineers and scientists varies from genre to genre and from film to film. Some of the portrayals like Geologist Amy Barnes in *Volcano*, NASA Engineer Sarah Holland in *Space Cowboys*, and Molecular Biologist Denise Gaines in *The Nutty Professor*, present realistic representations of engineers and scientists, showing these women as ordinary women dressed in professional attire or attire appropriate for the laboratory or field setting in which they work. Other portrayals, however, like those of Comparative Physiobiologist Diane Farrell in *Love Potion No. 9* and Botanist Pamela Isley in *Batman and Robin* reinforce popular stereotypes of scientists by showing them as unkempt, unstylish, and even "nerdy."

Another popular theme that emerges from the images and texts of films that portray women engineers and scientists stresses the conflicts of balancing professional and personal lives either in regards to romantic interests or family responsibilities. Numerous images of women engineers and scientists emphasize how the demands of their careers keep them from romantic relationships. In *Nell*, a male colleague asks Psychiatrist Paula Wilson: "What would you know about happy couples." When a romantic relationship intensifies between Astronomist Ellie Arroway and Palmer Joss, Arroway abruptly leaves Joss one morning to go to work, and she never calls the phone number he leaves in her cabin. She seems embarrassed when they later meet by coincidence. Other films emphasize the lack of romantic relationships for scientists like Biologist Diana Reddin in *Junior* who freezes her own eggs in her laboratory until she is able to start a relationship with someone and like Pysiobiologist Diane Farrell in *Love Potion No. 9* who only is seen as attractive by men under the influence of a love potion. A number of the films show women engineers and scientists falling in love later in the films, and in some cases with a male colleague who initially questioned their expertise or ridiculed their ability: Psychiatrist Paula Wilson in *Nell*, Biologist Diana Reddin in *Junior*, Geologist Amy Barnes in *Volcano,* and Botanist Rae Crane in *Medicine Man*.

Few of the women scientists are shown with families or with their children. One of the few portrayals of a full-time, working mother is Robotics Engineer Eve Simmons in *Eve of Destruction*. Dr. Eve Simmons also is one of few single, working mothers seen on film, although her role as mother receives little attention throughout the film. Her work as a robotics engineer goes uninterrupted during most of the film, and only near the end of the film, is she shown with her young son, Tim. In this scene, as Dr. Simmons frantically types at the computer, Tim asks for his mother's attention. When she replies, "One second, Tim," he walks over to her computer and shuts it off. Dr. Simmons laughs and goes to look at the books Tim has been coloring. As Simmons jokes with Tim, she is interrupted by a phone call. Simmons hangs up the phone and explains that she has to leave. She then hugs Tim, and promises to take him to the aquarium later. Tim walks away despondently. Despite his mother's reassurances and her promise to spend time with him later, Tim clearly is disappointed by her unexpected return to the working world.

Another theme that emerges in some of these films focuses on the lack of ability of the women engineers and scientists. For example, the abilities of Astronomist Ellie Arroway in *Contact* and Botanist Rae Crane in *Medicine Man* are questioned by their male colleagues. When Crane meets Richard Campbell, an older male scientist working in the rain forest, she responds to his doubts about her ability by reciting a long list of her qualifications and accomplishments: "I'm published, and more extensively than Dr. Sealove. I hold degrees from CCNY, Berkeley and Cambridge. I'm the recipient of the Thurman Award in '82 and '86, the first and only time it's ever been given to the same person twice." Campbell appears to be unimpressed and asks, "When was the last time you did field research? No, when's the first time?"

Another theme noted in images of women scientists and engineers in films shows these women as distractions, even deadly distractions, in the lives of their male colleagues. In *Body Chemistry,* Dr. Claire Archer, who studies sexual response in humans, is a threat to both the career and marriage of male colleague, Dr. Tom Redding. Although Redding is promoted to laboratory director at the Neurology Institute when he convinces Archer to bring her research and funding to the Institute, his affair with Archer later claims his career and his life. When Redding tries to break off the relationship with Archer in order to save his marriage, Archer sets fire to his house, threatens his son's life, and shoots him when he shows up at her home seeking revenge. In *Batman and Robin,* Botanist Pamela Isley is responsible for the death of a male colleague, Dr. Jason Woodrew, when she discovers he has been sneaking her samples back to his laboratory and using them for a "maniacal scheme for world domination."

INFLUENCE OF MEDIA IMAGES ON CAREER ASPIRATIONS

Media effects are neither uniform nor direct and vary as a result of a number of factors including household attributes (socioeconomic status, race, and norms about media use), child attributes (age, mental ability, comprehension, and affinity for media use), and situational influences (presence of parents or other children, time of viewing, and emotional state during viewing) [48]. Tracing the ways in which media images contribute to the gender gap in engineering, science, and technology is a complex endeavor in light of the many differences in girls' individual characteristics and attributes and the many differences in their backgrounds and experiences related to race, socioeconomic status, ethnicity and ability. In addition, the mass media certainly are not the only sources of influence in the lives of adolescent girls.

The pervasiveness of the mass media and the years of repeated exposure to images in the mass media, however, do suggest some kind of influence. In fact, studies show that the mass media become important sources of information about both current and future roles during the adolescent years when girls begin to assert their independence from parents and teachers [2], [49]-[50]. While few studies have examined the specific impact of media images of women engineers and scientists on adolescent girls' professional aspirations, these images are likely to have a significant impact because the mass media are an important source of information about occupations [51] and because of the dearth of real-life role models in the lives of many adolescent girls [38].

RECOMMENDATIONS FOR INTERVENTION PROGRAMS

Intervention efforts to increase girls' interest in engineering, scientific, and technological professions can be enhanced by an understanding of the cultural representations of gender in girls' everyday lives. Media portrayals of women, in general, and images of women engineers and scientists, in particular, often reinforce "narrow notions of femininity" [4]. For image-conscious adolescent girls whose primary concern is being popular and who have been taught for years to value "feminine" ways, both the absence of positive images and the presence of stereotypical images send a strong message about the role of women in engineering and science: A message that further perpetuates cultural representations of engineering and science as "masculine" pursuits.

Intervention programs are important in encouraging girls to pursue educational and professional opportunities in engineering, science, and technology. Below are some recommendations for enhancing intervention programs based on the preliminary findings of this research:

1. Assess the influence of cultural representations on adolescent girls' conceptions of engineers and scientists.
2. Acknowledge the influence of cultural representations of gender and science (in addition to factors in schools and at home) on girls' perceptions of engineering, scientific, and technological careers.
3. Offer alternative images or counter-stereotypical images of women engineers and scientists.
4. Intervene earlier by providing alternative images to foster positive conceptions of engineers and scientists during girls' preschool years.
5. Explore ways of reaching more girls on a regular, everyday basis through the mass media programs and the World Wide Web.

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