

EVOLUTION OF GENDER ROLES
PORTRAYED IN THE ADVERTISEMENTS OF *PHYSICS TODAY*

by

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Abstract

The way people are portrayed within advertising images conveys implicit and explicit assumptions about the roles in which people partake. These assumptions can be particularly thought provoking when issues of gender differences are taken into account. While many studies have examined various categories of media images by gender, little work has been done in the area of physics, particularly looking at the advertisements used to sell products to physicists. This study used a combination of quantitative and qualitative techniques to examine the portrayal of men and women in the advertisements published in *Physics Today* in 1955, 1970, 1985, and 2000. The quantitative analysis looked at trends in the representation of men and women in advertising images while the qualitative analysis identified thematic roles constructed by the images over time. Advertising images predominantly pictured males, although women appeared roughly in line with their representation within the physics community. Physicists were typically portrayed as men working independently and in isolation. Men who were not portrayed in physics roles were often depicted in entertaining and skillful roles. In contrast, women were portrayed in many physics roles ranging from support staff to students to part of a team to professional scientists. When not participating in science, women's images often objectified their appearances, emphasizing looks alone. These results challenge the physics community to consider what stereotypes we may possess as a community or at least what stereotypes are held about this community. If we want more women to be represented among the physics community, then we must address underlying assumptions about the roles that women can and should take as physicists.

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Evolution of Gender Roles Portrayed in the Advertisements of *Physics Today*

Women and minorities are severely underrepresented in the physical sciences and engineering, particularly in the area of physics. While female students make up almost half of the students taking high school physics in 1997, the AIP Report on *Women in Physics, 2000* shows that the numbers drop quickly as you proceed up the academic ladder (Ivie & Stowe, 2000). Women currently go on to earn about 19% of the physics bachelor's degrees and only 13% of the physics Ph.D. degrees and as of 1998, women held only 3% of the full professor positions in physics.

These low representation numbers, the so-called "leaky pipeline," are attributed to a variety of potential causes and subsequent issues in the literature. Studies have been conducted to examine the climate for students, particularly female students, at both the graduate (Dresselhaus, Franz, & Clark, 1995) and undergraduate levels (Schneider, 2001; Whitten, Foster, & Duncombe, 2003). Reviews (e.g., L. McCullough, 2001) have been published that bring together many of the issues related to this problem. Researchers have examined the impact of introductory curriculum on female students (Duch, Onn, & Cuddy, 1997; Laws, Rosborough, & Poodry, 1999) and specially designed assessment tools (McCullough, Foster, & Heller, 2000) that attempt to take into account the interests and experiences typical of female students.

In addition to these commonly discussed problems, messages about the acceptable roles for the different genders as conveyed by the media may also contribute to this problem. Stereotypical images of scientists have been found to be well established and hard to change already at a very young age (Buck, Leslie-Pelecky, & Kirby, 2002), but may continue to influence people's perceptions throughout their adult careers. M. Barbercheck (2001) conducted

a study of all pictorial advertisements (size > 1/3 page) found in *Science* from 1995 to 1997 (N = 4,070). She looked at the frequency of occurrence of images by gender and by race and completed a thematic analysis of the portrayals of people. Her analysis of the portrayal of people resulted in a typology of the stereotypes appearing within the images. This typology included (1) the hero, (2) the nerd, and (3) men at work and play. The themes related to the portrayal of women that emerged from her analysis were categorized as (1) science made simple, (2) women at work and not at play, and (3) mother nature. While some informal work has been done to examine the images within the main publication for the physics community (Geller, 2003; McCullough, 2003), no systematic analysis of the advertising images used in such a journal has been published.

Pictorial representations of people found in advertisements in physics journals such as *Physics Today* may play a two-fold role in the process resulting in the leaky pipeline. These images may reflect the current (at time of publication) expectations of the physics research community since they are developed by advertisers to reach the members of this community. In addition, they may convey images of what it means to be a member of this community to potential future community members. While these messages may not be explicit or conscious, they may convey implicit assumptions about the role of men and women within the physics community.

By examining the pictorial images of people used within *Physics Today* over the past five decades, the purpose of this study is to uncover and examine the evolution of the roles of men and women as constructed through advertisement images from the 1950s to the present.

Methods

Research Design

The overall design of this project followed the conceptual framework of the multiple case study design (Creswell, 1998) combined with the analytic strategies reported by Barbercheck (2001). Stake (1995) and Creswell (2002; 1998) describe a case study as an in-depth investigation of a bounded system composed of individuals or representing a process. In a multiple case study, several cases are studied to provide insight into the central phenomenon. In this study, each of the four sampled years of publication represented a case and they were analyzed separately. Once the individual case analyses were finished, a cross-case analysis was completed to look for trends across time.

Research Questions

The central question addressed in this study was: What roles for men and women have been constructed through advertisement images found in *Physics Today* from the 1950s to the present? The subquestions addressed included:

How many advertisements used pictorial images representing people?

How is gender represented throughout these ads?

How does the gender representation change through time?

What roles are conveyed by the pictorial images?

How do these roles change with time?

How do these roles change with gender?

Sample

Four cases were selected as part of this study, where each case represented a calendar year of published issues of *Physics Today*. *Physics Today* was first published in 1948. This study began with the examination of the issues from the 1955 volume. This year was selected as the starting point due to its accessibility (that year was represented in its entirety in the author's library) and the belief that enough time had past since its debut so that the journal would be established and into a routine. The remainder of the sample was selected using a fifteen-year interval, resulting in the selection of the publication years of 1955, 1970, 1985, and 2000.

Once the four cases were identified, the sample comprised the advertisements using pictorial images within the twelve regular issues published during the selected years (a total of 48 issues). The special "Buyer's Edition" supplement was not included since it only occurred during the years of 1985 and 2000 and did not exist during the earlier years found in the sample.

Quantitative Data Collection and Analysis

Once the pictorial advertisements with human images were identified, each was photocopied for analysis purposes. The unit of analysis for this project was individual advertisements. Each individual advertisement was rated on the eight characteristics specified in Table 1. If an advertisement was used multiple times, each occurrence was coded separately. In cases where multiple images and/or activities appeared within a single ad, the advertisement was coded based on the author's judgment of which aspect was the main feature. Therefore, each individual advertisement received a single coding on each of the specified categories. All categories except "type of human image" were applied only to those advertisements that included an identifiable person (more than a hand or other body part).

Table 1. Categories used to code each individual ad.

Characteristics	Coding Categories
Type of human image	Person(s) Hand(s) only Body part (e.g., an eye)
Number of males portrayed	Number (range: 0 – 21)
Number of females portrayed	Number (range: 0 – 5)
Number of probable non-Whites portrayed	Number (range: 0 – 4)
Size of ad	Measured in units of pages (range: 1/6 – 3)
Ad purpose and/or type of product	Scientific hardware and software Job recruitment Educational materials Publications Other (e.g., charity, public awareness, or professional organizations)
Primary profession of person(s)	Physicist/ Scientist Technical/Office support Educator/Student Other (e.g., race car driver)
Primary activity in which person(s) is engaged	No activity Working with equipment Writing/Thinking/Problem solving Communicating Leisure/Sports/Walking

Qualitative Data Collection and Analysis

In Barbercheck's study, human images were initially coded based on predetermined gender stereotypical representations such as the "nerd" and the "hero". It became obvious at the beginning of this study that those predetermined categories, along with other categories that emerged from her data analysis, would not be appropriate for the advertisements from *Physics Today* spanning the 45 years included within the sample. Therefore, instead of starting with any predetermined categories, this analysis used inductive thematic analysis strategies to develop categories representing the human images found in the ads. For a given sampled year, advertisements were divided into two categories: those containing only male images and those that included female images (either alone or in combination with male images). All advertisements within a given category (male only or including females) were displayed at once by spreading the photocopies out in a room. Advertisements judged to be portraying human images that conveyed similar roles were grouped together. For example, if a number of advertisements portrayed cowboys engaged in various activities, then these advertisements were grouped together to form a "cowboy" or "wild west" theme. Once thematic categories were identified for each case, then a cross-case analysis was completed. The identified roles were examined across the years to look for overarching trends. This cross-case analysis resulted in the identification of major categories that transcended the sampled time.

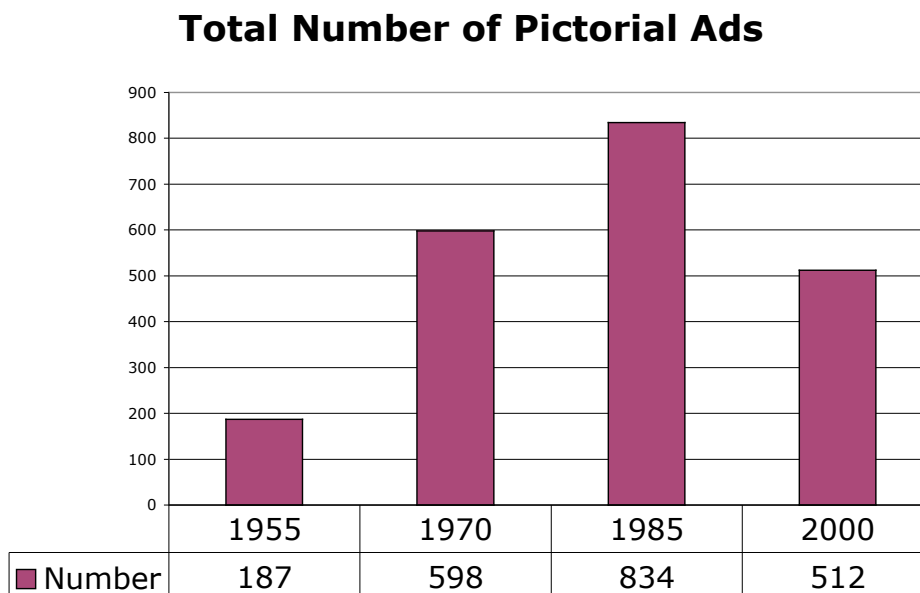
Results

Quantitative Results: Use of Human Images in Advertisements

Across the four selected years, a total of 2,131 pictorial advertisements were identified from the 48 issues of *Physics Today*. The break down of this total by year is shown in Fig. 1,

with 1955 having the fewest pictorial advertisements (187) and 1985 the greatest number (834). This histogram shows that the total number of advertisements using pictorial images generally has increased with time since 1955, but the drop in 2000 may indicate a decrease or leveling off of the number.

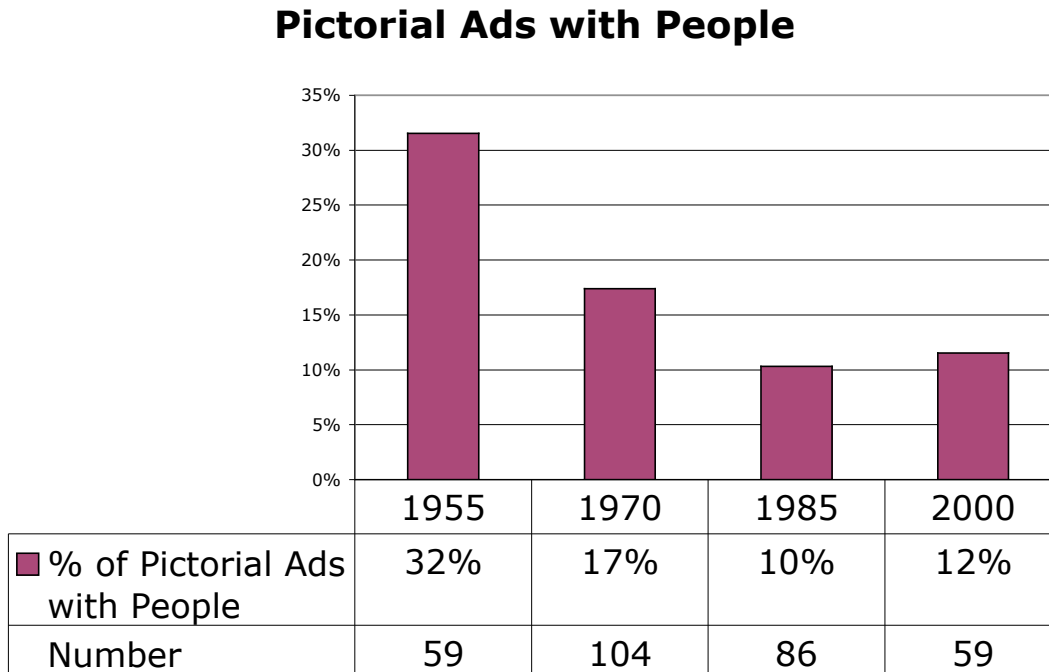
Fig. 1. Total number of pictorial advertisements identified in each sampled year.



Only 411 of the 2,131 pictorial advertisements included some kind of a human image, for an overall percentage of 19%. In comparison, Barbercheck found 27% of the pictorial *Science* advertisements depicted human images. As shown in Fig. 2, the percentage of pictorial advertisements that included the image of a person or persons ranged from 32% in 1955 to 10% in 1985. Whereas the total number of advertisements has generally increased with time, the inclusion of people has generally decreased. Most pictorial advertisements that did not include a human image typically included the image of a piece of equipment. The majority of

advertisements that included a human image depicted an identifiable person (75% overall), but a large number simply included a hand or body part, such as an eye. Since this study is interested in the portrayal of *people* within advertising images, the subsequent analysis was based only on the advertisements that included a person or persons and did not include advertisements with only a hand or gender-neutral body part.

Fig. 2. Percentage of all pictorial advertisements that included images of people.

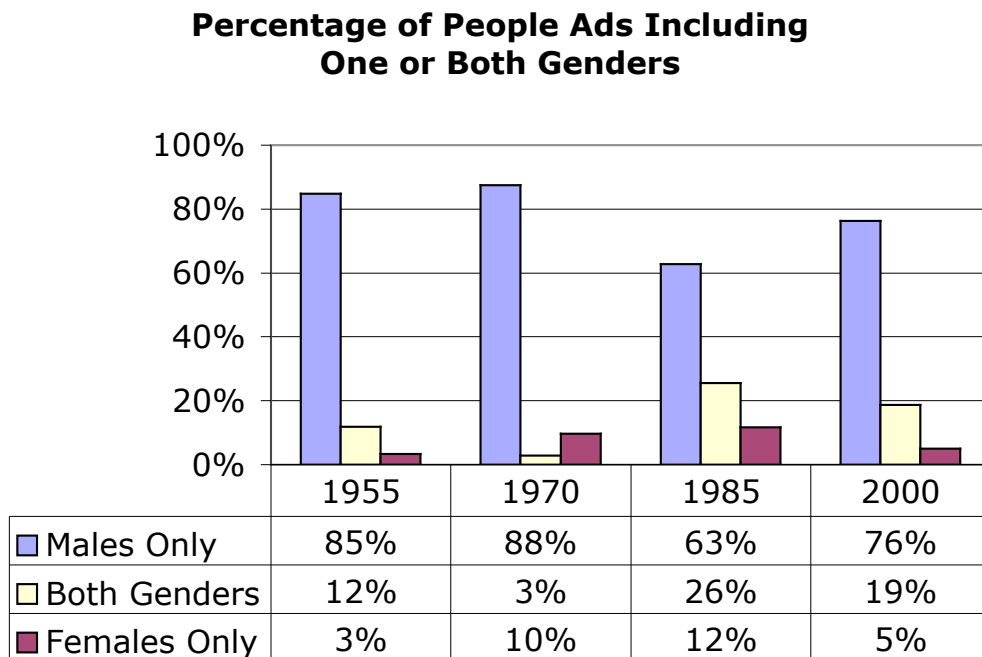


Quantitative Results: Breakdown by Gender

Representation of males and females within the ads. A total of 308 advertisements were identified that included the image of a person or persons. The greatest number of advertisements with people was found in 1970 ($n = 104$), followed by 1985 ($n = 86$), and by 1955 and 2000, which both had 59 advertisements using pictorial images of people. Fig. 3

summarizes the breakdown of these advertisements by gender categories of 1) advertisements depicting males only, 2) advertisements depicting both females and males, and 3) advertisements depicting females only. A total of 240 advertisements were found that depicted only male persons, which is 78% of all advertisements depicting people. In contrast, only 25 advertisements (8% of all people ads) were found that depicted only female persons and 22% of the advertisements included at least one female person (including those advertisements that pictured both male and female persons).

Fig. 3. Breakdown of people advertisements by gender.



To further gauge the representation of the genders within the ads, the average number of males and females pictured in all the advertisements including people was computed. The average number of males pictured per individual advertisement ranged from 1.4 in 1985 to 2.9 in 2000. In comparison, the average number of females pictured per advertisement ranged from 0.2

in 1955 and 1970 to 0.6 in 2000. In addition, the mean size of the advertisements was calculated for advertisements that included only males and those that included females (either with or without males). The mean size of advertisements with males only was 0.82, 0.83, 0.98, and 0.78 (all in units of a page) for the years of 1955, 1970, 1985, and 2000. When considering the advertisements that included females, the respective mean sizes were 0.68, 0.87, 0.92, and 0.79, respectively - virtually the same average size as the advertisements including only males. Gender portrayal made no meaningful difference in the size of the advertisement.

Representation of non-Caucasians within the ads. Although this study was focused on the representation of the genders within *Physics Today* advertisements, the presence of non-Caucasians was also noted in an attempt to examine the representation of ethnic-minority groups. The number of people advertisements that included identifiably non-Caucasian individuals is summarized in Table 2. This number ranged from 0 advertisements in 1955 to 14 in 1985 (16% of advertisements with people for that year) and included individuals of Asian, African American, and Hispanic ethnicities. It must be noted that identifying a person's gender from an image is generally straightforward, but that this is not the case with identifying racial demographics. These values should not be considered as precise, but simply as indicating an overall low representation of ethnic minorities within the advertisements of *Physics Today*.

Table 2. Representation of racial diversity within the ads.

	1955	1970	1985	2000
Number of advertisements including non-Caucasians	0	12	14	8
Percentage of people advertisements including non-Caucasians	0%	12%	16%	14%

Purpose of the ads. Using the coding categories listed in Table 1, each advertisement was coded for the intended purpose of the ad. This judgment was determined by identifying the overall purpose of the advertisement (i.e., to sell a piece of equipment or to recruit applications for a position). The results of this analysis for advertisements with only males and those including females are shown in Table 3. There are a few striking trends in these results. Most of the 1970, 1985, and 2000 advertisements including people (males and/or females) were created with the purpose of selling scientific equipment. The other dominant category was that of job recruitment, which accounted for 80% of the advertisements using males only in 1955 and nearly 50% of the advertisements including females in 1985. These recruitment trends may indicate natural fluctuations in the job market since the other years had relatively few advertisements depicting people for the purpose of job recruitment. It is also interesting to note that advertisements for educational materials only appeared in the earlier years (1955 and 1970) and almost always included the depiction of females.

Table 3. Purpose of the advertisements reported as percentages of all pictorial advertisements with people.

	1955		1970		1985		2000	
	Males Only	Females	Males Only	Females	Males Only	Females	Males Only	Females
Scientific Equipment	16%	11%	95%	77%	72%	53%	58%	71%
Recruitment	80%	33%	1%	0%	18%	47%	9%	7%
Educational Materials	0%	11%	4%	23%	0%	0%	0%	0%
Publications	2%	0%	0%	0%	4%	0%	20%	7%
Other	2%	45%	0%	0%	6%	0%	13%	14%

Activities portrayed by gender. The activities in which people were shown to be engaged in the *Physics Today* advertisements fell within four broad categories: (1) no activity (person not shown doing anything but posing), (2) working with equipment, (3) leisure and sports activities, and (4) communicating, writing and/or thinking. Table 4 shows the percentage of the advertisements that fit each category for those including only males and all those that included females. Most of the advertisements depicted people (males and females) either working with equipment or not engaged in any activity. Most notable results included the high percentage of advertisements including females depicting no activity in 1970 (69% of the advertisements with females) and those including only males depicting no activity in 2000 (58% of the advertisements with males only).

Table 4. Activities in which advertisements portrayed people engaged as percentages of all pictorial advertisements with people.

	1955		1970		1985		2000	
	Males Only	Females	Males Only	Females	Males Only	Females	Males Only	Females
No Activity	2%	33%	41%	69%	35%	50%	58%	14%
Working with Equipment	56%	33%	42%	31%	48%	44%	24%	50%
Leisure/ Sports	20%	33%	9%	0%	4%	0%	16%	14%
Talking/ Writing/ Thinking	22%	0%	7%	0%	13%	6%	2%	21%

Qualitative Findings

While the quantitative data are interesting and convey the frequency of the advertisements and a superficial summary of the content of the ads, they do not describe the images contained within the advertisements or give a sense of the roles constructed by these images. These roles emerged through a thematic analysis of the human images that appeared within each year and the identification of thematic categories that transcended the four sampled years. The three identified categories for males portrayed within advertisements were *the physicist alone in the lab*, *the expert*, and *men at play*. The portrayals of females included *changing scientific roles* and *pretty to look at*. Each of these categories is briefly described below including sample images to illustrate each of the thematic categories.

Men: Physicist alone in the lab. The most dominant thematic category that emerged from the 308 advertisements depicting people was the physicist alone in the lab. These advertisements portrayed male, usually Caucasian, physicists working alone with scientific equipment. Samples of advertisements making up this category are shown in Fig. 4. Note that these samples are indicative of a whole set of advertisements within this theme. In fact, 38% of all the advertisements with people ($n = 117$) fit this category and 49% of the advertisements that included only males depicted male physicists alone with their scientific equipment. Even in cases where multiple male images appeared within a single ad, each male was usually depicted in a separate panel. These advertisements convey an image of physicists working independently and in isolation with little to no sense of them working together with colleagues. The images contained in these advertisements were very uniform across the years with only the haircuts and available technology changing, but the overall constructed role remaining virtually unchanged.

Fig. 4. Sample advertisements conveying an image of physicists alone in the lab.

(a)

(b)

(c)

(d)

- a: (1955, May). *Physics Today*, p. 37.
- b: (1970, March). *Physics Today*, p. 22.
- c: (1985, October). *Physics Today*, p. 114.
- d: (2000, October). *Physics Today*, p. 88.

Note: Images are not displayed in this file due to copyright protection.

Men: The expert. Next to the images of male physicists alone with their lab equipment, the other major theme formed by the images of males within the advertisements was that of the expert. The images making up this category included pictures of famous and/or easily identified physicists. These images often included historical photos and were printed in grayscale even when color advertisements were common. It was also common to show a key researcher affiliated with the company in the advertisement. Typically these images did not depict the person engaged in any activity and instead showed the expert as if posing for the camera (see sample images in Fig. 5). All images judged to be conveying this sense of individual expertise and authority depicted male physicists. This category included 13% of all the advertisements with people ($n = 40$) and 16% of the advertisements that only included males.

Fig. 5. Sample advertisements conveying an image of the expert.

(a)

(b)

a: Woo. (1970, January). *Physics Today*, p. 6.

b: Bohr. (1985, December). *Physics Today*, p. 67.

Note: Images are not displayed in this file due to copyright protection.

(c)

(d)

c: Einstein. (2000, March). *Physics Today*, p. 45.

d: Hubble. (2000, June). *Physics Today*, p. 53.

Note: Images are not displayed in this file due to copyright protection.

Women: Changing scientific roles. While 65% of the advertisements depicting only males fit neatly within two thematic categories, the roles constructed by the images of women were more diverse. These different roles are depicted in the collage of images presented in Fig. 6. Women were portrayed as support staff in 1955 (n = 4 ads), students in 1970 (n = 3), part of a research team in 1985 (n = 13), and as scientific professionals in 1985 and 2000 (n = 21). These images show a general trend to more professional and scientific roles for women with the progression of time. However, these roles were not always empowering and positive. For example, in 1985 there was a set of advertisements (n = 5) portraying women using scientific equipment, but the intention was to convey how simple the equipment was to use – conveying a sense that it is so easy even a woman can do it (See Fig. 6, panel c for an example). Likewise, while it is positive to find women professionals portrayed as working as part of a team, it stands in contrast to the large number of images that show male physicists working alone.

Fig. 6. Sample advertisements conveying the changing roles of women.

(a)

(b)

(c)

(e)

(d)

- a: Support. (1955, August). *Physics Today*, p. 33.
- b: Student. (1970, June). *Physics Today*, p. 14.
- c: It's so easy. (1985, November). *Physics Today*, p. 89.
- d: Part of the team. (1985, July). *Physics Today*, p. 118.
- e: Professional. (2000, June). *Physics Today*, p. 16.

Note: Images are not displayed in this file due to copyright protection.

Men: Men at play. Advertising images did not always picture people in the act of working in scientific endeavors. Many advertisements (22% of those with males only) also tried to sell products using flashy images from broader aspects of life including sports and recreational activities. When men were portrayed partaking in non-scientific roles, they were usually actively engaged and having fun. As demonstrated in Fig. 7, men at play included being a cowboy (n = 4) in 1955, racing (n = 7) in 2000, participating in other professions like exploring a jungle (n = 5) in 1985, or even kicking back with a cigar or drink with some hip friends (n = 10) in 1970. In some sense, these images convey powerful and skilled activities in which males participate and construct meaningful analogies for the characteristics valued and used by physicists.

Fig. 7. Sample advertisements conveying an image of men at play.

(a)

(b)

a: Cowboys. (1955, July). *Physics Today*, p. 23.

b: Swingers. (1970, June). *Physics Today*, p. 0.

Note: Images are not displayed in this file due to copyright protection.

(c)

(d)

c: Other professions. (1985, May). *Physics Today*, p. 81.

d: Racers. (2000, January). *Physics Today*, p. 12.

Note: Images are not displayed in this file due to copyright protection.

Women: Pretty to look at. Advertisements picturing women in non-scientific roles often emphasized the physical appearance of females and put females into passive and diminutive roles. As illustrated in Fig. 8, females were portrayed in roles of little girls ($n = 5$) in 1955, as babes or sexual objects ($n = 5$) in 1970, and as artwork ($n = 5$) in 1985. In the advertisements of 2000, women were not obviously objectified in the advertising images, they were just at the mall shopping. These passive roles portrayed for women accounted for 25% of all the advertisements that included female images.

Fig. 8. Sample advertisements conveying an image of women as pretty to look at.

(a)

(b)

(c)

(d)

- a: Little girls. (1955, January). *Physics Today*, p. 36.
- b: Babes. (1970, September). *Physics Today*, p. 91.
- c: Artwork. (1985, April). *Physics Today*, p. 35.
- d: Like a woman. (2000, April). *Physics Today*, p. 60.

Note: Images are not displayed in this file due to copyright protection.

Discussion

This study has created an interesting look at the advertisement images used throughout the years in the journal of *Physics Today*. The role of "physicist" can be constructed from the advertising images examined within this study. When considering all of the images of people, physicists are portrayed as men, usually white men, pursuing their physics endeavors independently and establishing themselves as experts of the field. Advertising images that construct this image of a physicist accounted for 65% of all the advertisements picturing only males. This construction of what a physicist looks like and what a physicist does, was found to be very consistent across time and is probably an image most physicists can identify with. However, upon further consideration, this stereotype does not tell the full story, or even any of the story! Think of how much research is done in collaboration and how much time is spent in activities other than sitting alone in the lab, twisting dials on a power supply. While this image already excludes women, they are also not very reasonable or constructive for males wanting to understand what it means to be a physicist.

The results for the representation of women within the advertisements of *Physics Today* were mixed. Some results showed little to no gender difference, such as the average size of the advertisement whether depicting men only or including females. But what about more meaningful measures? In order to better evaluate the results, an appropriate comparison is needed. Of course, women have generally been about half of the population, so it would be great if this level of inclusion were found in the ads. However, considering the well-known underrepresentation of women in physics, that may not be a fair standard (although an appropriate goal). In Table 5 a number of the results of this study are compared with the percentage of physics Ph.D.s awarded to women during each of the years of this study (Ivie & Stowe, 2000).

Table 5. Representation of women.

	1955	1970	1985	2000
Percentage of physics PhDs awarded to women [†]	2 %	3 %	9 %	13 %
Percentage of depicted people who were female	8 %	12 %	22 %	17 %
Percentage of advertisements including females [‡]	15 %	13 %	37 %	24 %
Percentage of advertisements including only females [‡]	3 %	10 %	12 %	5 %
Percentage of advertisements depicting women as scientists [‡]	0 %	5 %	26 %	12 %

[†] Data comes from *Women in Physics, 2000*. (American Institute of Physics Rep. No. R-430).

[‡] Quoted percentages represent the percentage of advertisements that included people.

Looking at the percentage of physics Ph.D. degrees granted to women, one finds that the numbers are disappointingly low, but they do at least indicate a consistent upward trend from 2% in 1955 to 13% in 2000. This is indicative of the increasing numbers of women who are participating in the physics community. How about the representation of women in the *Physics Today* ads? Table 5 includes the percentages of depicted people who were female, advertisements including females (some advertisements also include men), advertisements including only females, and advertisements depicting women as scientists. The good news is that by most measures, women are represented in the advertisements in numbers at least equal to their representation among degree earners. However, unlike the percentages of females earning physics Ph.D. degrees, the representation of women among the advertisements shows a general up-and-down trend with all categories decreasing from 1985 to 2000. This good news/ bad news conclusion is in line with similar examinations of the representation of women in *Physics Today* reported in two Letters to the Editor in the June 2003 issue (Geller, 2003; McCullough, 2003).

The roles constructed by the images of females within the advertising images are equally a mix of good and bad. Women's roles have progressed and do include roles as scientists. However, their images are often passive and disappointing and cannot compete with the consistent notion of what a "real" physicist looks like. This study cannot say whether advertisers are subjecting readers to their own ideas of what physicists look like or are giving the audience what they expect. However, it is important to note that, whether physicists like it or not, messages are being conveyed by these images. These messages can be accepted blindly or they can be used as an opportunity to reflect on the conceptions of the role of gender within the physics community.

This study has a number of limitations, particularly in the fact that only four years were sampled. However, the results make it clear that more work needs to be done before women will be represented equally within the physics community. As part of that work, teachers are challenged to assign projects like this to their physics students at the high school level or beyond. More research can be conducted looking at the representation of gender and underrepresented minorities within textbooks, popular and technical journals, and more volumes of *Physics Today*. Such projects can have many advantages. They can be more appealing to students who are more interested in the humanities than traditional blocks-and-bombs physics problems. Students can practice research skills and be introduced to applying both quantitative and qualitative techniques in rigorous and systematic ways. They may even pick up a little physics along the way if they are examining scientific journals! More importantly, the students may also confront and challenge their own ideas about commonly accepted stereotypes and the ideas held by the community at large. Stereotypical assumptions can only be changed if their existence becomes known.

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