

## WITH THE BEST INTENTIONS: RETHINKING THE FIT BETWEEN WOMEN AND TECHNOLOGY

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**Abstract** ---- This collaborative paper juxtaposes approaches from two very different disciplines (sociological career development theory and feminist film criticism) in order to understand more fully the cultural forces that still discourage young women from entering the fields of science, math, engineering, and technology (SMET). In the opening section, Nancy Steffen-Fluhr shows how Hollywood films and television have persisted in representing science and technology as both hyper-masculine and socially isolating. In the second part of the paper, Anne Wiley argues that SMET recruitment programs that stress building 'self-efficacy' may unintentionally reinforce the prevailing cultural message that there is a bad fit between female gender and technological aptitude. She goes on to demonstrate an alternative approach that first validates girls' existing interests—especially interests in people-oriented work—and then shows them (and their male counterparts) that these interests fit naturally with SMET careers.

### Introduction

In their 1988 article "Women (Still) Need Not Apply," Margaret Eisenhart and Elizabeth Finkel criticize women in engineering programs for their 'compensatory' approach—that is, for preparing women to measure up to male norms without directly challenging the validity of those norms. Alison Kelly (1987) and J. Whyte, *et. al.* (1985) make a related point about primary school science education, observing that, with the best intentions, science teachers often unconsciously collaborate with boys in the classroom "in a way which [makes] science seem more masculine than it really [is]" (in Whitelegg 378). Beyond the classroom, imagery of SMET in the mass media reinforces the notion that doing science and technology is not only unfeminine but socially isolating as well.

Most of us are aware of these telling criticisms. Yet as we design modern recruitment programs to increase the number of young women entering technological careers, we still often find ourselves unconsciously collaborating against our own goals—trapped in an old conundrum. Do we change the girls to fit engineering, or do we change engineering to fit the girls? Since changing engineering would be a dauntingly difficult and politically radical process—one for which we might receive very little hard or soft money—we

often unconsciously do the former. That is, SMET recruitment programs still tend to treat girls and their socialization as a problem to be solved.

In this paper, we propose a subtle but important paradigm shift. Moving away from an either/or stance (change the girls or change engineering), we argue that girls' existing career interests and skills already constitute a good fit with the interests and skills central to technological practice. In short, technology is woman's work. Girls do not have to sacrifice their interests or alter their gender identity in order to enter technological fields. We need to continually challenge cultural messages that say otherwise. Even more importantly, we need to continually challenge cultural messages that 'naturalize' technological aptitude as a male birthright.

Men are still assumed to be technologically competent until proven otherwise. And women are not. That presumption of male technological entitlement is hard-wired into U.S. culture, and changing it is extremely difficult—especially since we, as putative agents of change, are not any more immune to gender socialization messages than the young women we work with. These messages have special power in contemporary life because they have gone underground and become part of apparently gender-neutral norms. In discourse about science and technology, the default position is always male, always white. In engineering in particular, this colonization of the normal is so pervasive that it is invisible. Difference (implicitly *deviance*) is marked. There are *African-American* engineers and *Hispanic* engineers and *women* engineers. And then there are just plain old engineers. The real ones.

Berkeley sociologist Mike Messner tells a poignant and pointed story about how, when he was 8 years old, he finally cured himself of throwing a baseball "like a girl," for fear of being called a sissy by his father and his Little League peers. Only later as an adult did Messner learn that 'throwing like a girl' is actually a more anatomically natural motion for the human arm. 'Throwing like a man' is a learned action which can, repeated over time, actually seriously damage the arm" (Messner, 46-47). The notion that doing technology is a 'guy's thing' is a similar deeply held delusion—and it, too, does serious damage when repeated over time.

### Gender and Technological Agency

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## on the Screen

When we were growing up in the 1950's, a "woman scientist" was an anomaly; a "woman engineer" was an oxymoron—a contradiction in terms, a freak of nature. Technological agency and masculine identity were so securely welded together that any woman who was good with machines opened herself up to the charge of 'sexual deviancy' or, at the very least, 'sexual dysfunction'. Heddy Lamar, Lillian Gilbreth, and Rosie the Riveter were exceptions, but they merely proved the rule. The gorgeous Lamar kept her engineering interests under wraps; the efficient Gilbreth was lauded for her fecundity, not her brains; and the muscular Rosie was shipped back to her Levittown kitchen at the end of WWII.

Despite the equation of masculinity and machine-power, images of women and machines are not entirely absent from Postwar U.S. popular culture, however. Indeed, they had to be there to maintain the prevailing belief system. Deviance and wrong thinking always need to be at least minimally visible in order to be recognized and condemned. In this sense, images of the deviant Old Maid scientist/engineer are not merely consonant with the masculinization of science and technology; they help to create that masculinization in the first place. In 1950's iconography, hyper-feminine women are klutzy children who can never figure out how machines work (Lucy Ricardo in the candy factory, for instance). Women who can figure out how machines work are unfeminine—i.e., wear glasses, have severe hair-dos, and lack husbands. These two stereotypes working in tandem constitute a powerful regulatory fiction—a fiction that not only keeps women in line but polices male gender codes as well. Technological competence becomes a visible guarantor of an invisible inner state that is otherwise impossible to prove: that one is a real man. He *is* because she's *not*. (Lorber, 186-187)

Regulatory fictions always contain traces of the very point of view they are designed to suppress, however. For example, in his 1950 novel *I, Robot*, SF writer Isaac Asimov describes robotics expert "Susan Calvin" as "a frosty girl, plain and colorless, who protected herself against a world she disliked by a mask-like expression and a hypertrophy of intellect"—words almost identical to James Watson's vicious caricature of real-life crystallographer Rosalind Franklin. (Roberts 280; Sayre 188-193) And yet, just as Franklin was the secret source of Watson's Nobel prize-winning discovery, Calvin is the secret "I/eye" of *I, Robot*—a superior female 'machine' that threatens male hegemony. She is the novel's Einstein—and its Sherlock Holmes as well. She has much more technological agency and social power than most women characters in the Doris Day culture of the 1950's.

The 1957 Spencer Tracy-Katherine Hepburn comedy *The Desk Set*, the first Hollywood film to feature a computer, contains a similarly problematic female figure. Hepburn's character, "Bunny Watson," is a corporate

research librarian with an encyclopedic memory. Her rival for Tracy's attention is a super-computer called EMERIC ("Emmy"). Like Asimov's Calvin, Watson is a pathetic Old Maid. And yet she is also a kind of superior 'thinking machine' who destabilizes male rule. Metaphorically, she is associated with Thomas Watson's real-life computer ENIAC (programmed by 'Amazing' Grace Hopper) and with John Watson's master, Sherlock Holmes. Surprisingly, the film's happy ending allows Bunny to get her man without sacrificing her career. She and 'Emmy' join forces. Unfortunately, their common enemy is another Old Maid scientist, so the dominant paradigm is re-enforced after all.

The disjunction between women and technological mastery that characterized U.S. culture in the 1950's and 1960's seemed to break up in the 1980's and 1990's. Career opportunities for women in the professions opened up, and gender roles seemed to be changing as well. The stereotype of the Old Maid scientist never really died, however. Consider, for example, Sandra Bullock's role in the 1995 film *The Net*. Bullock plays "Angela Bennett," a free-lance computer programmer who specializes in troubleshooting bugs and virus problems. She is the kind of character who would have been unthinkable in the film iconography of the 1950's—a geek girl action hero. Because it tends to *reverse* traditional gender roles without really *transforming* those roles, however, *The Net* provides little encouragement for young women who are potentially interested in technology. Angela triumphs over the male villains who threaten her, but she remains socially isolated. Her skill, bravery, and technological agency are represented as dangerously neurotic—and as incompatible with heterosexual family life. She ends up living with her mother!

Jodie Foster's portrayal of the pioneering scientist/space explorer "Ellie Arroway" in Robert Zemeckis' 1997 epic *Contact* is usually seen as providing a much more positive role model for girls interested in science and technology. Upon closer inspection, it, too, turns out to be a discouraging step backward, however. Unlike Angela Barrett, Arroway is united with Mr. Right at the end of the story. Unfortunately, it is *his* faith in her (rather than her faith in herself and the scientific method) that ultimately validates her identity. She is a technological Cinderella saved from bitter Old Maidhood by a very conventional Prince Charming.

Ellie Arroway is a sanitized version of a female character that has begun to appear with increasingly frequency in recent SF/horror films: the Hot Babe Scientist. Once again, the 'just add women and stir' approach is deceptive, however. Despite her p.c. exterior, the contemporary Hot Babe Scientist often conveys the very same messages about the gender of science/technology that her Old Maid counterpart did. For example, "Allegra Geller" (Jennifer Jason Leigh) in the 1997 film *eXistenZ* seems to be anything but a scientist Old Maid. Blond, beautiful, and sexy, Allegra is a technological superstar, a cybergoddess. Like most the characters Jason-Leigh plays, however, Allegra is subtly neurotic as well. She turns out to be an Ice

Princess, and technology is her igloo. In short, the character of Allegra shatters one stereotype (girls can't do computer science), only to shore up another one (computer scientists are isolated loners).

With role models like Allegra, Ellie, and Angela, it is not surprising that so many young women are still ambivalent about careers in SMET fields. The double messages they see in popular culture narratives combine with the double binds they experience in their lives to make them understandably wary of going where so few women have gone before. There are a few sources of encouragement, however, particularly TV's *Star Trek: Voyager* series. In *Voyager*, technology is women's work: both the star ship captain and the two chief engineers are female. Even more importantly, in *Voyager* technology is people work. Science and engineering are presented contextually, as part of a rich tapestry of human relationships between women and women and between women and men.

The show got off to a shaky start. Looking back at the 1995 pilot episode, *Caretaker*, it is clear that the series' male co-creators, Michael Piller and Rick Berman, still viewed the notion of a female scientist/captain as a contradiction in terms. They fell back on an old formula—the postwar Career Gal. The actress they chose to play “Captain Katherine Janeway,” Kate Muldrew, is the spitting image of Hepburn circa 1957—her long red hair coiled atop her head in a tight bun, exactly as Hepburn wore it in *The Desk Set*. Everything about her is tight, in fact—her rigid military posture, her terse instruction to a crew member not to call her “sir” or “ma’am.” The message is unmistakable: technological agency requires both isolation and androgyny.

Using input from female fans, producer Jeri Taylor and others have gradually re-tooled *Voyager*'s gender design, however. Seven years later, Captain Kate has acquired a new hairdo. The bun is gone. Her hair falls softly just above her collar in a style that is at once pragmatic and traditionally feminine. She has acquired new relationships as well, including a latently sexualized friendship with her first officer, Chakotay. In a recent episode, Janeway and Chakotay relax together in her quarters. He brings the wine. She ‘fixes dinner’—by using a screwdriver to repair the malfunctioning food simulator! Her technological competence is rarely foregrounded in the new *ST Voyager*. It is simply assumed. It is a natural part of her womanly competence.

### Strategies for Change

Aside from supporting *Star Trek: Voyager*, there is very little we can do directly to change the way in which the mass media represents technological activity, but there are a number of things we can do to mute the effect of those representations on young women (and young men). First,

we can more sensitively monitor our communications with girls and young women for unconscious messages that mark them as a ‘problem to be solved’. We can find wry ways of exposing the hyper-masculinization of science and technology as a visible, and risible, delusion. We can forge stronger cross-disciplinary alliances between WEPAN program-developers and specialists in the analysis of mass media texts and images---and with the primary designers of those texts and images. More importantly, we can work together to develop new pedagogical techniques to better equip young girls and boys to be ‘resistive readers’ of technological images in the mass media.

There is another important strategy shift we can make as well: We need to continually update research to establish what interests girls and young women today and then design SMET recruitment materials to ‘go with the flow’ of those existing interests. In particular, we need to re-shape and disseminate career-counseling materials for both young women and men that present SMET career aptitude in terms of ‘people skills’.

### Rethinking Gender and Technological Agency in Career Guidance Programs

Sex-role stereotyping; the masculine image of the profession; and the lack of role models, self-confidence and self-efficacy have all been identified as factors contributing to the under-representation of women in science and engineering (Blaisdell, 1995; Bogue, et al., 1998; Campbell & Metz 1986; Ginorio, 1995; Hossler, et al., 1989; Kimweli & Richards, 1999; Manis, et al, 1993; Seymour & Hewitt, 1994; Stephenson & Burge, 1997). The colonization of SMET by males has resulted in an organizational culture where masculinity is the “norm”. Skills, aptitudes, personalities and characteristics defining SMET are male – not because they are absolutely necessary for the job but rather because certain males have so dominated the field as to claim it for themselves. Is it any wonder that girls and women (and some men) have felt disconnected from SMET?

During the past 25-30 years, there have been a number of efforts by higher education, government, business and professional societies to address the under-representation of women in science, engineering and technology. Women in Engineering Programs have sponsored a number of initiatives specifically designed to attract women to engineering careers. And indeed the percentage of women enrolling in engineering majors increased dramatically in the 1970's and 1980's. Then, we reached a plateau. Enrollments for women in engineering have hovered around 19% over the last 5-6 years. We need to explore new paradigms that go beyond changing women.

Most of the programs and initiatives designed to recruit and retain women in engineering majors focus on showing women that they can develop the skills and self-confidence they need to succeed in technological majors and careers. In

other words, there is a tacit assumption that women are lacking something. We work particularly hard to improve women's self-efficacy as it relates to SMET. The self-efficacy model theorizes that an individual's belief that she can successfully perform a given task or action influences whether she will attempt it and be successful. (Zunker, 1998) We've assumed that if we can raise young women's self-efficacy as it relates to technological careers, they will enter the majors, persist, and be successful.

Hackett and Betz (1981) first explored the applicability of self-efficacy to career development for women. They noted that women's socialization and learning experiences "are often such that strong internal barriers develop which restrict their range of options." Boyd (2000) suggests that women may self-select themselves out of career choices because they perceive they are too "masculine" or believe that they are unable to perform well enough to succeed.

Theorists have identified four sources of information that contribute to one's sense of efficacy: (1) past performance accomplishments (I have done this before and I was successful); (2) vicarious learning (I have seen other females like me do this); (3) encouragement and support (I can do this because she says I can); (4) psychological arousal (This is not hard and it does not scare me). (Boyd, 2000)

We, therefore, can build women's self-efficacy by having them successfully perform certain tasks, by showing them other women who have succeeded, by providing them with encouragement and support, and/or by alleviating their anxiety about technology. But what about those images and perceptions that we are not addressing? Are we inadvertently accepting the "maleness" of the profession as norm and then "working" with women to show them how they can "fit" that norm?

Women often cannot "see" themselves in technological careers. They have "conflicting future images" of themselves. They perceive a "clash" between "images projected in the field" and their own "desired future images." (Packard and Wong, 1999) In interviews with college women who had completed two years of college science, Packard and Wong found that:

Students questioned if they were in the right field because they were unable to identify images that were consonant with their desired future images. Specifically, the students' positive image of being 'collaborative' clashed with the field's negative projected image of being 'competitive', the positive image of 'combining family and career' clashed with the negative projected image of 'being childless and unbalanced', the positive image of scientific work as 'contributing to society' clashed with the negative projected image of scientific

work as done 'for the money or sake of science.'

These women were reluctant to give up who they are and what they want in order to pursue SMET majors. Again the images and perceptions of the professions are those perpetuated by the colonizers of SMET professions – competitive, isolating, and masculine. None of these images are intrinsic to the professions themselves. Individuals in SMET are collaborative as well as competitive; they do combine family and career; and they do contribute to society as well as make money. The imagery is the problem, not the individuals or the professions.

We must continually explore what young women want from a career, what is fun for them, what is challenging. It is only then that we can show them if and how their interests and aspirations "fit" with SMET majors and careers. They need not change. The images and perceptions need to change. Women and men require more complete and accurate information about SMET professions that counters persistent distortions prevalent in the mass media.

How do we do this? By focusing on women's own interests, skills, aspirations, and dreams. At NJIT we are using a different "pitch" to high school girls in our new women's brochure. We are asking young women to tell us what they care about, what they like to do for fun, and what interests they wish to satisfy in terms of majors and careers. We then propose to show them how they can satisfy those interests and future aspirations at a technological research university. In the same way, we believe we can ask young women the kinds of things they want from a career and then show them how SMET can satisfy those needs and interests.

Ceel Pasternak and Linda Thornburg have written a series of books that we believe provide a good model for doing this. Two books in particular target the young women we are discussing: *Cool Careers for Girls in Computers* and *Cool Careers for Girls in Engineering*. They specifically address the issue of interests and lifestyles:

We all want to do work we enjoy and to make a good living at it...Your career path will no doubt take many turns as you follow your talents, interests, and opportunities. Because your future includes more than work, you need to think about lifestyle choices, and how these will complement the type of work you do. (*Cool Careers for Girls in Computers*)

Here we can see the introduction of the idea of girls following their interests and talents while considering computing careers. The authors do not acknowledge the imagery of the profession that might perpetuate the belief that this is a career young women would not be interested in but, rather, ask young women to explore the profession to see if it "fits" their talents and interests.

They also speak to interests that challenge the stereotypes surrounding engineering:

Engineering offers many options for careers, many rewards, and is just plain fun. If you like working with people, or exploring ways to do things faster and better, then engineering may be the career for you. (*Cool Careers for Girls in Engineering*)

In this paragraph, the authors counter masculine imagery associated with engineering without giving that imagery a voice. Instead, they correct the distortions by letting girls (and boys, too) know that engineering is fun and involves working with people.

Each book includes the stories of several women in the profession as well as advice on how to get started on a career path, recommended readings and professional groups you can contact. What is most relevant is the Career Checklist for each career. For example, in the story of a female mechanical engineer and entrepreneur, the checklist notes:

- You'll like this job if you...
- Like Mathematics
- Are not easily discouraged
- Are a good judge of people
- Have a positive attitude
- Have a work ethic, are self-motivated
- Will learn what you need to know

Some of these attributes and interests are not ones normally associated with mechanical engineers, i.e. the connection with people. They also avoid the "imagery" that may turn off some women, i.e. working in plants and factories which is just a function of where you work not what you do. Another for a computer engineer states:

- You'll like this job if you...
- Are independent and curious
- Are willing to ask lots of questions
- Know how to use your voice to speak up  
and make your opinion known
- Like to be on the cutting edge of ideas  
and technology
- Love to figure out how to make creative things
- Like to work with others and on your own

Again, we see the job described in terms of interests (being creative; working with people) instead of structures (machines, buildings). The imagery that represents where and how one performs a job is replaced with why one performs a job.

The authors use the same technique for their computer book. The checklist for an instructional technologist proposes that:

- This career is for you if you...
- Can think of better ways to do things
- Like to make things that are useful
- Like to use technology to help people
- Are good at listening to people and asking  
questions
- Like to travel

The imagery of technologists helping people, listening to people, and making things that are useful offers a broader

view of working with computers than the dominant imagery of isolation and programming. And for an internet communicator:

- This career is for you if you...
- Love people and can motivate them
- Are a risk taker
- Are creative and visual
- Are fascinated with new ideas and new trends

The images of creativity and people are once again central to the essence of this position. The "norms" associated with these professions are changed, and they are no longer the male-dominate ones of the SMET colony. They are expanded and more inclusive of women and men.

Career interest inventories, like John Holland's theory of types, match an individual's characteristics and personalities with those of individuals already in specific occupations (personality-environment fit). "People express themselves, their interests and values, through their work choice and experience." (Sharf, 1997) Holland identifies six types of individuals and work environments: realistic, investigative, artistic, social, enterprising and conventional. Studies have shown that men are more likely to score high on realistic, investigative or enterprising scales that identify individuals who would rather work with things than people, who search for solutions to problems through mathematical and scientific interests and competencies, and who are interested in acquiring wealth; women are more likely to score high on social, artistic, and conventional scales that identify individuals who are creative, who would rather work with people than things, and are detail-oriented. Occupations such as computer science and engineering are more likely classified as realistic or investigative types of occupations. (Zunker, 1998) So we can see that more men than women would be a "match" for these careers.

The problem is not in the classifying of men and women but rather in the classifying of computer science and engineering. Both professions are portrayed as much too one-dimensional. As we see in Pasternak and Thornburg's books, women in computer science and engineering classify their professions as creative, people-oriented, helpful to individuals and society. These professions work across the artistic, investigative, realistic, conventional, enterprising and social categories. They have been classified as realistic/investigative because the particular individuals who colonized these professions were realistic/investigative people. However, that is a limitation of a false norm. The professions in and of themselves require more than realistic and/or investigative types of individuals.

The next step for us, we believe, is to develop materials and programs that will allow us to change how we recruit. Let's find out what women want from a career, what they enjoy doing, what excites them, what is important to them. Then, let's challenge the current classifications and descriptions of SMET professions. WEPAN should work with women and men in the professions to develop materials that provide girls and young women, guidance counselors,

teachers, and parents with complete and accurate information about SMET careers. It is important that we provide girls and women the opportunity to consider all options. To do so, we must develop new imagery and help establish new norms for SMET careers.

[Note: The version of "With Best Intentions" presented here is an excerpt. The full text is available from the authors.]

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