This study examined the efficacy of media literacy training designed to teach critical thinking about gender stereotypes on middle school-aged children's recognition of gender stereotypes, perceptions of women in science, engineering, and technology (SET), and attitudes toward SET and SET careers. A total of 302 seventh-grade students were randomly assigned to one of three conditions: discussion, discussion plus viewing of media images of women, or a control. No significant differences were found on attitudes toward women in science and attitudes toward science among middle school-aged children who participated in either media literacy training condition compared with those who did not participate in media literacy training. However, significant differences in girls and boys' perceptions of women in SET and their attitudes toward women in SET were found for girls and boys' evaluations of the characteristics of female scientists, with girls rating female scientists as more skilled, intelligent, expert, and qualified than did boys. In addition, girls and boys had very different scores on items that asked about women in science, with girls being more likely than boys to have positive attitudes toward women being as good at science careers as men, women having access to science courses and career opportunities, and a woman's career having the same value as a man's career. The boys' negative attitudes toward women in science found in this study were related to the extent to which boys reported that the media played an important role in their lives. The implications for future research on media influences on middle school-aged children's perceptions of gender and science and the development of media literacy interventions to promote girls' interest in SET will be addressed.

INTRODUCTION

Programs to develop girls' interest in science, engineering, and technology (SET) have focused on a wide variety of approaches for creating "warmer climates" in homes, schools, workplaces, and elsewhere (National Science Foundation [NSF], 2003). Despite recent increases in the participation of women in SET, women still are underrepresented in many SET disciplines, with the most noticeable differences in representation occurring in physics, engineering, and computer science (Congressional Commission on the Advancement of Women and Minorities in Science Engineering and Technology Development, 2000; NSF, 2000; Thomas & Pedersen, 2001; U.S. Department of Education, 2000). Greater participation of women and other underrepresented groups in SET is needed to ensure a diverse workforce with the varied perspectives and experiences needed to develop new questions, approaches, procedures, and practices. Creating more supportive environments in SET clearly remains a high priority in efforts to increase the participation of girls; however, more attention needs to focus on the role of broader societal factors in contributing to the gender gap in SET. Existing intervention programs to promote girls' participation in SET can benefit from a greater understanding of the influence of media representations of gender in the everyday lives of children that can...
lead to the formation and maintenance of stereotypes about the role of women in SET.

Media images of women can have an especially strong influence on girls during the pre-adolescent and adolescent years. During this time of transition from childhood to adulthood, many girls experience a loss of self-confidence and become preoccupied with fitting in, looking thin and attractive, and finding romance (Brown & Gilligan, 1992; Orenstein, 1994). Many adolescent girls conform to traditional expectations of femininity in order to gain approval and acceptance and to avoid conflict (Brown & Gilligan, 1992). Girls’ preoccupation with meeting these expectations, however, can come at great cost by undermining their self-confidence and restricting future aspirations. For image-conscious adolescent girls whose primary concern is being popular and who for years have been taught to value feminine ways, media representations that reinforce traditional gender roles may limit career choices. 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 that women are not interested in important jobs outside the home (Morgan, 1982).

Consumers of media content can be taught to critically evaluate media content, and this critical evaluation can change the ways in which the content is processed and internalized (Irving & Berel, 2001; Potter, 1998). Media literacy programs focused on teaching a critical evaluation of media content have been found to be successful in (a) strengthening college women’s resistance to media images that focus on the thin ideal of beauty (Irving and Berel, 2001); (b) affecting children’s understanding of persuasive content; (c) changing their perceptions of alcohol advertisements and their behaviors toward alcohol (Austin & Johnson, 1997); and (d) changing girls’ perceptions of nontraditional occupations (Griffin, Sen, & Plotkin, 1994; Johnston & Ettema, 1982). Although these studies provide 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 outcomes of these interventions on specific attitudes and behaviors. In addition, more research needs to focus on the efficacy of media literacy programs in teaching children to recognize and resist gender stereotypes of women in the media.

Early adolescence is a time when many girls first start to show a decline in interest in SET (American Association of University Women, 1998, 2000), and children at this age and younger hold stereotyped perceptions of SET and women in SET careers (Andre, Whigham, Hendrickson, & Chambers, 1999; Barman, 1997; Chambers, 1983; Farmer, Rotella, Anderson, & Wardrop, 1998; Fort & Varney, 1989; Jacobowitz, 1983; Kahle, 1989; Maoldomnaigh & Hunt, 1988; Matthews, 1996; Mead & Metraux, 1957; Newton & Newton, 1998; Rosenthal, 1993; Song & Kim, 1999). Children’s perceptions of women’s roles in science, engineering, and technology careers as well as their attitudes toward SET are likely to be influenced by a variety of factors, including those found at home and in school. This research focuses on the potential influence of societal factors, and specifically the potential influence of the mass media, as socializing agents that may affect children’s perceptions of women in SET and their attitudes toward SET and SET careers. The purpose of this study is to assess the efficacy of media literacy training that teaches middle school-aged children to recognize and resist the stereotypes of women in SET careers they may encounter in the mass media. This study has three specific objectives:

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Middle School-Aged Children’s Attitudes Toward SET

1. To assess the influence of media literacy training on middle school-aged children’s ability to recognize gender stereotypes.
2. To assess the influence of media literacy training on their perceptions of women in SET.
3. To assess the influence of media literacy training on their attitudes toward SET and SET careers.

LITERATURE REVIEW

Media Images and Girls’ Perceptions of Gender Roles

The cumulative effect of all the media content girls see starting in their early years of childhood and into their adolescent years can influence their conceptions of gender. Signorielli (1997) explains the link between media content and adolescent girls’ perceptions of gender and gender roles: “Media’s portrayals contribute to girls’ perceptions, helping them define what it means to be a girl and later a woman” (p. 1). Numerous studies have documented the potential influence of media models on children’s perceptions and behavior, starting with studies dating back to the 1960s that first looked at the ways children learn behavior by modeling the actions of characters seen on television and in films (Bandura, Ross, & Ross, 1963a, 1963b). Media models that show women as intelligent and resourceful provide “enabling self-images” for adolescent girls; however, media models that overemphasize women’s physical appearance and depict women as weak convey “constraining self-images” that limit the future potential of girls (Arnold, 1993).

A review of the most popular television programs, movie videos, magazines, and books used by middle school-aged children as identified in the preliminary findings from “Getting the Media Message” (Bernt, Bernt, & Turner, 2003; Turner, Bernt, & Bernt, 2003) and A Content Analysis: Reflections of Girls in the Media (Signorielli, 1997) indicates that very few images of women scientists and engineers appear in the media most often used by adolescent girls. However, many images of women, in general, appear in the media that adolescent girls actually use every day. Typically, these images focus on female characters that appear to be more concerned about appearance and romance than academics or careers. While some media images portray girls and women as strong characters, showing them as independent, intelligent, honest, direct, and capable of solving their own problems, many more media images reinforce traditional stereotypes of girls and women as dependent, passive, and emotional (Signorielli, 1997). Years of research on media content, in fact, has documented stereotypical images of women in a variety of media, including fairy tales and children’s picture books (Baker-Sperry & Grauerholz, 2003; Turner-Bowker, 1996), children’s educational television programs (Barner, 1999), prime time television programs (Elasm, Hasegawa, & Brain, 1999; Launzen & Dozier, 1999, 2002), television commercials (Coltrane & Messineo, 2000; White & Kinnick, 2000), video games (Dietz, 1998), films (Hoerrner, 1996), and teen magazines (Massoni, 2004; Pierce, 1993). Before girls even reach adolescence, they have seen countless media images of women that emphasize feminine qualities and urge conformity to traditional gender stereotypes.
The mass media are important sources of information about gender roles for some children. Many children grow up in a media-rich environment and are active users of the media (Signorielli, 1997). Research indicates that many children first begin to watch television between the ages of 2½ and 3 (Comstock & Scherr, 2001). According to a major national study conducted for the Kaiser Family Foundation (1999), children ages 8 to 18 spend an average of 6 hours and 43 min using media each day. The media become even more important sources of influence as children enter adolescence and begin to assert their independence from their parents (Signorielli, 1997). During this time, adolescents look to the media for information on specific life tasks or issues that have the greatest salience to them—tasks such as developing a gender-role identity, learning how to interact with members of the opposite sex, and selecting an occupation and other future life roles (Faber, Brown, & McLeod, 1979). The amount of time children spend using the media each day (Comstock & Scherr, 2001) and their increasing reliance on the media for information during the adolescent years (Austin, Chen, Pinkleton, & Johnson, 2006; Austin & Johnson, 1997; Faber et al., 1979; Griffin et al., 1994; Irving & Berel, 2001; Irving, DuPen, & Berel, 1998; Johnston & Ettema, 1982) underscore the role of the media as pervasive and influential socializing agents in children’s lives.

Girls may rely on media images of women for information about future roles, including gender roles and occupational roles. During adolescence many girls try on different roles as they envision different “possible selves” (Ruvolo & Markus, 1992). Researchers explain that possible selves represent what girls “could become, would like to become, and are afraid of becoming” (Ruvolo & Markus, 1992, p. 95). Girls’ current representations or visions of self guide their behavior and affect their performance in a number of ways as girls shape their identities (Ruvolo & Markus, 1992). Media images of women can provide girls’ with representations of possible selves (Ruvolo & Markus, 1992) that may influence perceptions of themselves and their future roles.

**Theoretical Overview: Gender Schema Theory**

Images of women on television also may shape the extensive networks of gender knowledge children first develop during early childhood (Campbell, Shirley, & Candy, 2004). These networks are called gender schemas (Bem, 1981), the “cognitive structures stored in memory that organize gender-related knowledge, beliefs, attitudes, and preferences” (Liben & Signorelli, 1993, p. 141). Gender schemas have been described as ways of “selecting, processing, and storing information” (Barbera, 2003, p. 177). Gender schemas, just like other schemas children create and store in memory, are mental scripts (Schank & Abelson, 1977) that help children understand experiences in their lives and make decisions about how to behave. 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 upon gender schemas whenever they encounter new information related to gender (Bem, 1993). Research has found boys use gender schemas as early as the age of 25 months (Bauer, 1993). Another study showed that children begin labeling based on gender around the age of 2 or 3 years and show an increase in gender knowledge and sex-typed behavior studies also four activities as early & Beissel, 2002).

Gender schemas however, children 1989; Nihlen & B. children’s perception of gender stereoty (et al., 2004). Children later on (Campbell) regard the gender Nugent, 1998, p. imitation of gender stereotypes gender and gen & Liben, 1990); forget informative 2003; Ruble & St training in reduc

**Media Literacy**

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works of gender hirley, & Candy, native structures, attitudes, and een described as (p. 177). Gender mental scripts n their lives and for information about has, they start to everyday lives, and children related to gender as the age of 25 belonging based on knowledge and sex-typed behavior between the ages of 2 and 3 years (Campbell et al., 2004). Other studies also found that children show some knowledge of adult gender-stereotyped activities as early as by the end of their 2nd year (Poulin-Dubois, Serbin, Eichstedt, Son, & Beissel, 2002).

Gender schemas are important for the development of children's gender identity; however, children often derive gender stereotypes from gender schemas (Levy & Carter, 1989; Nihlen & Bailey, 1998). Research shows that gender stereotypes can then influence children's perceptions, beliefs, and behavior (Bem, 1993). Children begin to show signs of gender stereotype knowledge of items such as toys around the age of 3 (Campbell et al., 2004). Children begin to develop gender stereotype knowledge of occupations later on (Campbell et al., 2004), and girls between the ages of 4 and 5 years “begin to regard the gender stereotyping of masculine occupations as excluding them” (Durkin & Nugent, 1998, p. 397). Gender schemas are dynamic and can be altered, but a temporary inhibition of gender stereotyping does not necessarily indicate a transformation of gender stereotypes (Barbera, 2003). As children encounter new information about gender and gender roles, changes in gender stereotype knowledge may occur (Bigler & Liben, 1990); however, children with more rigid gender schemas tend to alter or forget information that is inconsistent with existing gender schemas (Hughes & Seta, 2003; Ruble & Stangor, 1986). Little research has assessed the efficacy of media literacy training in reducing gender stereotyping and altering gender schemas.

Media Literacy Interventions

Media literacy has been defined a number of ways by researchers, practitioners, and educators. The Center for Media Literacy (Thoman & Jolls, 2005) defines media literacy as follows:

Media Literacy is a 21st century approach to education. It provides a framework to access, analyze, evaluate and create messages in a variety of forms – from print to video to the Internet. Media literacy builds an understanding of the role of media in society as well as essential skills of inquiry and self-expression necessary for citizens of a democracy (p. 21).

This definition of media literacy focuses on messages as constructs with embedded values and recognizes the unique experiences of viewers or audience members (Thoman & Jolls, 2005). Hobbs (2004) identified the following key principles that underlie most media literacy efforts: “All messages are constructions” (p. 26); “messages are representations of the world” (p. 26); “messages have economic and political purposes and contexts” (p. 26); “messages use languages and conventions” (p. 27); and “people interpret messages differently” (p. 27).

Several studies of media literacy interventions have noted the efficacy of media literacy curricula and programs in changing perceptions and attitudes. A comparison of a media literacy intervention focused on critical thinking and social action, a media literacy intervention focused on how to “challenge negative body-related conditions that arise in response to media” (Irving & Berel, 2001, p. 104), and a media literacy intervention that involved watching the video, Slim Hopes, found that all three interventions were
effective in reducing college women's perceptions that media images of thinness are realistic (Irving & Berel, 2001). A study of a media literacy intervention designed to reduce eating disorder risk factors found the media literacy program was more effective than a self-esteem program in reducing eighth-graders' concerns about weight (Wade, Davidson, & O'Dea, 2003). Another study found that a media literacy intervention focused on an information-based lesson and a media literacy intervention focused on emotion were both effective in increasing seventh- and eighth-graders' knowledge about advertising practices and increased their skepticism toward advertisers (Austin et al., 2006). A study designed to change children's responses to violent television found that an evaluative approach focused on negative evaluations of television characters was more effective than a factual approach focused on providing facts about a television program's production techniques in changing children's responses to a violent television program (Nathanson, 2004). These findings were noted for younger children (ages 5-7) as well as older children (ages 10-12), but particularly for the younger children (Nathanson, 2004). A study of children in K-6 grades found that those who watched gender stereotypical clips from the television program One World received instruction refuting the accuracy of the gender stereotyped information and were provided with counter-stereotypical information had less favorable evaluations of a stereotyped program and were more accepting of nontraditional gender roles (Nathanson, Wilson, McGee, & Sebastian, 2002).

Other studies of media literacy interventions have noted changes in both attitudes and behavior. A study of third graders who had participated in media literacy training that included a discussion after viewing a videotape about the techniques used by advertisers found that media literacy training changed children's perceptions of alcohol advertising and perceptions of social norms, desirability, and behavior (Austin & Johnson, 1997). A study of high school students found that an 8-week media literacy curriculum that included lessons to raise awareness of the marketing strategies used by tobacco companies and also incorporated peer influence and resistance skills noted changes in tobacco-related knowledge, attitudes, and behaviors (Gonzales, Glik, Davoudi, & Ang, 2004).

**HYPOTHESES AND RESEARCH QUESTIONS**

This study investigated the overall hypothesis that media literacy training designed to teach critical viewing of stereotyped media portrayals of women will help middle school-aged children recognize and resist gender stereotypes that lead to inaccurate perceptions of women in SET. Based on the literature cited above, the following hypotheses and research questions were posed:

**H1.** Participation in media literacy training that provides instruction on gender stereotypes in the media in addition to viewing videos of gender stereotyped and counter-stereotyped media portrayals of women will be more effective than only participating in the instruction on gender stereotypes in the media and more effective than a control condition in improving middle school-aged children's ability to recognize gender stereotypes.
H2. Participation in media literacy training that provides instruction on gender stereotypes in the media in addition to viewing videos of gender stereotyped and counter-stereotyped media portrayals of women will be more effective than only participating in the instruction on gender stereotypes in the media and more effective than a control condition in positively affecting changes in middle school-aged children's perceptions of women in SET occupations.

H3. Participation in media literacy training that provides instruction on gender stereotypes in the media in addition to viewing videos of gender stereotyped and counter-stereotyped media portrayals of women will be more effective than only participating in the instruction on gender stereotypes in the media and more effective than a control condition in improving middle school-aged children's attitudes toward SET and SET careers.

RQ1. Will differences be found for middle school-aged girls compared with middle school-aged boys related to their recognition of gender stereotypes, perceptions of women in SET occupations, and attitudes toward SET and SET careers?

RQ2. Will differences be found for children who participated in media literacy training compared to children who did not participate in media literacy training related to their perceptions of the accuracy of media portrayals of women?

RQ3. Will importance placed on the media be related to participants' attitudes toward women in SET occupations and attitudes toward SET and SET careers, and will this vary by participants' biological sex?

METHOD

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 12 (American Association of University Women, 1998, 2000), and many girls show a heightened awareness of gender roles at this age (Erkut, Marx, Fields, & Sing, 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%) than boys (47%) took part in the study. The study included students who reported themselves as Caucasian (58%), African American (14%), Mixed race (primarily African American and Caucasian; 14%), Hispanic/Latino/a (5%), Asian or Pacific Islander (2%), or Other (8%). Participants received written consent from a parent or guardian and gave their own written assent. Participation took place at the schools between January and June 2005 during regularly scheduled science classes over a 7-day scheduled period.
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, eight students failed to fully complete both the pretest and the posttest, and nine participants missed more than one of the intervention sessions. These participants were eliminated from the final data analysis resulting in a final sample size of 302. Previous research has indicated that approximately 10% of the variance in outcomes similar to this study can be explained with this type of intervention (Austin & Johnson, 1997), and a power analysis indicated that a sample size of approximately 52 participants per group can detect effects with 90% power. Over-sampling allowed for attrition from Posttest 1 to Posttest 2 and allowed for the inclusion of biological sex as a factor in the analysis.

**Pilot Study**

The media literacy conditions, discussion only, and discussion and video were piloted with 36 local middle school students who 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. Following the pilot, modifications were made to the content of the intervention and to the questionnaire, the details of which are addressed in the following sections. The data from the pilot were not included in the final analysis.

**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 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: (a) discussion only, (b) discussion and video, and (c) control. Participants in Group 1 (discussion only) participated in a media literacy training that included discussions of stereotypes and counter-stereotypes 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 counter-stereotypical images of women in television programs and films as well as discussions of the stereotypes and counter-stereotypes 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. Each intervention lasted for approximately three 40-min class sessions and took place every other school day. Participants in the control group did not receive any treatment, but watched video clips on female or male science and engineering roles and Boy v. Girl? (Abrahams & Austin, 1997). The media perpetuated images of occupations and gender stereotypes, as in Group 1. The participants:

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The instruction included defining gender stereotypes and character notes on the occupation. The students were asked to create a storyboard.
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Many assigned to the treatment sessions. These participants were included in a final sample of 108. The variance in intervention (Austin & Jf approximately 52 sampling allowed for biological sex as a variable in the final analysis.

The media literacy training (discussion only) was designed to teach middle school-aged children to recognize gender stereotypes on television programs and in films and included three interactive discussion sessions. The sessions were adapted from lesson plans for middle school-aged students from Gender Equity Lesson Plans and Teacher Guide developed by the Western Massachusetts Gender Equity Center (1999) and Boy v. Girl? How Gender Shapes Who We Are, What We Want, and How We Get Along (Abrahams & Ahlbrand, 2002). Class Session 1 focused on gender stereotypes and how the media perpetuate these stereotypes. Class Session 2 focused on gender stereotypes of occupations and included a discussion of stereotyped and counter-stereotyped media images of professional women. Class Session 3 focused on gender stereotypes of SET occupations and included a discussion of stereotyped and counter-stereotyped media images of professional women in SET. The lesson plans used for each of these class sessions are described below.

Class Session 1 (Images of Women in the Media). The instructor provided an introduction that included informing the group they would be talking about some of their favorite television and film characters, defining stereotypes and gender stereotypes, asking the group for examples of gender stereotypes, explaining how gender stereotypes limit or "box in" people, and telling the students that stereotypes and gender stereotypes of women are created by the people who create these shows. The participants also completed two activities:

1. Students wrote down the name of their favorite female and male television characters and wrote about their appearances and behavior, and the instructor discussed the gender stereotypical and counter-stereotypical characteristics noted for these characters.
2. Students were assigned to draw a picture of what they thought a female character would look like and to describe what she would act like if shown in a particular role on television (cheerleader, wife and mother, interior designer, babysitter), and the instructor then commented on gender stereotypes as the class looked at transparency of the students' drawings.

The instructor concluded with a review of the information covered in the introduction.

Class Session 2 (Images of Working Women in the Media). The instructor provided an introduction similar to the one given during the first class session. The introduction included defining stereotypes and gender stereotypes, asking the group for examples of gender stereotypes, explaining how gender stereotypes limit or box in people, and telling the students that stereotypes and gender stereotypes of working women are created by the people who create these shows. The participants also completed two activities:
1. Students completed a worksheet that listed different types of occupations and asked students to mark whether they thought that job was done by a man or a woman.

2. Students worked in pairs to draw a picture of what they thought a stereotyped or nonstereotyped working woman on television would look like and wrote down how they thought she might act, and the instructor then discussed the students' responses noting gender stereotypes and counter-stereotypes.

The instructor concluded with a review of the information discussed in the introduction.

Class Session 3 (Images of Women in SET careers in the Media). The instructor provided an introduction similar to the one given during the first class session. The introduction included defining stereotypes and gender stereotypes, asking the group for examples of gender stereotypes, explaining how gender stereotypes limit or box in people, and telling the students that stereotypes and gender stereotypes of women scientists are created by the people who create these shows. The participants also completed two activities:

1. Students worked individually on a worksheet that asked about the appearance and behavior of female and male scientist television characters, and the instructor then asked the students questions that focused on the gender stereotypes and counter-stereotypes of the female scientist characters.

2. Students worked individually on a worksheet that asked them to describe the obstacles they thought women face when they are trying to become scientists or worked as scientists, and the instructor explained ways in which women can overcome these obstacles.

The instructor concluded with a review of the information discussed in the introduction.

Group 2: Media Literacy Training (Discussion and Video)

Students in Group 2 participated in media literacy training designed to teach middle school-aged children to recognize gender stereotypes on television programs and in films followed by viewing videos that showed stereotyped and counter-stereotyped portrayals of women in television programs and films popular among middle school-aged children. The content of the sessions for Group 2 (discussion and video) was much like the content in the discussion class sessions for Group 1 (discussion only), but three videos were used to correspond to the themes and objectives of the class sessions. The video for Session 1 featured stereotyped and counter-stereotyped images of women from television programs and films popular among middle school-aged students. The video for Session 2 featured stereotyped and counter-stereotyped images of women professionals from television programs and films popular with middle school-aged students. The video for Session 3 featured stereotyped and counter-stereotyped images of women SET professionals from popular films.

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The first author and a research assistant viewed over 140 video clips from television programs and films identified to be popular among children ages 12 to 17 based on data from Nielsen Media Research (2004), data from studies on middle school students' media use (Bernt et al., 2003; Signorielli, 1997), and data from a previous study on images of women scientists in popular films (Steinke, 2005). The first author selected 30 of the 140 video clips that best showed stereotypes or counter-stereotypes of women based on previous analyses of media images of women (Steinke, 1999, 2004; Steinke & Long, 1996). Gender stereotypes of women focused on the following attributes or characteristics: (a) physical appearance and beauty; (b) interest in relationships and romance; (c) caring, nurturing, and affectionate nature; (d) emotional and unpredictable; (e) physically weak; (f) silly; (g) unimportant; (h) indecisive; (i) unintelligent; (j) interested in domestic concerns; and (k) lack of interest in professional careers. Gender counter-stereotypes of women focused on the following attributes or characteristics: (a) independent; (b) assertive; (c) self-confident; (d) satisfied or not concerned with physical appearance and beauty; (e) physically strong, (f) knowledgeable and intelligent; (g) leadership skills and abilities; and (h) interest in professional career.

A total of 30 video clips of stereotypes and counter-stereotypes of women from eight television programs (Friends, Gilmore Girls, Will and Grace, 7th Heaven, Dawson's Creek, Buffy the Vampire Slayer, That '70s Show, ER) and 11 films (Happy Gilmore, Medicine Man, Junior, Batman and Robin, Eve of Destruction, Space Cowboys, Love Potion No. 9, Contact, Jurassic Park: The Lost World, Twister, Evolution) were then reviewed and evaluated by two middle school teachers (from schools other than those that participated in the final data collection) and a university physics professor who has mentored young women interested in science. The consultants were presented with an overview of the purpose of the project, definitions of gender stereotypes and counter-stereotypes as described in the previous paragraph, a description of the focus of each of the three class sessions (media stereotypes of women, media stereotypes of working women, media stereotypes of women in SET careers) and each class session's learning objectives:

1. Learn about socially-maintained gender role stereotypes.
2. Learn how the media perpetuate gender role stereotypes (stereotypes of gender roles and occupations, gender role stereotypes of SET careers).
3. Develop analysis skills to recognize gender stereotypes in the media (gender stereotypes of occupations, gender stereotypes of SET professionals).

The reviewers then completed a questionnaire for each video clip that included nine Likert-type items with a five-point response format ranging from "strongly agree" to "strongly disagree." The questionnaire included items to assess (a) the vividness of the gender stereotypes and counter-stereotypes, (b) appropriateness of the content and language for a middle school audience, (c) likelihood that the video clip would interest a middle school audience and stimulate discussion, and (d) usefulness of the video clip in helping a middle school audience think critically about gender stereotypes. The consultants independently completed the questionnaire and then discussed the gender stereotypes and counter-stereotypes in each video clip with the first author. The final
selection of 12 video clips based on the ratings and comments provided by the three consultants is presented in Table 1.

Table 1. Video Clips Selected for Group 2 (Discussion and Video)

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<td>Images of Working Women</td>
<td>Happy Gilmore; 7th Heaven; Friends; ER</td>
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<tr>
<td>Images of Women Scientists</td>
<td>Junior; Love Potion No. 9; Jurassic Park; Contact</td>
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</table>

*Films

Class Session 1 (Images of Women in the Media). The instructor provided an introduction that included informing the group they would be talking about some of their favorite TV and movie characters, defining stereotypes and gender stereotypes, asking the group for examples of gender stereotypes, explaining how gender stereotypes limit or box in people, and telling the students that stereotypes and gender stereotypes seen in images of women scientists portrayed on television and in movies are created by media professionals. The participants in this group then watched four video clips that included stereotypes and counter-stereotypes of women in television programs popular among middle school-aged children. After watching each video clip, the instructor stopped the videotape and asked students questions about the appearance and behavior of the female characters, noting stereotypes and counter-stereotypes of women in these portrayals. For this set of video clips, the instructor asked questions that focused on stereotypes that portrayed women as doing housewives or caregivers and as unprofessional in the workplace and questions that focused on counter-stereotypes that showed women as bold, independent, outspoken, and able to provide a valuable alternative perspective. The instructor concluded with a review of the information discussed in the introduction.

Class Session 2 (Images of Working Women in the Media). The instructor provided an introduction similar to the one given during the first class session. The introduction included defining stereotypes and gender stereotypes, asking the group for examples of gender stereotypes, explaining how gender stereotypes limit or box in people and telling students that stereotypes and gender stereotypes seen in images of working women scientists on television and in movies are created by media professionals. Students then watched four video clips that included stereotypes and counter-stereotypes of working women in television programs and films popular among middle school-aged children. After watching each video clip, the instructor stopped the videotape and asked students questions about the appearance and behavior of the television characters, noting stereotypes and counter-stereotypes of working women in these portrayals. For this set of video clips, the instructor asked questions that focused on the stereotypes of working women as assistants and subordinates viewed and treated as unimportant in the workplace and counter-stereotypes of working women as strong, outspoken, and competent workers able to effectively juggle work and family responsibilities and succeed in traditionally male-dominated careers. The instructor concluded with a review of the information discussed in the introduction.

Instrumentation

As a check on the scales, constituting subject to confirm and parallelism; these analyses are by the authors:

As a check on the scales, which they saw the visibility and perceptions of the items were retained.

Recognition as a pictorial image is likelihood that the scientist is...). The potential order of items assessing e items derived from the authors.

There were eight...
Middle School-Aged Children's Attitudes Toward SET

Class Session 3 (Images of Women in SET careers in the Media). The instructor provided an introduction similar to the one given during the first class session. The introduction included defining stereotypes and gender stereotypes, asking the group for examples of gender stereotypes, explaining how gender stereotypes limit or box in people, and telling the students that stereotypes and gender stereotypes seen in images of women scientists on television and in movies are created by media professionals. Students then watched four video clips of women in SET careers in popular movies. After watching each video clip, the instructor stopped the videotape and asked students questions about the appearance and behavior of the female characters, noting stereotypes and counter-stereotypes of women in SET careers in these portrayals. For this set of video clips, the instructor asked questions that focused on the stereotypes of women scientists as clumsy, absent-minded, geeky, and antisocial and asked questions about the counter-stereotypes of women scientists as competent, brave, adventurous professional, dedicated, determined, and social. The instructor concluded with a review of the information discussed in the introduction.

Group 3: Control
The control group watched three different educational science videos over three different class sessions. The videos were selected to insure they did not show images of women or men in SET careers. Participants in the control group did not participate in media literacy training.

Instrumentation and Measurement
The content of several existing measures was modified in order to be appropriate for this study. Because these modifications may have altered the psychometric properties of the scales, construct validity and reliability were established for all scales. All scales were subject to confirmatory factor analysis (CFA) in order to establish internal consistency and parallelism; standardized item alphas were calculated for each scale. The results of these analyses are provided below; additional details of the analysis are available from the authors.

As a check on the intervention, perceptions of intervention content was assessed by several 7-point, semantic differential items asking participants to estimate the extent to which they saw the content of the intervention as vivid and credible. Perceptions of the vividness of the intervention were measured with four items (e.g., dull/vivid; $\alpha = .81$), and perceptions of credibility were assessed with two items (e.g., realistic/unrealistic; $\alpha = .67$). CFA confirmed two distinct unidimensional dimensions of perceptions. All scale items were retained and items for each dimension were summed.

Recognition of gender stereotypes was assessed by providing participants with a pictorial image of a male and female scientist and asking participants to rate the likelihood that the scientist embodies a variety of characteristics (i.e., "I think this scientist is... "). The order of administration of the pictures was varied to minimize potential order effects. The images were piloted to ensure that the stimulus pictures were approximately equivalent on ratings of perceived attractiveness and age. The items assessing endorsement of stereotypes consisted of a series of semantic differential items derived from Steinke's (1997) work on stereotyping of women in SET careers. There were eight semantic differential items with a 7-point response format in which
participants are asked to rate the likelihood that the male and female scientists would have each characteristic. Examples of the bipolar adjectives used in the measure are “Intelligent/Unintelligent,” “Geeky/Cool,” and “Important/Unimportant.”

Attitudes toward women in SET were assessed using a modified version of Erb and Smith’s (1984) Women in Science Scale (WiSS). The original scale consisted of three dimensions and a total of 27 Likert-type items with a 6-point response format ranging from “strongly agree” to “strongly disagree.” Example items from the WiSS include: “We need more women in science careers” and “Women can make important scientific discoveries.” Erb & Smith (1984) provide evidence for the construct validity and reliability of the scale with a sample of early adolescents. The items were modified from a 6-point to a 7-point response format to allow for a neutral point and to maintain consistency with other measures in the study. CFA of the WiSS scale indicated three unidimensional factors following the removal of one item from each factor; the 7-item scale measuring endorsement of women’s competency in science careers (WiSS F8; $\alpha = .78$), the 8-item factor measuring perceptions of female scientists ability to balance careers and family lives (WiSS F9; $\alpha = .74$), and the 13-item factor measuring attitudes toward women’s competency in SET relative to men’s competency (WiSS F10; $\alpha = .87$). The items on each scale were summed; higher numbers indicate more positive attitudes toward women in science. The means and standard deviations for the WiSS and TOSRA subscales are presented in Table 2.

Table 2. Means and Standard Deviations for Women in Science Scale (WiSS) and Test of Science-Related Attitudes (TOSRA) Subscales

<table>
<thead>
<tr>
<th>Scale</th>
<th>Mean</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Women in Science Scale (WiSS)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Women’s Competency in Science Careers (WiSS F8)</td>
<td>4.17</td>
<td>0.73</td>
</tr>
<tr>
<td>Balance Career and Family (WiSS F9)</td>
<td>3.76</td>
<td>0.69</td>
</tr>
<tr>
<td>Women’s Competency in Science Careers Relative to Men’s Competency (WiSS F10)</td>
<td>4.10</td>
<td>0.72</td>
</tr>
<tr>
<td>Test of Science-Related Attitudes (TOSRA)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enjoyment of Science Lessons (ESL)</td>
<td>2.82</td>
<td>0.63</td>
</tr>
<tr>
<td>Normality of Scientists (NS)</td>
<td>3.38</td>
<td>0.66</td>
</tr>
<tr>
<td>Leisure Interest in Science (LIS)</td>
<td>2.49</td>
<td>0.91</td>
</tr>
<tr>
<td>Career Interest in Science (CIS)</td>
<td>2.78</td>
<td>0.83</td>
</tr>
</tbody>
</table>

Attitudes toward SET and careers in SET were assessed with Fraser’s (1978) Test of Science-Related Attitudes (TOSRA). This measure consists of seven subscales each containing Likert-type items on a 5-point response format (which was modified to a 7-point response format) ranging from “strongly agree” to “strongly disagree.” Schibeci & McGaw (1981) provide evidence for the factor structure of the measure and Joyce and Ferenga (1999) provide reliability data with Alpha coefficients ranging from .60 to .93 for the subscales. For the present investigation, four subscales of the TOSRA were used because the other dimensions were not directly relevant to the present investigation. CFA yielded four unidimensional scales in which all but one item was retained. A 7-item subscale on which respondents rate the importance of various factors in their lives that they are currently not pursuing was not included because of low item reliability. The means and standard deviations for the TOSRA subscales are presented in Table 2.
item subscale titled "Normality of Scientists" (NS) addressed beliefs about a scientist's lifestyle (α = .75); a 6-item "Enjoyment of Science Lessons" (ESL) assessed the extent to which respondents enjoy learning about science in the classroom (α = .89 with one item removed following CFA). The "Leisure Interest in Science" (LIS) scale assessed participation in science-related activities outside of school (six items, α = .80), and the "Career Interest in Science" (CIS) scale assessed the likelihood that respondents would choose a career in science (six items, α = .86).

Perceptions of media portrayals of women were measured with two Likert-type items with a 7-point response format. The wording of these items was "The media sometimes misrepresent female scientists" (reverse scored) and "women portrayed on television are just like real people." Higher scores indicate belief that the media accurately represent women.

Media importance was measured by asking participants the extent to which they see various types of media (e.g., television, radio, etc.) as important to their lives. Participants rated the importance of various media on a series of 7-point semantic differential scales ranging from "important" to "unimportant" in which higher numbers indicated greater importance. Following CFA, items were summed to form a unidimensional scale with six items (α = .62).

**RESULTS**

**Perceptions of the Intervention**

Prior to testing the hypotheses and research questions, the participants' perceptions of the content of the interventions were assessed. These analyses indicate that participants viewed the video-plus-discussion condition (M = 4.12, SD = 1.18) as more vivid than the discussion-only (M = 4.06, SD = 1.23) and control (M = 3.65, SD = 1.35) conditions [F(2, 320) = 3.90, p = .02, η² = .03, r = .17]; this difference was statistically for the discussion relative to the control [t(202) = 2.12, p = .03] and the discussion plus video relative to the control [t(200) = 2.55, p = .01].

For the credibility factor, the participants' rated the video-plus-discussion condition (M = 5.28, SD = 1.48) as more vivid than the discussion-only (M = 5.23, SD = 1.30) and control (M = 5.68, SD = 1.36) conditions [F(2, 299) = 3.05, p = .05, η² = .02, r = .14]; this difference was statistically significant for the discussion relative to the control [t(202) = 2.31, p = .02]. Further examination of this effect revealed a significant biological sex X intervention interaction [F(2, 299) = 3.36, p = .03, η² = .02, r = .14], which indicated that boys generally rated the interventions as less credible than girls, and in particular, boys (M = 4.90, SD = 1.76) rated the video-plus-discussion condition as significantly less credible than girls (M = 5.56, SD = 2.28).

**Recognition of Gender Stereotypes**

The first hypothesis predicted differences by condition in endorsements of stereotypes of female scientists. A series of ANOVA's with biological sex of participant and experimental condition as independent variables and scientist rating items as the
dependent variables revealed no differences by experimental condition or interactions between condition and participants' biological sex on these variables. The means and standard deviations for these analyses are presented in Table 3.

Table 3. Stereotype Means and Standard Deviations for Female and Male Scientists by Experimental Condition

<table>
<thead>
<tr>
<th></th>
<th>Female Scientist Ratings</th>
<th>Male Scientist Ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>Discussion</td>
</tr>
<tr>
<td>Cool</td>
<td>3.74 (1.74)</td>
<td>3.53 (1.41)</td>
</tr>
<tr>
<td>Serious</td>
<td>3.56 (1.78)</td>
<td>3.42 (1.61)</td>
</tr>
<tr>
<td>Boring</td>
<td>4.14 (1.93)</td>
<td>3.78 (1.65)</td>
</tr>
<tr>
<td>Smart</td>
<td>5.99 (1.21)</td>
<td>5.76 (1.31)</td>
</tr>
<tr>
<td>Hardworking</td>
<td>5.70 (1.52)</td>
<td>5.43 (1.69)</td>
</tr>
<tr>
<td>Professional</td>
<td>5.65 (1.75)</td>
<td>5.68 (1.43)</td>
</tr>
<tr>
<td>Skillful</td>
<td>5.64 (1.53)</td>
<td>5.46 (1.34)</td>
</tr>
<tr>
<td>Expert</td>
<td>5.49 (1.54)</td>
<td>5.41 (1.41)</td>
</tr>
</tbody>
</table>

Note: None of the hypothesized differences for stereotypes were significant at \( p < .05 \).

The analysis for Research Question 1 indicated significant main effects for biological sex of participants on their evaluation of scientists. In particular, girls in the study rated female scientists as more skillful \( [F (1, 283) = 4.33, p = .04, \eta^2 = .02, r = .14] \), intelligent \( [F (1, 284) = 4.26, p = .04, \eta^2 = .02, r = .14] \), and expert \( [F (1, 290) = 4.57, p = .03, \eta^2 = .02, r = .15] \), than boys. Main effects for sex on the other variables measuring endorsement of stereotypes were not significant. Boys and girls did not differ significantly on their ratings on male scientists. The mean scores (and standard deviations) on the items for boys and girls are presented in Table 4.

Table 4. Stereotype Means and Standard Deviations for Female and Male Scientists by Biological Sex of Participants

<table>
<thead>
<tr>
<th></th>
<th>Female Scientist Ratings</th>
<th>Male Scientist Ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Boy Mean (SD)</td>
<td>Girl Mean (SD)</td>
</tr>
<tr>
<td>Cool</td>
<td>3.41 (1.54)</td>
<td>3.50 (1.50)</td>
</tr>
<tr>
<td>Serious</td>
<td>3.46 (1.73)</td>
<td>3.49 (1.61)</td>
</tr>
<tr>
<td>Boring</td>
<td>3.79 (1.83)</td>
<td>3.93 (1.64)</td>
</tr>
<tr>
<td>Smart</td>
<td>5.67 (1.60)*</td>
<td>5.99 (1.01)*</td>
</tr>
<tr>
<td>Hardworking</td>
<td>5.43 (1.71)</td>
<td>5.71 (1.43)</td>
</tr>
<tr>
<td>Professional</td>
<td>5.58 (1.61)</td>
<td>5.67 (1.44)</td>
</tr>
<tr>
<td>Skillful</td>
<td>5.30 (1.70)*</td>
<td>5.67 (1.27)*</td>
</tr>
<tr>
<td>Expert</td>
<td>5.13 (1.74)*</td>
<td>5.48 (1.30)*</td>
</tr>
</tbody>
</table>

Note: a, b, & c are statistically different at \( p < .05 \).
Attitudes Toward Women in SET

The second hypothesis tested the effect of the interventions on attitudes toward women in SET careers. This hypothesis was tested by a series of ANOVA analyses with biological sex and condition as the independent variables and scores on the three dimensions of the WiSS scale as the dependent variables. Analysis of the first dimension (F1), which measured the extent to which participants perceived women as competent to hold SET careers, indicated no main effect for condition [F (2, 290) = .35, \( p = .71 \)], a significant main effect for sex [F (1, 290) = 18.92, \( p = .01 \), \( \eta^2 = .06 \); \( r = .25 \)], and no significant effect for interaction between sex and the intervention conditions [F (2, 290) = .13, \( p = .87 \)]. The means and standard deviations for these effects are presented in Table 5.

Table 5. WiSS Means (M) and Standard Deviations (SD) for Boys and Girls by Experimental Condition

<table>
<thead>
<tr>
<th>Condition</th>
<th>Sex</th>
<th>Women's Competency to Have SET Careers M (SD)</th>
<th>Women in SET Can Have Successful Careers and Family M (SD)</th>
<th>Women's Competency in SET Careers Relative to Men's M (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>Boys</td>
<td>4.05 (.77)</td>
<td>3.64 (.74)</td>
<td>3.94 (.68)</td>
</tr>
<tr>
<td></td>
<td>Girls</td>
<td>4.39 (.53)</td>
<td>3.96 (.63)</td>
<td>4.21 (.65)</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>4.23 (.67)</td>
<td>3.81 (.70)</td>
<td>4.09 (.67)</td>
</tr>
<tr>
<td>Discussion</td>
<td>Boys</td>
<td>4.02 (.82)</td>
<td>3.69 (.72)</td>
<td>4.08 (.62)</td>
</tr>
<tr>
<td></td>
<td>Girls</td>
<td>4.33 (.58)</td>
<td>4.01 (.56)</td>
<td>4.31 (.68)</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>4.17 (.73)</td>
<td>3.84 (.67)</td>
<td>4.20 (.66)</td>
</tr>
<tr>
<td>Discussion</td>
<td>Boys</td>
<td>3.94 (.85)</td>
<td>3.45 (.74)</td>
<td>3.93 (.68)</td>
</tr>
<tr>
<td></td>
<td>Girls</td>
<td>4.34 (.52)</td>
<td>3.82 (.64)</td>
<td>4.26 (.56)</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>4.17 (.71)</td>
<td>3.66 (.71)</td>
<td>4.12 (.63)</td>
</tr>
<tr>
<td>Marginal Means</td>
<td>Boys</td>
<td>4.08 (.80)(^a)</td>
<td>3.59 (.73)(^b)</td>
<td>3.98 (.65)(^c)</td>
</tr>
<tr>
<td></td>
<td>Girls</td>
<td>4.35 (.54)(^a)</td>
<td>3.92 (.61)(^b)</td>
<td>4.26 (.62)(^c)</td>
</tr>
</tbody>
</table>

For the second WiSS factor (F2), which measured the extent to which participants perceived that females in SET could have both successful career and family lives, analysis indicated that there was not a significant main effect for condition [F (2, 290) = 2.67, \( p = .07 \)]. The ANOVA indicated a significant main effect for sex [F (1, 290) = 18.21, \( p = .01 \), \( \eta^2 = .06 \); \( r = .25 \)], and the interaction between sex and the intervention conditions was not significant [F (2, 290) = .04, \( p = .96 \)].

Analysis of scores on the WiSS factor designed to measure the extent to which participants endorse women in science careers relative to men (F3) indicated no significant main effect for condition [F (2, 290) = 1.07, \( p = .36 \)], a significant main effect for sex [F (1, 290) = 13.26, \( p = .01 \), \( \eta^2 = .04 \); \( r = .20 \)], and no significant for the interaction between sex and the intervention conditions [F (2, 290) = .17, \( p = .85 \)]. Thus, across WiSS...
dimensions, a similar pattern emerges; significant main effects for sex with girls having more positive attitudes towards women in science than boys (RQ1) and no main effects for condition or interactions between sex and experimental condition (H2). The means and standard deviations for these effects are presented in Table 5.

**Attitudes toward SET and SET Careers**

The third hypothesis examined the effects of the intervention on TOSRA subscale scores. Analysis of scores on the NS scale indicated a small but significant main effect for sex \(F(1, 290) = 4.53, p = .03, \eta^2 = .01, r = .12\) and for experimental condition \(F(2, 290) = 3.17, p = .04, \eta^2 = .02, r = .15\). The interaction between the two scores was not significant \(F(2, 290) = .08, p = .93\). Examination of the means (Table 6) indicates that mean scores were highest for people in the control condition. Girls exhibited higher means scores than boys.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Gender</th>
<th>Normality of Scientists Mean (SD)</th>
<th>Enjoyment of Science Lessons Mean (SD)</th>
<th>Leisure Interest in Science Mean (SD)</th>
<th>Career Interest in Science Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>Boy</td>
<td>3.42 (0.65)</td>
<td>2.95 (0.64)</td>
<td>2.54 (0.88)</td>
<td>2.91 (0.93)</td>
</tr>
<tr>
<td></td>
<td>Girl</td>
<td>3.57 (0.56)</td>
<td>2.95 (0.65)</td>
<td>2.56 (0.87)</td>
<td>2.87 (0.78)</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>3.50 (0.60)</td>
<td>2.95 (0.64)</td>
<td>2.55 (0.87)</td>
<td>2.89 (0.85)</td>
</tr>
<tr>
<td>Discussion</td>
<td>Boy</td>
<td>3.29 (0.79)</td>
<td>2.78 (0.64)</td>
<td>2.50 (1.00)</td>
<td>2.78 (0.87)</td>
</tr>
<tr>
<td>Only</td>
<td>Girl</td>
<td>3.49 (0.60)</td>
<td>2.89 (0.58)</td>
<td>2.52 (0.87)</td>
<td>2.87 (0.70)</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>3.39 (0.68)</td>
<td>2.84 (0.61)</td>
<td>2.51 (0.93)</td>
<td>2.82 (0.79)</td>
</tr>
<tr>
<td>Discussion</td>
<td>Boy</td>
<td>3.19 (0.68)</td>
<td>2.83 (0.62)</td>
<td>2.59 (0.93)</td>
<td>2.76 (0.80)</td>
</tr>
<tr>
<td>and Video</td>
<td>Girl</td>
<td>3.33 (0.61)</td>
<td>2.62 (0.58)</td>
<td>2.30 (0.93)</td>
<td>2.56 (0.84)</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>3.31 (0.71)</td>
<td>2.70 (0.60)</td>
<td>2.42 (0.94)</td>
<td>2.64 (0.82)</td>
</tr>
</tbody>
</table>

ANOVA indicated a small but statistically significant main effect for the intervention variable \(F(2, 290) = 3.24, p = .03, \eta^2 = .02, r = .15\) on scores on the ESL measure. Examination of the means indicates that the mean scores were in the opposite of the predicted direction (see Table 6). The main effect for sex \(F(1, 290) = .21, p = .64\) and the interaction between sex and experimental condition \(F(2, 290) = 1.62, p = .20\) were not significant.

Analysis of the LIS scores indicated neither the main effects for experimental condition \(F(2, 290) = .33, p = .72\) or sex \(F(1, 290) = 58, p = .45\) nor the interaction between the two \(F(2, 290) = .95, p = .39\) were significant. Similarly, for scores on the CIS, neither the main effects for experimental condition \(F(2, 290) = 2.01, p = .13\) or sex \(F(1, 290) = .25, p = .62\) nor the interaction between the two \(F(2, 290) = 81, p = .45\) were significant. Thus, the analysis of TOSRA subscale scores indicates effects for experimental condition of two of the dimensions; not in the direction predicted by H3 (Table 6) and a significant main effect for sex on the normality of science scale (RQ1) such that girls viewed scientists as more normal than did boys.

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**Volume 12, Issue 4**

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Research of women as th women are acc 4.98, p = .03, \eta^2 that people in th women are acc = .82) or video . = .05, r = .22]. B and discussion not differ from Research media related the extent to which 7 indicate a ne for boys but no (ESL, NS, LIS).
Research Question 2 was tested via 2 X 2 ANOVA with biological sex and experimental conditions as the independent variables and evaluation of media portrayals of women as the dependent variable. These analyses indicated a significant main effect for biological sex such that boys \( (M = 2.81, SD = .86) \) were more likely to indicate that women are accurately portrayed in the media than girls \( (M = 2.6, SD = .71, F(1, 290) = 4.98, p = .03, \eta^2 = .02, r = .13) \). There was also a significant main effect for condition such that people in the control condition \( (M = 2.94, SD = .73) \) were more likely to indicate that women are accurately portrayed in the media than those in the discussion \( (M = 2.67, SD = .82) \) or video and discussion condition \( (M = 2.49, SD = .76; F(2, 290) = 7.53, p = .01, \eta^2 = .05, r = .22) \). Bonferroni post hoc analysis indicated that both the video and discussion and discussion only differ significantly from control, but that these two conditions did not differ from one another \( (p = .05) \).

Research Question 3 examined the extent to which the importance placed on the media related to participants' attitudes toward science and women in science and the extent to which these vary by sex of the participant. The correlations presented in Table 7 indicate a negative association between WiSS factor 8 and 9 and media importance for boys but not for girls. The data also indicate a negative association between TOSRA (ESL, NS, LIS) scores and media importance for girls but not for boys.

### Table 7. Correlations between the Media Importance Scale and WiSS and TOSRA Dimensions for Boys and Girls

<table>
<thead>
<tr>
<th>Scales</th>
<th>Boys</th>
<th>Girls</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Women's Competency in Science Careers</td>
<td>-0.10</td>
<td>0.26</td>
</tr>
<tr>
<td>WiSS 8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Balance Career and Family WiSS 9</td>
<td>-0.25**</td>
<td>0.003</td>
</tr>
<tr>
<td>Women's Competency in Science Careers Relative to Men's WiSS 10</td>
<td>-0.21*</td>
<td>0.02</td>
</tr>
<tr>
<td>Enjoyment of Science Scale (ESL Scale)</td>
<td>-0.08</td>
<td>0.38</td>
</tr>
<tr>
<td>Normality of Scientists (NS Scale)</td>
<td>-0.06</td>
<td>0.5</td>
</tr>
<tr>
<td>Leisure Interest in Science (LIS Scale)</td>
<td>-0.10</td>
<td>0.26</td>
</tr>
<tr>
<td>Career Interest in Science (CIS Scale)</td>
<td>0.01</td>
<td>0.96</td>
</tr>
</tbody>
</table>

* indicates effects for the scores on the ESL scale (RQ1) for experimental condition \( F(2, 290) = .21, p = .64 \) and for scores on the \( (2, 290) = .17, p = .33 \) or \( (2, 290) = 81, p = .02 \) indicates effects for the interaction and no main effects on (H2). The means on TOSRA subscale significant main effect for the scores on the ESL scale (RQ1) for experimental condition \( F(2, 290) = .21, p = .64 \) and for scores on the \( (2, 290) = .17, p = .33 \) or \( (2, 290) = 81, p = .02 \) indicates effects for the interaction and no main effects on (H2).
DISCUSSION

The overall goal of the study was to assess whether media literacy training designed to teach critical viewing of stereotyped media portrayals of women influenced middle school-aged children's ability to recognize gender stereotypes, their perceptions of women in SET, and their attitudes toward SET and SET careers. The study also was designed to understand the role of the media literacy training on evaluations of media portrayals of women and to examine the role of media importance on attitudes. Contrary to expectations, there were no significant differences found among middle school-aged children who participated in media literacy training compared with those who did not participate in media literacy training on scores on the WISS and TOSRA. This was true for children who participated in the media literacy condition that included only interactive discussions on gender stereotypes in the media and for children who participated in the media literacy condition that involved interactive discussion on gender stereotypes in the media plus viewing of stereotyped and counter-stereotyped images of women from television programs and films popular among middle school-aged children. These findings occurred despite the fact that both boys and girls rated the video plus discussion intervention as more vivid and interesting than the control.

Because the interventions focused on discussions of media images of women and the discussion-plus-video intervention featured primarily images of women, the lack of influence of the interventions on boys' attitudes was not completely unexpected. Research indicates that the effectiveness of a message is related to viewers' perceived similarity to the source of the message (Appiah, 2002; Basow & Howe, 1980), and other research shows that children are more likely to identify with same-sex characters on television (Miller & Reeves, 1976). Our finding, which indicates that boys considered the interventions as less credible than the girls, is one explanation for the limited findings for boys. It was more surprising that no differences were found for girls who had participated in the media literacy training, especially those who had participated in the media literacy training that included video clips featuring stereotypes and counter-stereotypes of women on television and in films.

Several factors may be useful in strengthening the media literacy intervention. First, the duration of the intervention may not have been long enough. Although effects have been noted for media literacy interventions of similar (Wade et al., 2003) or even shorter duration (Austin & Johnson, 1997; Irving & Berel, 2001; Nathanson, 2004; Nathanson et al., 2002), a longer intervention period may be needed in order to detect the effects assessed in this study because such changes correspond to alterations in gender schemas, which are known to be highly resistant to change (Hughes & Seta, 2003; Ruble & Stangor, 1986). Second, the content of the intervention may not have provided strong enough messages about the inappropriateness of using gender to define women's professional roles and women's abilities as professionals in SET careers. Recent research has begun to examine how different approaches in media literacy training such as media literacy instruction that involves factual vs. evaluative approaches (Nathanson, 2004) and media literacy instruction that involves information-based vs. an emotive teaching style (Austin et al., 2006) may influence outcomes. Third, the media literacy training may have unintentionally made middle school-aged students more resistant to accepting changes in gender schemas, thus also resistant to changing attitudes toward gender roles. If existing gender change existing in perceptions a day after the and updating of determining how follow-up question because of the Fifth, it may be such as critical which can be women in the perceptions. P women are accepting. This finding in skills might be important in girls' and boys' There were differences of female science and qualified items that ask have positive having access to the same value in this study with an important role had more negative media were likely boys may hold stereotypes women's science hold stereotypes 1997; Chamber 1989; Maoldon Newton, 1998; school-aged girls who ways and suggest women's science study on mid toward women.

Although girls' interest is important to the development of
The study also was influenced by the perceptions of media literacy and TOSRA. This perception that included for children who did not participate in interventions on stereotyped middle school- and girls rated the intervention as important. Although Nathanson et al., 2003; Nathanson, 2004; and other research on stereotypes of women and men, the lack ete unexpected. Researchers perceived sex characters on the media and for girls in the media and the lack of critical thinking rather than more long-term outcomes such as attitude change, which can be more difficult to achieve. Our findings regarding critical evaluation of women in the media indicate that the interventions were influential in modifying these perceptions. Participants in the control conditions were more likely to indicate that women are accurately portrayed by the media than those in the intervention conditions. This finding indicates that targeting these endogenous factors such as critical evaluation skills might be most profitable when creating media literacy training programs.

Interestingly, the findings of this research found a number of significant differences in girls' and boys' perceptions of women in SET and their attitudes toward women in SET. There were differences in the ways in which girls and boys evaluated the characteristics of female scientists, with girls rating female scientists as more skillful, intelligent, expert, and qualified than did boys. In addition, girls and boys had very different scores on items that asked about women in science, with girls being more likely than boys to have positive attitudes toward women being as good at science careers as men, women having access to science courses and career opportunities, and a woman's career having the same value as a man's. The boys' negative attitudes toward women in science found in this study were related to the extent to which boys reported that the media played an important role in their lives. That is, boys who indicated the media were very important had more negative attitudes toward women in science than those who indicated the media were less important. These findings suggest that middle school-aged girls and boys may hold very different perceptions of female scientists, with girls perceiving female scientists in less gender-stereotyped ways. Previous research shows children hold stereotyped perceptions of SET and women in SET (Andre et al., 1999; Barman, 1997; Chambers, 1983; Farmer et al., 1998; Fort & Varney, 1989; Jacobowitz, 1983; Kahle, 1989; Maoldomhnaigh & Hunt, 1988; Matthews, 1996; Mead & Metraux, 1957; Newton & Newton, 1998; Rosenthal, 1993; Song & Kim, 1999). These findings suggest that middle school-aged girls and boys may hold very different perceptions of female scientists, with girls perceiving female scientists in less gender-stereotyped ways. Previous research shows children hold stereotyped perceptions of SET and women in SET (Andre et al., 1999; Barman, 1997; Chambers, 1983; Farmer et al., 1998; Fort & Varney, 1989; Jacobowitz, 1983; Kahle, 1989; Maoldomhnaigh & Hunt, 1988; Matthews, 1996; Mead & Metraux, 1957; Newton & Newton, 1998; Rosenthal, 1993; Song & Kim, 1999). These findings suggest that middle school-aged girls and boys may be less likely than boys to see female scientists in stereotypical ways and suggest that girls have overall more positive attitudes towards the value of women's science careers and women's abilities in science. These findings from this study on middle school-aged boys' attitudes toward women in science were consistent with previous research that found high school-aged boys have more negative attitudes toward women in science than did girls (Stake, 2003).

Although many science intervention programs have centered around improving girls' interest and ability in SET (NSF, 2003), these findings suggest that it is equally important to explore the efficacy of science intervention programs to encourage the development of positive attitudes among boys related to girls and women in SET. The
need for the development of science intervention programs focused on promoting boys' positive attitudes toward girls and women in SET, when offered to complement the many existing science intervention programs focused on developing girls, may be critical for changing the overall culture of the SET workforce. Recent research has documented the negative experiences voiced by women in scientific workplaces (Gunter & Stamach, 2005). One study found that larger percentages of female scientists than male scientists described "uncomfortable, tense, or hostile interactions" (Gunter & Stamach, 2005, p. 133). Another study described the extra burden placed on women who experience conflict that stems from the "inflexible social organization of science" at work (Gupta, Kemelgor, Fuchs, & Etzkowitz, 2005, p.1383), a disproportionate amount of domestic responsibilities because of traditional gender role expectations, and exclusion from strong professional networks (Gupta et al., 2005). Careful attention to boys and girls' attitudes toward women in SET is needed in order to ensure workplace cultures that are inclusive of women as well as men.

The findings for media importance indicate the influential role of this factor in shaping attitudes and indicate that this variable manifests differently for boys and girls. Specifically, these findings indicate that the extent to which boys view the media as an important part of their lives is negatively associated with their attitudes toward women in science. These findings were not replicated for girls in this sample. For girls, these data indicate that media importance was negatively associated with the extent to which girls enjoy science, view scientists as normal, and take a leisure interest in science; there was no such pattern of effects for boys. These findings suggest that it is important to examine, more specifically, the media used by boys and to examine the specific messages and images in this media content. It is important to determine, for example, whether the media messages and images in the media most often used by adolescent boys are gender stereotyped and to assess the impact, if any, of this media content on boys' perceptions of women in SET. Studies from the 1980s have shown gender bias in science television programming for children (LaFollette, 1981; Steinke & Long, 1996), but more recent research in this area needs to address current media content that is most likely to be used by adolescent boys today.

**FUTURE RESEARCH**

Future research should continue to explore how media literacy training can be best designed as part of science intervention programs to foster positive attitudes toward women in SET. Although many science intervention programs have been found to increase girls' interest in SET, the effectiveness and long-term influence of these programs varies. For example, one study showed that participation in computer-assisted career intervention increased middle school-aged children's interest in nontraditional careers and suggested that interventions may need to be combined with career planning and vocational development (Turner & Lapan, 2005). Another study indicated it was possible to change children's attitudes toward science through the use of female role models as teachers and the use of informal hands-on science and engineering activities (Teshome, Maushak, & Athreya, 2001). An intervention that included teaching female students about the effects of "stereotype threat" (Johns, Schmader, & Martens, 2004) has been found to be effective in increasing the motivation of female students to pursue careers in science, technology, engineering, and mathematics (STEM) fields. However, a 2019 study by Potter and colleagues found that female students who received this intervention were more likely to believe that they could achieve high levels of success in these fields, which was not observed in the control group. Further research is needed to explore the potential impact of this intervention on the long-term success and retention of female students in STEM fields.
In promoting boys' activities to complement the girls' activities, it has been documented by Gunter & Stamach (2005) that male scientists and Stamach, 2005, experience exclusion from the male-dominated cultures that are prevalent in these fields. For boys and girls, the media are influential in shaping attitudes toward careers, and leisure interest in activities such as computer-assisted career planning. Studies have indicated that female role models, career information, and exercises to dispel stereotypes of women in science have shown to improve these women's performance on a math test. However, a 2-week residential program that included hands-on experiments, female role models, career information, and exercises to dispel stereotypes of women in science found the program had no affects on science self-concept, enjoyment and interest in science, and career aspirations in science (Jayaratne, Thomas, & Trautmann, 2003).

Although studies that have employed similar approaches to the one used in this study have noted changes in perceptions, attitudes, and behavior (Austin & Johnson, 1997; Irving & Berel, 2001; Johns et al., 2004; Wade et al., 2003), further research is needed on the most effective strategy for using media images in media literacy interventions. Research needs to determine the specific criteria girls use when evaluating media models and messages in order to assess how specific features of media models such as attractiveness, age, race, and appearance might influence girls' perceptions. Different effects may be noted for interventions that use stereotyped images to dispel gender stereotypes compared with interventions that use counter-stereotyped images to emphasize the dearth of gender stereotypes or compared with interventions that use both stereotyped and counter-stereotyped images to reduce gender stereotyping. In this study, participants in the discussion-plus-video media literacy condition viewed stereotyped and counter-stereotyped images as part of the media literacy training. It is possible the participants were influenced more by the stereotyped images than the counter-stereotyped images. It is also possible that even positive images sometimes conveyed subtle stereotypes. Furthermore, additional research is needed to assess better the potential influence of media role models on girls' perceptions of women in SET, attitudes toward SET, and SET careers.

Further research on the efficacy of media literacy training also needs to explore ways of incorporating what Potter (2004) calls "a cognitive theory of media literacy." As Potter writes:

Educating people to be more literate involves far more than simply making them aware of the media content, motives of the media industries, and the potential negative effects; it needs to build from a deep understanding about how people use the media in their everyday lives, how people come to believe that their media usage is functional to achieving their goals, and how unwanted effects accumulate as byproducts of everyday exposure (p. 266).

A cognitive approach to media literacy that takes into account the influence of existing cognitive structures, like gender schemas, would provide additional insight on what motivates changes in perceptions, attitudes, and behavior. Future research also should include longitudinal studies to determine how enduring are perceptual changes, when achieved through media literacy interventions (Finson, 2002), and how these perceptual changes then influence behavior.

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