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What is This?
Assessing Media Influences on Middle School–Aged Children’s Perceptions of Women in Science Using the Draw-A-Scientist Test (DAST)

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Gender stereotypes in the mass media perpetuate traditional views of women that may influence children’s perceptions of women in science, engineering, and technology. This study used a randomized posttest-only control group design to determine the efficacy of media literacy training on middle school–aged children’s perceptions of scientists. Participants were randomly assigned to one of three conditions: discussion, discussion plus viewing of television and film clips that featured images of women, or a control. A total of 304 seventh-grade students were asked to complete the Draw-A-Scientist Test and to write down the source of information for their drawings. Across conditions, boys were more likely than girls to draw male scientists, and girls were more likely than boys to draw female scientists. Boys also were more likely to depict other stereotypes of scientists. Media sources were listed as the primary source of information for the drawings.

**Keywords:** images of women scientists; girls and science; media literacy
Greater participation of women and other underrepresented groups in science, engineering, and technology (SET) is needed to ensure a diverse workforce that will provide more varied perspectives to develop new questions, approaches, practices, and interpretations. Despite recent increases in the enrollment of women in SET disciplines and increases in the number of women receiving bachelor’s, master’s, and doctoral degrees in SET fields (National Science Foundation 2007), women still are outnumbered by men in the SET workforce for most SET fields, including the computer and math sciences, life sciences, physical sciences, and engineering (Tsapogas 2004). The greatest gap in participation in the SET workforce exists in the computer and math sciences (27 percent women) and engineering occupations (13 percent women; Tsapogas 2004).

The underrepresentation of women in SET careers stems from an array of factors that often originate during childhood. The messages about science and the images of scientists that children gather throughout their childhood years influence their perceptions of scientists, attitudes toward science and scientists, and interest in science courses and future scientific careers (Knight and Cunningham 2004). Children’s perceptions of scientists and engineers are likely to be influenced by a number of social and cultural factors, including those found at home and conveyed by parents (Barton et al. 2001; Schnabel et al. 2002; Scott and Mallinckrodt 2005; Tenenbaum and Leaper 2003), those found in schools and conveyed by teachers and peers (Lee 2002; Papadimitriou 2004; Parrott et al. 2000), and those found in popular culture and conveyed by a variety of media sources (Long, Boiarsky, and Thayer 2001; Steinke 2005; Steinke, Lapinski, Zietsman-Thomas, Crocker, et al. 2006; Steinke and Long 1996). Some studies suggest that children’s perceptions of scientists are developed during the early years of childhood and are influenced primarily by factors outside of the classroom (Baker and Leary 1995; Jones, Howe, and Rua 2000; Knight and Cunningham 2004).

While most children do not typically come in contact with actual scientists, many grow up seeing images of scientists in popular culture as depicted by...
characters and images in books, movies, television programs, magazines, comics, video games, clip art, Web sites, and a variety of other media sources. These images of scientists may be considerable sources of influence that shape children’s views of the appearance, characteristics, traits, and lifestyles of scientists. The images of scientists that children encounter during their childhood years are important to examine because of the potential role of these images in shaping individual perceptions of scientists, and ultimately, influencing children’s interest in pursuing SET courses and occupations in the future.

Examining the prevalence of gender stereotypes in media images of women scientists is of particular interest because research indicates that adolescents are likely to have gender-stereotyped views of occupational roles and have been found to show “strong endorsement of both stereotypically masculine and feminine values” (Weisgram and Bigler 2006, 345). Moreover, SET occupations have typically been viewed by children as masculine pursuits (Kelly 1985; Lightbody and Durndell 1996). Studies have pointed to the role of factors such as gender role stereotypes and cultural stereotypes in shaping children’s occupational aspirations and choices (Eccles et al. 1983; Hammrich 1997). For adolescent girls, in particular, these factors may influence their interest in future SET careers. As adolescent girls envision possible future occupational roles, many are not likely to see SET occupations as compatible with feminine values or as appropriate for women because of the existing masculine gender stereotype of SET occupations. Recent studies have reported that girls have a relatively low interest in science (Miller, Slawinski Blessing, and Schwartz 2006; Weisgram and Bigler 2006). Findings from one of these studies revealed that girls, as well as boys, “see scientists as loners who have little time for their families or friends because they work long hours in a laboratory on problems that have little obvious relevance to people or social problems” (Miller, Slawinski Blessing, and Schwartz 2006, 377).

The purpose of this study was to assess the efficacy of media literacy training designed to teach critical thinking about images of women, including women in SET professions, in changing middle school students’ perceptions of women scientists. Two different media literacy training conditions were examined relative to a control. The first condition focused on discussions of stereotypes and counterstereotypes of women in television programs and films. The second condition included viewing video clips of stereotypical and counterstereotypical images of women in television programs and films as well as discussions of stereotypes and counterstereotypes of women in the video clips. Both of these conditions included discussions on stereotypes and counterstereotypes of women professionals in SET.
Literature Review

Draw-A-Scientist Test (DAST)

Early research on children’s perceptions of scientists found that most children have gender-stereotyped perceptions of scientists or hold a “masculine image of science” (Kelly 1985, 134). Mead and Metraux (1957) noted that when asked to write essays about scientists, both male and female high school students mostly described male scientists. This study also found that students described scientists as neglectful toward their wives, children, and friends (Mead and Metraux 1957). Research on children’s perceptions of scientists from the 1980s and 1990s focused on studies that used the DAST to assess children’s stereotypes of scientists (Chambers 1983). Some of these studies used a modified version of the DAST, called the DAST-C, which provided a checklist for coding specific features found in drawings of scientists (Finson, Beaver, and Cramond 1995). Both the DAST and DAST-C ask children to draw a picture of a scientist. Drawings with a greater number of stereotypical features indicate more stereotypical views of scientists. One of several features assessed by the DAST is gender, which was the primary focus of the use of the DAST for this study.

Most of the DAST studies of children of various age groups in the United States have found that children have the stereotypical perception of scientists as being male. In a study of over 4,000 children in kindergarten to grade five, only 28 girls drew women scientists (Chambers 1983). A survey of students from across the United States found that only 14 percent of the drawings by girls and 8 percent of the drawings by boys depicted female scientists, and only 20 of the 1,600 drawings by both girls and boys depicted scientists of color (Fort and Varney 1989). A study of undergraduate biology and liberal studies majors showed that students in both groups drew more male scientists than female scientists, and only female students from both groups drew female scientists (Rosenthal 1993). Another study found that children in kindergarten through twelfth grade primarily drew pictures of male scientists (Barman 1999), and older students were less likely to draw female scientists than were younger students (Barman 1997). In addition, 74 percent of the students’ drawings in this study depicted Caucasian scientists (Barman 1997). A study of students in grades six through eight who were administered the Draw an Engineer Test (DAET), a variation of the DAST, found that the gender of most of the drawings of engineers was not discernible, and that 25 of the 64 drawings depicted a female engineer in the drawings where gender was able to be
determined (Knight and Cunningham 2004). These studies revealed that it is most likely girls who will have the counter gender-stereotyped perception of scientists as female.

A few studies have noted specific interventions that have been effective in changing children’s stereotypical perceptions of scientists as being male or have documented when certain samples are less likely to view scientists as predominantly male. For example, one study found that after meeting a female engineer, some fourth- and fifth-grade girls drew female scientists when they had previously drawn male scientists for the pretest (Bodzin and Gehringer 2001). A study that used a modified version of the DAST, called the Draw an Environmental Scientist Test (DAEST), noted that when gender was coded using a gender-neutral option, students were just as likely or more likely to indicate scientists could be male or female as they were to indicate scientists could be male (Thomas and Hairston 2003). A study of Navajo children in grades four through six found less gender-stereotyping in the students’ drawings of scientists, with half of the children (47 out of 94) depicting female scientists in their drawings and the other half of the children depicting male scientists in their drawings. This study noted that almost all the girls depicted scientists as females, while almost all the boys depicted scientists as males, and the researcher suggested that more girls may have drawn female scientists partly because of the traditional matriarchal Navajo society (Monhardt 2003).

Findings from DAST studies conducted with children in other countries are similar to those found for children in the United States. A study of students at a primary school in Ireland found that not a single male student (n = 76) drew a picture of a female scientist, and only twenty-three out of forty-five female students drew pictures of female scientists (Maoldomhnaigh and Hunt 1988). The researchers noted, however, that female students who received instruction about stereotypical representations of scientists were more likely to draw a picture of a female scientist when instructed to make a second drawing (Maoldomhnaigh and Hunt 1988). A study of secondary school and undergraduate school students in England also observed that gender-stereotyping of scientists was less evident when students were asked to draw pictures of two scientists (Matthews 1996). This study found that 44 percent of the students drew two male scientists, 44 percent drew a female and a male scientist, and 13 percent drew two female scientists (Matthews 1996). A study of children in England, ages four to eleven years old, indicated both boys and girls drew more pictures of male scientists than female scientists and reported that by age ten all the boys and over 80 percent of the girls drew pictures of male scientists.
(Newton and Newton 1998). A study of drawings and descriptions of scientists by 1,137 Korean students ages eleven, thirteen, and fifteen found that 74 percent described a male scientist and 16 percent described a female scientist (Song and Kim 1999). A study of children in Turkey ages five to eight found that none of the twenty-four boys drew female scientists and five of the thirteen girls drew female scientists (Buldu 2006).

A few of these studies noted the potential influence of media portrayals of scientists on children’s images of scientists. Both male and female students in one study reported that the main source of their perceptions came not from teachers or parents, but from films, animated cartoons, children’s science journals, scientists’ biographies, and cartoons (Song and Kim 1999). Another study noted that children who wanted to be like the scientists in their drawings indicated that the scientists were people they knew or characters they had seen on television (Buldu 2006).

Gender Schema Theory, Media Images, and Gender Stereotype Development

Images of scientists on television may influence or reinforce children’s perceptions of the gender of scientists. Children first develop extensive networks of gender knowledge during early childhood (Campbell, Shirley, and Candy 2004). These extensive networks are called gender schemas (Bem 1981) or the “cognitive structures stored in memory that organize gender-related knowledge, beliefs, attitudes, and preferences” (Liben and Signorella 1993, 141). Gender schemas, just like other schemas children create and store in memory, are the mental scripts that help children understand experiences in their lives and make decisions about how to behave (Schank and Abelson 1977). Just as children develop schemas for information about everyday routines and experiences, they develop schemas for information about gender and gender roles. Once children have developed gender schemas, they start to apply them to the situations and experiences they encounter in their everyday lives (Bem 1993). Gender schemas store gender-related information in memory, and children call on gender schemas whenever they encounter new information related to gender (Bem 1993). Research shows that children begin labeling based on gender around the age of two or three years and show an increase in gender knowledge and sex-typed behavior between the ages of two and three years (Campbell, Shirley, and Candy 2004).

Gender schemas are important for the development of children’s gender identity; however, children also often learn gender stereotypes from gender
schemas (Levy and Carter 1989; Nihlen and Bailey 1988). Research shows that gender stereotypes influence children’s perceptions, beliefs, and behavior (Bem 1993). Children begin to show signs of gender-stereotyped knowledge of items like toys around the age of three (Campbell, Shirley, and Candy 2004) and develop gender-stereotyped knowledge of occupations later on (Campbell, Shirley, and Candy 2004). Girls between the ages of four and five years “begin to regard the gender stereotyping of masculine occupations as excluding them, while boys see themselves as capable of most of the activities shown but nevertheless have a preference for the traditionally sex appropriate ones” (Durkin and Nugent 1998, 397). As children encounter new information about gender and gender roles, changes in gender-stereotype knowledge may occur (Bigler and Liben 1990), although children with more rigid gender schemas tend to alter or forget information that is inconsistent with existing gender schemas (Hughes and Seta 2003; Ruble and Stangor 1986). The mass media are sources of gender stereotypes that may influence or prime individuals’ knowledge of gender in subtle ways (Schneider 2004).

The gender knowledge and gender stereotypes that pervade media images and messages about scientists may influence not only children’s perceptions of others but also their perceptions of themselves in regards to their ability to succeed in SET careers. Research on stereotype threat (see Smith, Sansone, and White 2007, 99) shows that an awareness of negative gender stereotypes can lead to changes in women’s perceptions of their ability and competence in math and science and can lead to poorer performance even when they are highly capable of succeeding in these areas (Smith, Sansone, and White 2007). Reaction to the priming of stereotypes or labels associated with group membership has been documented in other domains in the literature on stereotype threat (Davies, Spencer, and Steele 2005; Steele and Aronson 1995) and stereotype contrast. The literature on stereotype threat indicates that when members of stigmatized groups perceive they are stereotyped, they run the risk of confirming that stereotype, and this can negatively influence performance on tasks related to the stereotype (e.g., intellectual test performance; see Steele and Aronson 1995) and reduce aspirations and goals related to the stereotype (Davies, Spencer, and Steele 2005). Stereotype threat is important to consider in examining girls’ interest in SET careers because research shows that children have gender-stereotyped beliefs about occupations (Liben, Bigler, and Krogh 2002), assign more status to occupations that have traditionally been considered masculine (Liben, Bigler, and Krogh 2001), and rate men as more competent than women at masculine occupations (Levy, Sadovsky, and Troseth 2000).
Images of women on television that reinforce traditional gender roles and gender-stereotyped views of professional roles threaten to limit the career choices of image-conscious adolescent girls who often have been taught to value feminine roles. As children enter adolescence and begin to assert their independence from their parents and begin to think about future roles, the mass media become increasingly important sources of information (Faber, Brown, and McLeod 1979; Signorielli 1997). In fact, research shows that adolescent girls who watch more television are more likely to agree with gender-stereotyped views of women that claim women are happiest working in the home and caring for children and are not interested in important jobs outside the home (Morgan 1982). Although images of women on television vary, many of these images reinforce traditional gender stereotypes. Years of research on media content have documented stereotypical images of women found in a variety of media (Baker-Sperry and Grauerholz 2003; Barner 1999; Coltrane and Messineo 2000; Dietz 1998; Elasmar, Hasegawa, and Brain 1999; Hoerrner 1996; Lauzen and Dozier 1999; Massoni 2004; Pierce 1993; Signorielli 1997; Turner-Bowker 1996; White and Kinnick 2000). Research focused specifically on images of women in the media that adolescent girls actually use found these images typically focused on female characters who were more concerned about appearance and romance than academics or careers (Signorielli 1997).

Media images of women in general and women scientists in particular and the stereotypes girls develop from these media images may influence girls’ science self-concept. Several studies have examined girls’ science self-concept, a construct derived from the idea of self-efficacy (Bandura et al. 2001) that represents one’s confidence in one’s ability to perform and succeed in particular behaviors. These studies have found a positive science self-concept is related to girls’ professional aspirations for a career in SET (Lee 1998; Mau 2003; Nauta and Epperson 2003). One study found that girls are more likely to have gendered self-concepts and gendered perceptions of science that keep them from science careers (Lee 1998). Another study showed that “the stereotyped view of male dominance in science” (Handley and Morse 1984, 606) affected girls’ attitudes toward science as they progressed from seventh to eighth grade (Handley and Morse 1984).

Media Literacy Interventions

Research suggests that consumers of media content can be taught to critically evaluate media content and that this critical evaluation can change the ways in which the content is processed and internalized (Irving and Berel 2001;
Media literacy programs focused on teaching a critical evaluation of media content have been found to be successful in changing children’s perceptions, attitudes, and behaviors. One program was successful in strengthening college women’s resistance to media images that focus on the thin ideal of beauty (Irving and Berel 2001). Another program reported success in affecting children’s understanding of persuasive content and changing their perceptions of alcohol advertisements and their behaviors toward alcohol (Austin and Johnson 1997). Another program was effective in changing high school–aged students’ tobacco-related knowledge, attitudes, and behaviors (Gonzales et al. 2004). One study reported findings from a program that was able to reduce eighth-graders’ concerns about weight (Wade, Davidson, and O’Dea 2003). Another program was effective in increasing seventh- and eighth-graders’ knowledge about advertising practices and increasing their skepticism toward advertisers (Austin, Chen, and Grube 2006). One program changed elementary and middle school–aged children’s responses to a violent television program (Nathanson 2004). Another program was successful in changing adolescent girls’ perceptions of nontraditional occupations (Griffin, Sen, and Plotkin 1994; Johnston and Ettema 1982). Another recent program was effective in promoting less favorable evaluations of a stereotyped program and encouraging acceptance of nontraditional gender roles in students in kindergarten through sixth grade (Nathanson et al. 2002).

Although this research provides some evidence that critical processing of media content can be learned, more research is needed to understand the types of media literacy interventions that work best and the impact of these interventions on specific attitudes and behaviors, such as changing children’s perceptions of scientists and engineers. The purpose of this study was to assess the efficacy of media literacy training in changing children’s perceptions of scientists as being males. This research is an important first step in exploring connections among girls’ perceptions of women as scientists, their gender stereotypes of scientists as being males, and their future interest in SET occupations.

**Hypotheses and Research Questions**

The potential influence of media sources in contributing to the noted gender differences in interest and participation in SET occupations led to the hypotheses and research questions posed for this study. The goals of this study were (1) to assess the efficacy of media literacy training designed to teach critical thinking about images of women, including women in SET
professions, in changing middle school students’ perceptions of women scientists in SET as measured by the DAST and (2) to examine the role of media images as a source of the gender stereotype of scientists. The DAST outcomes tested here are part of a larger study that tested additional outcomes (see Steinke, Lapinski, Zietsman-Thomas, Nwulu, et al. 2006). Based on the literature cited above, the following hypotheses and research questions were posed:

**Hypothesis 1:** Girls will be more likely than boys to draw female scientists.

**Research Question 1:** What are the most common stereotypes of scientists as measured by DAST and other research (Steinke 2004, 2005) (lab coat, eyeglasses, facial hair, middle-aged or elderly, working in lab or field, site/location of work, facial expression, hair, research symbols, symbols of knowledge, technology present, scientific captions or captions of discovery, mythic stereotypes, indications of danger, and indications of secrecy) drawn by middle school–aged children?

**Hypothesis 2:** Middle school–aged children who participate in media literacy training that provides instruction on gender stereotypes in the media in addition to viewing videos of gender stereotyped and counterstereotyped media portrayals of women (discussion plus video) will be more likely to draw images of scientists depicting female scientists than students who participate in media literacy training that provides instruction only on gender stereotyped and counterstereotyped media portrayals of women (discussion only) and than students in a control condition.

**Research Question 2:** Do middle school–aged children report media sources as the primary source of information for their perceptions of scientists?

**Research Question 3:** Do middle school–aged children’s primary sources of information for their perceptions of scientists vary by participant’s biological sex or experimental condition?

### Methods

#### Participants

Middle school–aged children were selected as the population for this study because research indicates most girls report a loss of interest in SET around the age of twelve (American Association of University Women 2000, 1998) and many girls show a heightened awareness of gender roles at this age (Erkut et al. 1999; Orenstein 1994). The sample included 319 participants from seventh-grade science classes at three middle schools in the Midwest. Participants were all seventh-graders with an average age of 12.65 ($SD = .57$); slightly more girls (53 percent) than boys (47 percent) took part in the study. The study included students who reported themselves
as Caucasian/white (58 percent), African American/black (14 percent), mixed race (primarily African American/black and Caucasian/white; 14 percent), Hispanic/Latino/Latina (5 percent), Asian or Pacific Islander (2 percent), or other (8 percent). Participants received written consent from a parent or guardian and gave their own written assent. Participation took place at the schools during regularly scheduled science classes over a seven-day period scheduled over two consecutive weeks between January and June 2005.

Approximately equal numbers of participants were randomly assigned to the discussion only \((n = 107)\), discussion and video \((n = 104)\), and control \((n = 108)\) conditions. Across conditions, fifteen students failed to fully complete the DAST or the intervention, resulting in a final sample size of 304. The relatively large sample size allowed for examination of differences between boys and girls.

**Pilot Study**

The media literacy conditions, discussion and discussion plus video, were piloted with thirty-six students from a local middle school that did not take part in the final study. The pilot participants also completed the study questionnaire after the intervention sessions. The purpose of the pilot was to give the facilitator familiarity with the intervention content, to review the intervention content, and to assess the amount of time needed to complete the questionnaire. Modifications were made to the content of the intervention and to the questionnaire.

**Procedure**

Participants were randomly assigned to conditions in order to maximize the likelihood of initially equivalent groups and negate the need for a pretest (Babbie 1992). This design was chosen because it maximizes the internal validity of the research in several ways. First, random assignment to experimental conditions creates initial equivalence of groups and negates the need for pretests, which are likely to sensitize participants. Second, the three experimental conditions allow for tests of the effectiveness of a discussion-only media literacy training and discussion-plus-video media literacy training as compared to a control. This research design assesses changes resulting from the intervention by comparing the two condition groups (discussion only, discussion and video) with a control group.

Participants were randomly assigned to one of three conditions: (1) discussion only, (2) discussion and video, and (3) control. Participants in group 1
(discussion only) participated in a media literacy training that included discussions of stereotypes and counterstereotypes of women in television programs and films. Participants in group 2 (discussion and video) participated in media literacy training that included watching video clips of stereotypical and counterstereotypical images of women in television programs and films as well as discussions of the stereotypes and counterstereotypes of women in the video clips. All of the intervention sessions for these two groups were moderated by the same facilitator, a female science instructor from a local university. Details on the specific content of the media literacy training have been published previously (see Steinke, Lapinski, Zietsman-Thomas, Nwulu, et al. 2006). Each intervention lasted for approximately three forty-minute class sessions, and took place every other school day. Participants in the control group did not receive any treatment, but watched videos that conformed to the normal science curriculum and did not show male or female scientists in the content of the videos.

DAST

A questionnaire was administered to students in all three groups following the intervention. The DAST was administered in a group format as one section of the questionnaire that measured outcomes of the larger study. Students were prompted to “draw a picture of a scientist.” At the bottom of the page, the instructions stated: “Take another look at the picture you just drew. Where did your ideas on how to draw this person come from? How did you know what to draw?”

The drawings were evaluated by two members of the research team using a coding sheet adapted from Barman (1999). Additional variables were added to Barman’s (1999) scheme based on studies of media images of women scientists (Steinke 2004, 2005). The following seventeen categories were used to assess stereotypes of scientists: male gender, lab coat, eyeglasses, facial hair, middle-aged or elderly, working in lab or field, site/location of work, facial expression, hair, research symbols, symbols of knowledge, technology present, scientific captions or captions of discovery, mythic stereotypes, indications of danger, and indications of secrecy. One of the categories on Barman’s (1999) coding scheme, Caucasian(s) only, was dropped from the coding scheme because the coders were unable to discern the race of the scientists from the students’ drawings. The coding definitions provided by Barman (1999) were used for all the categories except hair and facial expression, which were derived
from the first author’s research. Hair was coded as either messy or unkempt or neat, and facial expression was coded as either smiling or not smiling. Coders also classified students’ responses to the source of ideas for their drawings. The following ten categories were used to assess the sources of ideas for the drawings of scientists: TV/films, magazines/books/comics, science textbook, museum/field trip, personal experience/relative, science teacher, imagined/in my mind, normal person, other, or blank. The coders used the first response to code the primary source of information for the drawings when students listed more than one source.

The lead author trained a research assistant in use of the coding scheme by examining drawings that were not included in the portion of the sample used to calculate the intercoder reliability. The lead author and research assistant discussed discrepancies in coding and revised coding definitions to address these discrepancies. The data collection yielded a sample of 304 drawings. A randomly selected subset of drawings representing 9 percent of the sample was then coded independently by the two coders. The intercoder reliability was calculated using Cohen’s kappa (Cohen 1960). The reliability scores for the items on the coding scheme ranged from $\kappa = 0.67$ to $\kappa = 1.00$, with estimates for only two variables below $\kappa = 0.75$. Intercoder reliability could not be established for two items (mythic stereotypes and scientific captions), and these items were dropped from the analysis. The research assistant coded the rest of the sample for the remaining variables.

**Results**

**Biological Sex of Scientist**

The first hypothesis predicted girls would be more likely than boys to draw female scientists (see Figure 1). Analysis of the drawings indicated that 50 percent of girls drew a female scientist and 12.5 percent of boys drew a female scientist, $\chi^2(6) = 55.49, p = .001$.

Six girls and two boys drew two pictures—one of a male scientist and one of a female scientist (see Figures 2 and 3). The biological sex of the scientist could not be determined by coders in eleven pictures drawn by girls and thirteen pictures drawn by boys. Thus, the data were consistent with Hypothesis 1.
Stereotypes of Scientists

Across conditions, the categories of stereotypes of scientists found in each drawing were counted, and the percentage of each type of stereotype was calculated by comparing the number of stereotyped portrayals to the total number of drawings. The stereotypes with the highest percentages were found for the following variables: lab coat (66.8 percent), glasses (57.6 percent), male gender (56.9 percent), expression/not smiling (42.4 percent), crazy hair (34.5 percent), and lab work/works in lab (31.9 percent). DAST stereotypes scores were higher for boys than for girls on all DAST stereotypes except conducts lab work and lab coat (see Table 1).

See Figures 4 and 5 for drawings of male scientists by boys that depicted scientists with other DAST stereotypes.
Gender Stereotypes of Scientists in DAST Drawings and Media Literacy Training

Experimental condition did not predict the coded biological sex of the scientist drawn by participants, $\chi^2(4) = 6.75, p = .15$. The interaction between experimental condition and participants’ biological sex did not predict the coded biological sex of the scientist drawn; differences were not significant for boys, $\chi^2(6) = 4.61, p = .59$; or girls, $\chi^2(6) = 4.21, p = .65$. Thus, the findings of this study did not confirm Hypothesis 1. See Figure 6 for a drawing of a female scientist from a girl in the control group.

See Figure 7 for a drawing of a male scientist by a boy in the discussion group.
Source of Ideas for DAST Drawings

The percentages for the source of ideas for the students’ drawings were calculated by condition and by gender. Students listed a variety of sources of information for the ideas for their drawings. The highest percentage of students (40 percent) indicated that television and films were the source of ideas for their drawings. This item received the highest percentage of responses across all conditions and for boys as well as girls. A total of 47 percent of students in the discussion group, 41 percent of students in the discussion-plus-video group, and 31 percent of students in the control group reported television and films as the source of ideas for their drawings. Television and films were listed as the top choice for students in the control group. Students who noted media sources as their primary source of information wrote the following:
“I got this from movies I have seen. This is what one character looked like.”
(girl, video group, drew male scientist)

“It just popped into my head and I remember from the TV show I used to watch called like science guy or something.” (girl, control group, drew male scientist)

“My idea came from the movies and TV. I drew a woman because an obvious choice would have been men.” (girl, discussion group, drew female scientist)

“A scientist can look like anything or anyone so I drew a regular person.” (girl, video group, drew female scientist)

The findings for the top choices for source of ideas are reported in Table 2. Several of the drawings of scientists made by students who mentioned media sources (particularly television) as their primary source of information were of male scientists who resembled television characters like Dexter from *Dexter’s Laboratory* or Beakman from *Beakman’s World*, or depicted a male scientist who looked like the mythic stereotype of a mad scientist. See Figure 8 for an example of a drawing of a male scientist that
appeared to be influenced by media images of scientists. In fact, the girl who drew this picture noted that TV shows were the primary source of information for her drawing.

Students who cited a “normal person” or someone they knew often drew less stereotypical pictures of both male and female scientists. Students who cited a normal person as the primary source of information for their drawings wrote the following:

“My mother, my mom is a scientist.” (boy, discussion group, drew female scientist)
“My dad is a scientist.” (boy, discussion group, male scientist)
“A guy that worked in the lab at my old school.” (boy, discussion group, male scientist)
I knew what to draw because I have seen the types of things in laboratories, and what to wear. I wanted to make my scientist to look somewhat a little like my science teacher.” (girl, control group, female scientist)

Discussion

The media literacy interventions, both the discussion-only condition and discussion-plus-video condition, did not influence children’s gender stereotyping of scientists. No significant difference was found in middle school-aged children’s depiction of the gender of the scientist in the DAST drawings for children who had participated in the media literacy training as compared with children who were in the control group. This finding was contrary to expectations and was not consistent with other research that has found less stereotypical images of scientists on the DAST as a result of intervention.
strategies that have featured scientist role models (Bodzin and Gehringer 2001; Finson, Beaver, and Cramond 1995), visits with female scientist role models (Smith and Erb 1986), and the distribution of career information (Huber and Burton 1995; Mason, Kahle, and Gardner 1991). However, this finding was consistent with those of a study that found elementary school-aged children’s gender stereotyped images of scientists as male were unchanged after an intervention that featured visits from female scientists and that found the children even questioned whether these women were scientists (Buck and Leslie-Pelecky 2002).

There are several possible explanations for this finding. First, the delivery and length of the intervention may need to be changed. Although other interventions have used similar approaches and have been similar in length,
a longer intervention period may be needed in order to detect changes in
gender schemas that are known to be highly resistant to change (Hughes
and Seta 2003; Ruble and Stangor 1986). Researchers have noted that more
direct interventions are likely to be needed to change existing gender
stereotypes (Liben, Bigler, and Krogh 2001). In the last two decades, psy-
chologists interested in learning and memory began to change from cursory
(a day or two in length) interventions to longitudinal studies that take account
of the learners’ community and encourage students to engage in self-reflective
learning and critical inquiry (see Brown 1992 for a review). This study
involved the teaching of content that was separate from the content taught as
the usual science curriculum, expecting students to learn content out of con-
text to “please” the researchers. Changing students’ perceptions of science and
scientists is fundamentally important if we want to encourage traditionally
nonparticipants (e.g., women, people of color) to consider careers in science and engineering. Therefore, it may be important that media literacy intervention, or any type of intervention, be integrated into the science curriculum to provide a context and relevancy that will allow empirical research. Second, the media literacy training may have made middle school–aged students more resistant to changing attitudes toward gender roles. As the findings for this study indicate, boys’ stereotypical attitudes toward gender roles were not changed by the media literacy training. The media literacy intervention may have activated the boys’ gender schemas, also activating the cognitive structures that make them resistant to changing these gender schemas (Hughes and Seta 2003; Ruble and Stangor 1986). Third, changes in perceptions may need to be assessed directly after the intervention rather than a day after the intervention in order to detect immediate changes that may have occurred in short-term memory.

The results of the DAST showed differences in boys’ and girls’ perceptions of scientists. Girls across conditions were more likely than boys to draw female scientists than male scientists. Half of the girls drew a female scientist. Boys across conditions drew more male scientists than female scientists, thus showing greater gender stereotyping of scientists than did girls. This finding was similar to those of other DAST studies that have found only girls drew pictures of women scientists (Bodzin and Gehringer 2001; Buldu 2006; Chambers 1983; Rosenthal 1993) and DAST studies that have found that girls were more likely than boys to draw pictures of female scientists (Barman 1999, 1997; Fort and Varney 1989; Maoldomhnaigh and Hunt 1988; Matthews 1996; Newton and Newton 1998; Song and Kim 1999). However, this finding

### Table 2

Percentages for Sources of Ideas for Draw-a-Scientist Test (DAST)

<table>
<thead>
<tr>
<th></th>
<th>Discussion</th>
<th>Video</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boys</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. TV/films</td>
<td>53.6%</td>
<td>50.0%</td>
<td>36.7%</td>
</tr>
<tr>
<td>2. Normal person</td>
<td>7.1%</td>
<td>10.5%</td>
<td>10.2%</td>
</tr>
<tr>
<td>3. Books</td>
<td>5.4%</td>
<td>5.3%</td>
<td>8.2%</td>
</tr>
<tr>
<td></td>
<td>5.4%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Girls</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. TV/films</td>
<td>41.7%</td>
<td>37.5%</td>
<td>27.8%</td>
</tr>
<tr>
<td>2. Imagined</td>
<td>10.4%</td>
<td>14.3%</td>
<td>18.5%</td>
</tr>
<tr>
<td>2. Normal person</td>
<td>10.4%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Science teacher</td>
<td>8.3%</td>
<td>10.7%</td>
<td>11.1%</td>
</tr>
<tr>
<td></td>
<td>10.4%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
was different from other previous DAST research on children of various ages that reported both girls and boys generally draw more male than female scientists (Barman 1999; Bodzin and Gehringer 2001; Chambers 1983; Fort and
Varney 1989; Parsons 1997; Rosenthal 1993) and a study that used a modified version of the DAST, called the Draw an Engineer Test (DAET; Knight and Cunningham 2004). Further research needs to assess why more girls in this study drew pictures of female scientists than is typically noticed in most DAST studies, since this difference was not influenced by the media literacy training.

Boys across conditions also showed greater overall stereotyping of scientists than did girls on most of the other DAST stereotype variables. These findings suggest that middle school–aged girls and boys hold different perceptions of scientists, with girls showing less gender stereotyping of scientists than boys and perceiving scientists in less stereotyped ways for a variety of characteristics and traits. Boys’ greater stereotyping of scientists, including their gender stereotyping of scientists, underscores the need for science intervention programs for boys and research on strategies for changing the culture of science, especially in light of the recently documented reports of unconscious institutional bias that has led to instances of covert discrimination (Handelsman et al. 2005) and “subtle biased acts” (Gunter and Stamach 2005). Changes in the culture of science are needed to alter male-centered practices, policies, and environments that create and perpetuate barriers for women in SET careers (Miller, Slawinski Blessing, and Schwartz 2006).

Both boys and girls cited television programs and films as the primary source of information for their drawings of scientists. This finding must be interpreted with caution because approximately two-thirds of the participants had completed media literacy training prior to being asked for the primary source of information for their drawings. In fact, some of the participants did refer to the media literacy intervention and video content when reporting the media as the primary source of information for their drawings. However, it should be noted that many participants in the control group who did not participate in media literacy training also listed television and films as the primary source of information for their drawings of scientists. Some previous DAST studies have suggested the media are an important source of influence on students’ perceptions of scientists (Buldu 2006; Song and Kim 1999).

The findings from this research have several implications for the design of SET intervention programs for girls. Many SET intervention programs for girls use media resources—educational videos, computer games, interactive CD/ROMs, radio programs, and television programs—in efforts to influence girls’ perceptions of scientists. These programs should acknowledge the potential influence of cultural images of gender, consider the use of media images of engineers and scientists in interventions focused on stereotypes and counter-stereotypes, and assess girls’ responses to specific stereotyped and counter-stereotyped characteristics found in media images of women scientists. Media
models are an important area for future research because they may be effective social models for encouraging girls’ interest in SET. Additional research on the impact of media sources on girls’ science self-concept is needed to develop effective interventions for encouraging girls not only to see other women as scientists and engineers but also to see themselves as future scientists and engineers.

References


Steinke, Jocelyn, Maria Lapinski, Aletta Zietsman-Thomas, Nikki Crocker, Yaschica Williams, Stephanie Higdon, and Sarvani Kuchibhotla. 2006. Media influences and girls’ perceptions of
science and engineering. Paper read at the annual meeting of the American Association for the Advancement of Science, St. Louis, MO, February.


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