Gender Differences in Adolescents’ Wishful Identification With Scientist Characters on Television

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Abstract

Adolescents’ wishful identification with televised scientist characters was examined as related to interactions among the following variables: gender of participant, gender of scientist character, program genre, and selected character attributes. Findings indicated some gender differences in adolescents’ wishful identification with scientist characters they viewed on television. Boys showed more wishful identification with male scientist than with female scientist characters for all character attributes, and girls showed more wishful identification with female scientist than with male scientist characters portrayed dominant or as working alone. Both girls and boys showed more wishful identification with scientist characters in drama programs than for those in cartoon and educational programs across all character attributes. Both girls and boys showed more wishful identification for some character attributes depending on the program genre viewed. Implications of these

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findings for producers of television programs and other media are discussed related to efforts to encourage adolescent girls’ interest in science careers.

Keywords
adolescents, television, wishful identification, images of scientists, girls and science, gender differences

Introduction
Assessing adolescents’ wishful identification or wanting to be like the scientist characters that they see on television is important for efforts to increase adolescents’ interest in science and in future scientific careers. Televised scientist characters are potential occupational role models for adolescents. In fact, adolescents’ conceptions of actual scientists largely extend from the symbolic images of scientists they see in the media (Steinke et al., 2007). Television scientist characters may provide vicarious contact (Bandura, 2009; Fujioka, 1999) with scientist role models when opportunities to directly observe and interact with human role models are limited or not possible at all. Identification with televised scientist characters may be an important precursor for envisioning future careers in science and ultimately for the needed expansion and diversification of the scientific workforce (National Science Foundation, 2011).

Of particular interest in assessing adolescents’ wishful identification with televised scientist characters is the extent to which gender differences exist. Differences in boys’ and girls’ gender stereotypes (Miller, Lurye, Zosuls, & Ruble, 2009) and the influence of gender stereotypes on their perceptions of masculine and feminine occupations (Gupta, Turban, & Bhawe, 2008; Oswald, 2008) have been documented. However, research has not addressed how televised images of scientists influence girls’ identification with scientists. Determining the variables that influence girls’ identification with televised role models may be effective for intervention efforts centered on building a more diverse scientific workforce (Congressional Commission on the Advancement of Women and Minorities in Science Engineering and Technology Development, 2000). In addition, research focused on gender differences in adolescent viewers’ wishful identification with televised scientist characters is needed to better determine if current televised models of scientists are adequate vicarious role models for adolescent girls who at this age are likely to turn away from science activities and lose interest in science (American Association of University Women, 1998, 2000; Tracey & Sodano,
Previous studies of the representation and portrayals of women scientists on television have documented both a dearth of women scientists (La Follette, 1981; Long et al., 2010; Steinke & Long, 1996; Wagner & Caudill, 2003) and stereotypical depictions of women scientists that minimize their expertise and ability (Steinke & Long, 1996).

Television plays an important role in identity formation and career development for adolescents as they begin at this age to consider desired future roles, including future occupational roles (Roeser & Lau, 2002). Research has found that adolescents’ feelings of connection or identification with television characters can influence their occupational attitudes, values, and aspirations (Hoffner et al., 2006; Hoffner, Levine, & Toohey, 2008). The pervasiveness of the media in adolescents’ lives (Comstock & Scharrer, 2001) underscores television’s potential to influence their career choices; children aged 6 to 18 years watch or are exposed to approximately 3 hours of television a day (Jordan, Hersey, McDivitt, & Heitzler, 2008; Roberts, Foehr, & Rideout, 2005).

Identification has been defined by Cohen (2001) as “feelings of affinity, friendship, similarity, and liking of media characters or imitation of a character by audience members” (p. 249). According to this definition, audience members who identify with media characters perceive what they are watching as if the event were happening to them (Cohen, 2001). According to Cohen, during the process of identification, “an audience member imagines him or herself being a character and replaces his or her identity and role as audience member with the identity and role of the character within the text” (pp. 250-251). Identification in this context occurs at the moment of viewing (Cohen, 2001). Audience members’ connections, or their vicarious experiences with media characters while viewing television occur through their temporary “transportation” into the narrative world of the character (Green, Brock, & Kaufman, 2004, p. 312).

Identification also has been defined by Reeves and Miller (1978) as “a process by which viewers take on abstract psychological characteristics of a model such as values, personality traits or social roles” (p. 71). This definition describes viewers’ desires to “be like” and “do things like” television characters (Reeves & Lometti, 1979) and also accounts for “distance” or viewers’ perceptions of perceived differences as well as perceived similarities with television characters (Reeves & Miller, 1978). This definition of identification specifies that viewers need to identify first with television characters before imitation and behavioral changes occur (Reeves & Miller, 1978).

These early conceptualizations of identification have been extended through the concept of wishful identification in order to describe what viewers may experience beyond an immediate viewing situation (Hoffner, 1996).
Wishful identification has been defined as wanting or wishing to be like a fictional or media character (Feilitzen & Linne, 1975; Hoffner, 1996; Hoffner & Buchanan, 2005; Lonial & Van Auken, 1986). Wishful identification also has been referred to as “idealization” of television characters (Greenwood, 2007; Greenwood, Pietromonaco, & Long, 2008). Wishful identification is the result of a desire to be like a character rather than feelings of similarity with a character (Lonial & Van Auken, 1986). Wishful identification appears to be an important precursor to social learning (Bandura, 1969) and modeling as described in Bandura’s (2002) social cognitive theory. Studies have linked wishful identification to the imitation of television characters and have suggested that this imitation has the potential to lead to attitudinal and behavioral changes (Eyal & Rubin, 2003; Tian & Hoffner, 2007).

The purpose of the present study was to examine gender differences in adolescent viewers’ responses to televised scientist characters through their wishful identification with male and female scientist characters. In this assessment of wishful identification, a number of variables, in addition to the gender of the television viewer, also were taken into account. First, the gender of the televised scientist character was considered because research has found gender differences in boys’ and girls’ wishful identification with male and female characters (Hoffner, 1996; Hoffner et al., 2006). Second, the specific attributes of the televised scientist characters were considered because research has documented gender differences in children’s and young adults’ wishful identification with televised characters portrayed with different attributes (Hoffner, 1996; Hoffner et al., 2006; Miller & Reeves, 1976), and previous research found specific attributes to be more prevalent in portrayals of televised scientist characters (Long et al., 2010). Third, the television program genre was considered because studies have noted both differences in the portrayals of scientists in different genres of programs (Long et al., 2010) and gender differences in children’s preferences for television program genres (Cherney & London, 2006; Huston, Wright, Rice, Kerkman, & St. Peters, 1990).

Additionally, the design of the present study accounted for individual viewer differences (adolescents’ attitudes toward science, attitudes toward women in science, and perceptions of their own ability to succeed in science in school) as related to their wishful identification with televised scientist characters. Adolescents’ wishful identification with televised scientist characters is likely to be shaped and controlled by an array of environmental influences and personal factors of viewers as described by social cognitive theory (Bandura, 2009). Thus, the present study assessed specific preexisting attitudes of adolescent viewers related to science and their perceptions of their ability in science because these may influence wishful identification.
with televised scientist characters. Studies have noted that adolescents’ interest in science fields has been affected by their attitudes toward science (Cleaves, 2005) and self-efficacy beliefs toward science (Turner & Lapan, 2005; Weisgram & Bigler, 2006), but these studies have not examined the influence of these attitudes on viewers’ wishful identification with televised scientist characters.

In summary, the present study focused on gender differences in adolescent viewers’ wishful identification with scientist television characters by investigating interactions among the following four variables: (a) gender of the television viewer (girls, boys), (b) gender of the television character (female, male), (c) specific attributes or traits exhibited by the television character (intelligent, dominant, alone, respected, caring), and (d) program genre (cartoon, drama, education) in which the television character appeared (see Figure 1).

The present study’s investigation of wishful identification with television scientist characters utilized a novel methodological approach. Previous studies of wishful identification typically have relied on surveys (Greenwood, 2007; Greenwood et al., 2008; Hoffner & Buchanan, 2005; Hoffner et al., 2006; Hoffner et al., 2008) or interviews (Hoffner, 1996) to obtain viewers’

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**Figure 1. Wishful identification with televised scientist character**
self-reports of wishful identification. The present study examined wishful identification in an experimental setting in order to capture the potential influence of exposure to television characters on viewers’ wishful identification immediately after participants viewed the characters on television. Previous studies also have focused primarily on viewers’ wishful identification with favorite television characters (Chory-Assad & Cicchirillo, 2005; Greenwood, 2007; Greenwood et al., 2008; Hoffner, 1996; Hoffner & Buchanan, 2005; Hoffner et al., 2006; Hoffner et al., 2008). The present study, like those by Reeves and Miller (1978) and Tian and Hoffner (2007), explored viewers’ wishful identification with television characters whether reported as liked or not liked by the viewer.

**Literature Review**

**Social Cognitive Theory**

Wishful identification with television characters may be an important precursor for motivating and enhancing adolescent viewers’ modeling of the behavior of these characters. According to social cognitive theory, children learn intentionally and unintentionally through repeated observations of both actual models in their social environments and symbolic models such as those depicted in the media (Bandura, 1969, 2009). Observational learning from televised models can be particularly powerful because “in observational learning a single model can transmit new ways of thinking and behaving simultaneously to countless people in widely dispersed locales” (Bandura, 2009, p. 98). Children’s observations of media models can lead them to imitate the behavior of these models as well as to change their values and aspirations (Bandura, 1986, 2009; Hoffner et al., 2008). As Bandura (2009) states: “By drawing on these modeled patterns of thought and behavior, observers can transcend the bounds of their immediate environment” (p. 98).

Observational learning from media models and the extent of influence of these models is guided by four processes (Bandura, 2009). First, attention to the media models needs to occur; second, the media models need to be remembered or retained in memory; third, symbolic representations or knowledge of the models’ behaviors needs to be translated into action; and fourth, motivation to imitate the observed behavior must be present (Bandura, 2009). When this response occurs, children’s perceptions of social reality can be shaped by the vicarious experiences observed in media models. As Bandura (2009) explains, “seeing others gain desired outcomes by their actions can create outcome expectancies that function as positive incentives” (p. 103). The ultimate influence of media models on children’s behavior,
however, is ultimately determined by interactions among an array of personal, behavioral, and environmental factors.

**Wishful Identification With Television Characters**

Viewers’ observational learning from media models as described by social cognitive theory has been associated with their wishful identification with television characters. The influence of media models or the extent to which children are likely to learn from and imitate behavior they see on television has been linked to their identification with television characters (Eyal & Rubin, 2003). Prior research on wishful identification with television characters informed the selection of variables examined in this study.

The gender of the television viewer and the gender of the television scientist character are important variables to consider in examining wishful identification because prior research has showed that children and young adults identify more with characters of the same gender (Calvert, Strong, Jacobs, & Conger, 2007; Chory-Assad & Cicchirillo, 2005; Hoffner, 1996; Hoffner & Buchanan, 2005; Hoffner et al., 2008) and characters that they perceive to have similar characteristics to themselves (Hoffner, 1996; Hoffner & Buchanan, 2005; McDonald & Kim, 2001). A study of elementary school-aged children found that almost all boys, and about half of the girls, selected same-gender characters as their favorite characters (Hoffner, 1996). A study of late adolescents found that over 90% of male viewers and half of female viewers selected same-gender favorite characters (Hoffner et al., 2008). Formative research for the television science program *3-2-1 Contact* found that late elementary school boys preferred male cast members while girls preferred female cast members (Mielke, 1983).

The specific attributes of scientist characters are important variables to consider in examining wishful identification because previous research on television viewers’ wishful identification has noted gender differences in viewers’ wishful identification with characters exhibiting different attributes. In one study, elementary school boys reported wanting to be like male characters who were physically aggressive, and girls reported wanting to be like female characters who were physically attractive (Miller & Reeves, 1976). Another study reported that wishful identification for boys occurred with male television characters perceived as humorous and for girls with male television characters perceived as intelligent and humorous and with female characters perceived as attractive (Hoffner, 1996). A study of economically disadvantaged youths reported greater wishful identification with television characters who had higher incomes and jobs that required more education, were viewed as more realistic, and were perceived as having more extrinsic
values like benefits, respect, and excitement (Hoffner et al., 2006). A study of young adults found wishful identification for young men with male television characters perceived as successful, intelligent, and violent, while young women exhibited wishful identification with female television characters perceived as successful, intelligent, attractive, and admired (Hoffner & Buchanan, 2005).

Television program genre (cartoon, drama, education) is another important variable to consider in examining wishful identification. Vermeir, Hogeschool, and Geuens (2008) explain that “people gravitate to particular kinds of media because they have particular personality characteristics, issues and/or needs” (p. 873). In their analysis of the influence of television viewers’ empathy and affective orientation on wishful identification with television characters, Chory-Assad and Cicchirillo (2005) accounted for differences in character genre. This variable also was of interest in the present study because of differences in genre for television programs with scientists most likely to be viewed by adolescents (Nielsen Media Research, 2004; Steinke et al., 2007) and because of reported gender differences in children’s preferences for television program genres (Cherney & London, 2006; Huston et al., 1990).

All the variables listed above have been linked with wishful identification with television characters, but the specific nature of the relationships among these variables is not known. Thus, the following hypothesis was posed to examine the possible interactions among these variables:

**Hypothesis 1:** Middle school students’ wishful identification will differ as a function of the following: (a) gender of the television viewer (girl, boy), (b) gender of the television character (male, female), (c) specific attributes exhibited by the television character (intelligent, respected, dominant, caring, and alone), and (d) program genre (cartoon, drama, educational) in which the television character appears.

The present study of wishful identification also examined viewers’ attitudes toward science, attitudes toward women in science, and perceptions of their academic scientific ability as covariates related to their wishful identification with scientist characters. Research has indicated that television viewers’ personal characteristics may have an influence on the extent to which the behaviors of television models are imitated (Eyal & Rubin, 2003). Studies have examined specific personality characteristics of children (Persegani et al., 2002) and young adult television viewers (Nabi & Riddle, 2008) as related to their preferences for types of television content and the effects of that content. Another study by Chory-Assad and Cicchirillo (2005) has iden-
tified individual viewer differences that influenced wishful identification with television characters. Furthermore, social cognitive theory asserts that personal characteristics of audience members, in addition to environmental and behavioral factors, shape and control their responses to media models (Bandura, 2001).

**Method**

**Participants**

Participants for the study were 3701 middle school–aged ($M = 12.6$ years of age, $SD = 0.59$) students enrolled in the seventh grade in three middle schools in the Midwest. Participants were primarily male (54%); racial/ethnic distribution included people who identified as White (40.1%), Black (28%), mixed race (16.8%), Hispanic/Latino (6.7%), and other (8%). Middle school students were selected for this study because research indicates that children’s attitudes toward science generally decline during the middle and high school years (George, 2000), and girls, specifically, report a decline or loss of interest in science, engineering, and technology around the age of 12 (American Association of University Women, 1998, 2000; Tracey & Sodano, 2008).

Permission to conduct this research project was granted by school administrators and science teachers at each of the participating schools. Prior to conducting the study, the researchers met with school administrators and participating seventh-grade science teachers to describe the study and to explain how the study related to state standards and benchmarks for middle school science curriculum and instruction. The researchers also explained the university human subjects institutional review board policies and procedures for the study.

Seventh-grade students were recruited during their regularly scheduled science classes. All students enrolled in the participating science teachers’ classes at each of the schools were invited to participate. Parents/guardians were sent a letter describing the study and giving them the option of declining consent for their children’s participation. Student assent was obtained prior to study implementation, and students were reminded at the beginning of each day of the study that they could withdraw from participation at any time without prejudice or penalty.

**Design**

This study used a $2$ (gender of television viewer) $\times$ $2$ (gender of television character) $\times$ $3$ (television program genre) $\times$ $5$ (character attribute) repeated-meas-
sures design. Each participant watched 10 television clips for one of the selected television genres. The television clips featured a televised scientist character portrayed with one of five different character attributes. For each of these five character attributes, a participant watched a clip in which a male character was featured displaying an attribute and a clip in which a female character was featured displaying an attribute. The order of the viewing of the attributes was random, and the order of the viewing of the male and female scientist characters was counterbalanced.

Participants were assigned by the school to watch scientist characters from one of three television program genres: cartoon, drama, or educational. Because of the limited amount of time researchers were allowed at each school site, genre was confounded with school site, thus focusing the experimental power of the factorial design on the character attributes portrayed by the scientist characters.

**Stimuli.** Participants viewed television clips that featured scientist characters portrayed as lead characters in television programs that were popular or likely to have been seen by middle school students (National Science Foundation, 2007; Nielsen Media Research, 2004; Steinke et al., 2007). The television clips featured a scientist character in scenes selected from cartoon, drama, and educational science programs (Table 1). Television clips of scientists from one program genre (situation comedies) were not included in this study because the extremely limited number of scientists appearing in these programs (Long et al., 2010) would not yield enough television clips for this analysis. Scientist characters were selected from the following cartoon programs: *Danny Phantom, Dexter’s Laboratory, Kim Possible,* and *The Adventures of Jimmy Neutron: Boy Genius.* Scientist characters were selected from the following drama programs: *CSI, CSI-Miami,* and *CSI-New York.* Scientist characters were selected from the following educational programs: *Bill Nye the Science Guy, DragonflyTV,* and *Mythbusters.* Scientist characters of racially diverse backgrounds were selected whenever possible; however, few racially diverse scientist characters were shown in some program genres (Long et al., 2010).

Previous research identified some of the most frequently occurring character attributes in television portrayals of scientists for programs most likely to have been seen by middle school students; thus, specific scenes and scientists were selected to focus on these character attributes (Long et al., 2010). The four most frequently found character attributes in portrayals of scientist characters in these programs were intelligence, dominance, alone, and respected. An additional attribute, caring, also was included in this study even though it was not among the most frequently occurring attributes in
### Table 1. Scientist Characters, Character Attributes, and Program Genre Selected for Television Clips

<table>
<thead>
<tr>
<th>Character Attribute–Gender of Character</th>
<th>Cartoon Viewing Group</th>
<th>Drama Viewing Group</th>
<th>Educational Viewing Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intelligence–male</td>
<td>Wade</td>
<td>Warrick Brown</td>
<td>Tyler</td>
</tr>
<tr>
<td>Intelligence–female</td>
<td>Dee Dee</td>
<td>Sara Sidle</td>
<td>Shannon</td>
</tr>
<tr>
<td>Dominance–male</td>
<td>Drakin</td>
<td>Gil Grissom</td>
<td>Adam</td>
</tr>
<tr>
<td>Dominance–female</td>
<td>Cindy</td>
<td>Catherine Willows</td>
<td>Kari</td>
</tr>
<tr>
<td>Alone–male</td>
<td>Dexter</td>
<td>Sheldon Hawkes</td>
<td>Grant</td>
</tr>
<tr>
<td>Alone–female</td>
<td>Dee Dee</td>
<td>Lindsay Monroe</td>
<td>Kari</td>
</tr>
<tr>
<td>Respected–male</td>
<td>Jimmy</td>
<td>Danny Messer</td>
<td>Jamie</td>
</tr>
<tr>
<td>Respected–female</td>
<td>Maddie</td>
<td>Calleigh Duquesne</td>
<td>Scottie</td>
</tr>
<tr>
<td>Caring–male</td>
<td>Jimmy</td>
<td>Eric Delko</td>
<td>Ryan</td>
</tr>
<tr>
<td>Caring–female</td>
<td>Maddie</td>
<td>Stella Bonasera</td>
<td>Ramona Okumura</td>
</tr>
</tbody>
</table>

Character: A list of characters from the specified shows.

Show: The show where the character appears.

Program Genre: The genre of the show:
- Drama Viewing Group
- Educational Viewing Group
order to allow for comparisons between feminine and masculine gender-stereotyped character attributes. Descriptions of these character attributes are provided below:

**Intelligent:** Characters exhibited intelligence when they made factual statements or offered opinions about why a phenomenon may have happened, explained how a process worked, explained or used specialized terminology, offered suggestions on how to proceed with an experiment, or used scientific equipment to analyze material.

**Dominant:** Characters exhibited dominance when they exerted authority or influence over others (e.g., told or showed other characters what to do, told other characters that they were wrong).

**Alone:** A character was shown alone when he or she was the only living human being in a scene and was not interacting with another person.

**Respected:** Characters were respected when another character showed deference toward them (e.g., asked the scientist’s opinion or for advice, complimented the scientist) or when they were given an award.

**Caring:** Characters demonstrated caring when they exhibited behaviors or made statements designed to comfort or help others (e.g., fed a character that was hungry, expressed sympathy for another character’s plight, offered to help another character).

Based on findings from previous research that analyzed the content of television programs most likely seen by middle school students and that featured scientist characters (Long et al., 2010), specific scenes were selected for these clips. The scenes were selected based on the following criteria: (a) the featured scientist was previously coded as rating high for the specific attribute highlighted in the clip, (b) the featured scientist was the only or clearly the most frequently occurring scientist featured in the clip, and (c) the attribute highlighted in the clip was clearly identifiable in the scene selected. Two television clips were created for each of the five character attributes across each of three program genres (cartoon, drama, educational). For each attribute, a television clip was created that focused on a female scientist lead character exhibiting one of the five character attributes and another television clip was created that focused on a male scientist lead character exhibiting one of the five character attributes.

Ten television clips for each program genre (cartoon, drama, educational) were prepared. Each television clip was approximately 2 to 4 minutes in duration and focused on one scientist exhibiting the attribute of interest in more than one scene. The clips focused on scenes in which the scientist characters were shown working as scientists in laboratories or other settings.
Pilot study. A pilot study was conducted with 44 students from a middle school in the Midwest that did not participate in the final study. Pilot participants completed the questionnaires and the television-viewing intervention for one television program genre (10 clips total). The purpose of the pilot was to familiarize the facilitator with the intervention content and procedures, assess the amount of time needed to complete the questionnaires, determine the readability of the items on the questionnaires, and conduct a basic item analysis. Following the pilot, modifications were made to the content of the intervention and the questionnaires. The data from the pilot were not included in the final analysis.

Procedure. The study took place in science classes over 5 consecutive school days. On the first day, students completed a questionnaire that measured their frequency of viewing television programs that featured scientists as lead characters, attitudes toward science, attitudes toward women in science, academic science self-views, prior viewing and frequency of viewing of the television programs selected for the study, and basic demographic items. During the second, third, and fourth days of the study, participants watched 10 television clips of a scientist character from one of the three program genres. A facilitator showed students a picture of a specific scientist character and instructed the students to focus on that character while watching the television clip. Participants viewed 4 of these television clips on the second and third days and 2 on the fourth day. After viewing each clip, participants immediately answered a series of questions designed to measure their wishful identification with the scientist featured in each clip. After viewing the television clips on the fourth day and answering questions about their wishful identification with the featured scientist character, students completed a questionnaire identical to the one administered on the first day except for measures related to television viewing and basic demographic items. On the fifth day, a subset of students participated in focus groups; these findings are not related to this study’s focus on wishful identification and are reported elsewhere.

Measures

Dependent variable: Wishful identification. Wishful identification (WID) was assessed using five items such as “I’d like to do the kinds of things he/she does on the show”; “He/she is the sort of person I want to be like myself”; “I wish I could be more like him/her.” The items used a 5-point, Likert-type scale (1 = strongly disagree, 5 = strongly agree) in which higher scores indicated greater wishful identification; some of these items have been used with children aged 7 to 12 years (Hoffner, 1996). Confirmatory factor analysis
(CFA) indicated the data were consistent with a unidimensional scale when one item was removed from the scale. The WID scale was completed 10 times by each participant (once for each scientist character viewed). Alphas ranged from .89 to .93 across the 10 administrations of the scale.

**Covariates.** The covariate scales came from published instruments; nonetheless, the psychometric properties of the measures were assessed. Initially, attempts were made to confirm the factor structure for each covariate scale reported in the literature. If the data were inconsistent with the model, exploratory procedures were used to determine the best fit for the data. Table 2 contains the scale mean, standard deviation, and coefficient alpha for each covariate scale.

**Attitudes Toward Science Scale.** Attitudes toward science were assessed using the Misti et al. (1991) Attitudes Toward Science Scale, a 28-item measure on which participants responded using a 5-point Likert-type format. Misti et al. (1991) reported the scale comprises five dimensions, but this structure could not be confirmed with this study’s data. Exploratory and subsequent CFAs indicated three factors were consistent: attitude toward science (6 items, e.g., “Science is one of my favorite classes”), attitudes toward engaging in science-related behaviors (7 items, e.g. “I like to make science drawings”), and attitude toward science in the media (5 items, e.g., “Some science films are interesting”). Items were scored such that higher scores indicated more positive attitudes.

**Women in Science Scale.** Attitudes toward women in science were assessed using a modified version of Erb and Smith’s (1984) Women in Science Scale (WiSS). This scale consists of 29 Likert-type items with a 6-point response
format ranging from strongly agree to strongly disagree, with higher numbers indicating more positive attitudes toward women in science. This scale includes three dimensions: (a) “Women possess characteristics which enable them to be successful in science careers,” (b) “Women’s roles as mother and wife are compatible with successful science career pursuits,” and (c) “Women and men ought to have equal opportunities to prepare for and pursue science careers” (Erb & Smith, 1984, p. 393). Example items from the WiSS include “Women can be as good in science careers as men” and “Women can make important scientific discoveries” (Erb & Smith, 1984, p. 393). Erb and Smith provide evidence for the construct validity and reliability of the scale with a sample of early adolescents.

For the present investigation, the scale was modified to use a 5-point, Likert-type response format to allow for a neutral point and to maintain consistency with other measures in the study in order to simplify completion of the instrument. CFA procedures indicated that the data were consistent with a single, unidimensional factor following the removal of four items. The items removed were “A woman should be considered for a job based on her performance regardless of whether or not she is married”; “For a woman, it is more important to be a successful wife and mother than it is to be successful in a career”; “We need more women to work in science careers”; and “Women have less need to study math than do men.” See Table 2 for descriptive statistics and reliability estimates.

**Lips Academic Self-View Survey.** Current and possible (future) academic self-views were assessed with the Lips Academic Self-View Survey (LASS; Lips, 2004). The LASS contains scales that assess current and future academic self-views in a variety of academic domains: science, math, the arts, and writing. Only the science scale was used in this study. The response scale for the current examination was a 4-point scale with not like me and definitely like me as the anchors for the current science self-views measure and not like me in the future and definitely like me in the future as the anchors on the possible (future) science academic self-views items; higher items indicate greater endorsement of the item. All items were subject to CFA indicating a 5-item unidimensional solution for the science scale (see Table 2).

**Statistical Analyses**

One analysis (mixed-model analysis of variance) was conducted to test the study hypothesis following the measurement analyses. The overall study design was modeled by a four-way mixed model: gender of the television viewer (boy, girl) by gender of character (male, female) by program genre
(cartoon, drama, educational) by character attribute (alone, caring, dominant, intelligent, respected) by 10 rating cards treated as a repeated-measure factor. Mixed-model estimation was conducted in SAS, PROC MIXED with an unstructured covariance matrix designation, and all pairwise post hoc tests employed a modified Bonferroni adjustment to maintain a conservative experiment-wise Type I error rate.

Results

Descriptive Data: Participants’ Prior Viewing of the Television Programs

Students were asked to indicate the television programs they watched regularly that featured scientist characters in order to later determine if the characters they reported wishful identification with appeared in television programs likely viewed by this age-group. Both boys and girls reported that The Simpsons was the most regularly watched television programs of those most likely to have been seen by middle school students (National Science Foundation, 2007; Nielsen Media Research, 2004; Steinke et al., 2007). As noted in Table 3, after The Simpsons, the most regularly watched programs reported by girls were CSI, The Adventures of Jimmy Neutron: Boy Genius (tied), and CSI-Miami, and the most regularly watched programs reported by boys were Mythbusters, The Adventures of Jimmy Neutron: Boy Genius, and Danny Phantom.

Covariate Analysis

Since the study design confounded genre with school site, the comparability of the schools was examined across several demographic and covariate variables. The schools did not differ in gender of the participants, $\chi^2(2, N = 304) = 4.40, p = .11$. Because of the small number of participants who categorized themselves as belonging to racial/ethnic groups other than White, these groups were collapsed for purposes of comparison; results indicated that schools differed in terms of the number of participants who categorized themselves as White as compared with non-White, $\chi^2(2, N = 298) = 43.10, p < .01$.

Differences in multiple covariate measures as a function of school site, participant gender, and race were tested. General linear model analysis of parallel three-way models—participant gender (boy, girl) by race (White, non-White) by school site (1, 2, 3)—for attitudes toward science, attitudes toward engaging in science behaviors, and attitudes toward science in the media (three construct scales derived from the CFAs of the Attitude Toward
Science Scale) and toward women in science (WiSS) revealed the following pattern of statistically significant findings. For attitudes toward science, school site, \( F(2, 283) = 5.19, p < .01; \) and race, \( F(1, 283) = 10.94, p < .01; \) main effects were noted. For attitudes toward engaging in science-related behaviors, only a school site main effect was observed, \( F(2, 283) = 4.37, p < .02; \) for attitudes toward science in the media, the gender of the participant, \( F(1, 294) = 11.92, p < .01; \) and school site, \( F(2, 283) = 3.08, p < .05; \) main effects were statistically significant.

The covariate, Future Academic Science Self-View (LASS), revealed statistically significant differences for race, \( F(1, 295) = 10.04, p < .01; \) and school, \( F(2, 295) = 7.28, p < .01; \) main effects and a gender by race interaction, \( F(1, 295) = 4.85, p < .03. \) The interaction was a function of non-White girls reporting significantly lower mean scores for Future Academic Science Self-View relative to all other groups. The covariate, Current Academic Science Self-View, revealed three statistically significant main effects and no interactions: gender, \( F(1, 294) = 4.54, p < .04; \) race, \( F(1, 294) = 9.98, p < .01; \)

### Table 3. Viewing of Television Programs With Scientist Characters (Program Genre) for Those Reporting Regular Viewing of These Programs

<table>
<thead>
<tr>
<th>Television Program</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
</tr>
<tr>
<td><strong>The Simpsons</strong> (Sitcom)**a</td>
<td>65.8</td>
</tr>
<tr>
<td><strong>Mythbusters</strong> (Educational)</td>
<td>47.5</td>
</tr>
<tr>
<td><strong>The Adventures of Jimmy Neutron: Boy Genius</strong> (Cartoon)</td>
<td>45.2</td>
</tr>
<tr>
<td><strong>CSI</strong> (Drama)</td>
<td>36.6</td>
</tr>
<tr>
<td><strong>CSI-Miami</strong> (Drama)</td>
<td>35.8</td>
</tr>
<tr>
<td><strong>Danny Phantom</strong> (Cartoon)</td>
<td>33.9</td>
</tr>
<tr>
<td><strong>Friends</strong> (Sitcom)**b</td>
<td>32</td>
</tr>
<tr>
<td><strong>Dexter’s Lab</strong> (Cartoon)</td>
<td>30.5</td>
</tr>
<tr>
<td><strong>CSI-New York</strong> (Drama)</td>
<td>28.1</td>
</tr>
<tr>
<td><strong>Kim Possible</strong> (Cartoon)</td>
<td>26.7</td>
</tr>
<tr>
<td><strong>The X Files</strong> (Drama)</td>
<td>18.5</td>
</tr>
<tr>
<td><strong>Bill Nye the Science Guy</strong> (Educational)**b</td>
<td>13.8</td>
</tr>
<tr>
<td><strong>Strange Days at Blake Holsey High</strong> (Drama)</td>
<td>6.3</td>
</tr>
<tr>
<td><strong>DragonflyTV</strong> (Educational)**b</td>
<td>3</td>
</tr>
</tbody>
</table>

- a. Sitcoms were not included in the stimuli to assess wishful identification because of the low number of scientists appearing in these programs.
- b. Not broadcast locally during time of the study; however, some students reported viewing elsewhere.
and school, $F(2, 294) = 11.82, p < .01$. The last covariate, Attitudes Toward Women in Science (WiSS) revealed only statistically significant differences in the main effects for gender of the participant, $F(1, 284) = 12.97, p < .01$; and race $F(1, 284) = 10.13, p < .01$. Table 4 presents a summary for the main effects. Although some differences among sites were noted in these analyses, none indicated that site interacted with the other factors considered. Thus, these preliminary analyses support a general conclusion that, after inclusion of the covariate, the genre/site confound has not adversely biased the understanding of genre within the primary design.

**Hypothesis Test**

Hypothesis 1 predicted a four-way interaction on mean WID scores measured over 10 television clips among the four independent variables: gender of the participant/television viewer (boy, girl), gender of the scientist character (male, female), selected scientist character attribute (intelligent, dominant, respected, caring, and alone), and program genre (cartoon, drama,
Steinke et al. 

The initial analysis utilized a four-way mixed (random regression) model with multiple covariates to evaluate the impact of differences on six covariate variables: attitude toward science, attitude toward engaging in science-related behaviors, attitudes toward science in the media, attitudes toward women in science, current academic self-views and future academic self-views related to science, and race as a blocking factor on mean WID scores as a function of the four independent variables. Only two covariates, attitudes toward science and WiSS, were statistically significant; therefore the model was simplified by deleting all nonsignificant covariates including race. Based on this initial analysis and the aforementioned demographic analysis, the school site by program genre confound presents an unlikely explanation for the subsequent results of the reduced four-way model.

The final model tested for mean differences in WID as a function of gender of the participant/television viewer (boy, girl), gender of the scientist character (male, female), television program genre (drama, cartoon, educational), and scientist character attribute (intelligent, dominant, respected, caring, and alone) over 10 rating card trials after controlling for attitudes toward science and attitudes toward women in science. This analysis indicated that the predicted four-way interaction was not statistically significant, $F(8, 289) = 1.32, p = .24$; but there were three statistically significant three-way interactions that are described below.

The first statistically significant three-way interaction was between gender of the participant/television viewer, character attribute, and gender of character, $F(4, 289) = 5.56, p < .01$. The initial simple effect analysis blocked on character attribute and examined mean WID scores as a function of gender of the participant/television viewer and gender of the character. Table 5 presents these findings along with the adjusted means.

These analyses indicate that boys showed more wishful identification with male characters than for female characters for all character attributes. Girls showed more wishful identification with female characters than with male characters for the character attribute of dominant and working alone. In addition, girls showed more wishful identification than boys with female characters having the character attributes of intelligent, dominant, and caring (see Figure 2).

The second statistically significant three-way interaction was for program genre by character attribute by gender of character, $F (8, 290) = 10.12, p < .01$. Although this interaction involved the genre–school site confound, our simple effect analysis blocked on genre. Thus, interpretation of the interaction does not pool over genre, so the confound does not constitute a viable alternative explanation for the findings. The comparison of interest is
character attribute differences within gender of character and program genre. The \( p \) value was set at .01 in order to adjust for the fact that there are five levels of attributes (.05/5). The adjusted means and notation indicating significant differences are presented in Table 6.

Within the cartoon genre, when participants viewed female characters, there were differences only in mean WID scores for female characters with the character attribute dominant as compared with those with the character attribute caring. When these same participants viewed male characters, several different patterns in WID scores appeared (see Table 6). One notable finding is higher mean WID scores for the character attributes of caring, dominant, and respected in comparison with the character attribute, alone.

Within the drama genre, when participants viewed female characters there were differences in mean WID scores for the respected character attribute compared with the alone and the intelligent character attributes. Within the educational program genre, several different patterns for mean WID scores appeared (see Figure 3).

One notable finding for participants’ mean WID scores with male characters was that there were higher means for male characters with the character attribute dominant than for male characters portrayed with any of the other character attributes. Several different patterns also emerged when participants viewed female characters in educational programs. Two notable findings are that participants’ mean WID scores were higher for female characters with the character attribute dominant when compared with female characters with the character attributes caring or intelligent. Likewise WID was higher for female characters with the character attribute alone than for those with the character attributes caring or intelligent.

<p>| Table 5. Adjusted Mean WID Scores for the Three-Way Interaction of Gender of Participant, Gender of Television Character, and Character Attribute |
|---------------------------------|-----------------|---------------|---------------|---------------|---------------|---------------|</p>
<table>
<thead>
<tr>
<th>Gender of Participant</th>
<th>Gender of Character</th>
<th>Alone</th>
<th>Caring</th>
<th>Dominant</th>
<th>Intelligent</th>
<th>Respected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boy</td>
<td>Male</td>
<td>2.71\textsuperscript{a}</td>
<td>2.70\textsuperscript{c}</td>
<td>2.74\textsuperscript{h}</td>
<td>2.55\textsuperscript{i}</td>
<td>2.83\textsuperscript{m}</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>2.49\textsuperscript{a}</td>
<td>2.18\textsuperscript{cde}</td>
<td>2.47\textsuperscript{g}</td>
<td>2.24\textsuperscript{kd}</td>
<td>2.55\textsuperscript{m}</td>
</tr>
<tr>
<td>Girl</td>
<td>Male</td>
<td>2.52\textsuperscript{b}</td>
<td>2.61\textsuperscript{e}</td>
<td>2.44\textsuperscript{hi}</td>
<td>2.77\textsuperscript{j}</td>
<td>2.67</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>2.69\textsuperscript{b}</td>
<td>2.66\textsuperscript{d}</td>
<td>2.88\textsuperscript{de}</td>
<td>2.66\textsuperscript{k}</td>
<td>2.64</td>
</tr>
</tbody>
</table>

Note: WID = wishful identification. Means that share the same superscript are statistically significantly different within the column, \( p < .05 \).
Figure 2. First significant three-way interaction: Gender of the participant (boy, girl), character attribute (A = alone, C = caring, D = dominance, I = intelligence, R = respected), and gender of character (F = female, M = male).
The third statistically significant three-way interaction was between gender of the participant/television viewer, character attribute, and program genre, $F(8, 290) = 4.11, p < .01$. Tables 7 and 8 present these analyses: testing for mean WID differences between male and female participants as a function of character attribute and program genre. Four comparisons were statistically significant under the Bonferroni-adjusted alpha, which was set at $0.05/3 = 0.0167$, adjusted for the three program genre types.

Boys showed statistically significant higher mean WID scores than girls when viewing scientist characters in educational television programs that exhibited the respected attribute. Girls showed statistically significant higher mean WID scores than boys when viewing scientist characters in drama programs that exhibited the caring, dominant, or respected attributes (See Figure 4).

**Discussion**

The overall purpose of this study was to examine gender differences in adolescents’ wishful identification with scientist characters on television. This study focused on interactions among the gender of the television viewer, gender of the television character, selected character attributes exhibited by the television scientist character, and program genre in which the television scientist character appeared. The data were not consistent with the hypothesis that predicted an interaction among all four of these variables but were consistent with three, statistically significant, three-way interactions, indicating that the effects of these variables on adolescents’ wishful identification are

<table>
<thead>
<tr>
<th>Character Attributes</th>
<th>Male Character</th>
<th>Female Character</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cartoon</td>
<td>Drama</td>
</tr>
<tr>
<td>Alone</td>
<td>2.18$^{abc}$</td>
<td>3.10</td>
</tr>
<tr>
<td>Caring</td>
<td>2.54$^{ad}$</td>
<td>3.12</td>
</tr>
<tr>
<td>Dominant</td>
<td>1.72$^{bdef}$</td>
<td>3.23</td>
</tr>
<tr>
<td>Intelligent</td>
<td>2.39$^e$</td>
<td>3.25</td>
</tr>
<tr>
<td>Respected</td>
<td>2.50$^{df}$</td>
<td>3.22</td>
</tr>
</tbody>
</table>

Note: WID = wishful identification. Means that share the same superscript are statistically significantly different within the column, Bonferroni Type I error–adjusted $\alpha = .01$.

*Means are not statistically different because of large standard error of the mean difference.
complicated. Two of these three-way interactions showed significant gender differences in adolescents’ wishful identification with scientist characters. Two covariates had effects on mean wishful identification scores, attitudes toward science and attitudes toward women in science, and were included in the tests of the final model.

Figure 3. Second significant three-way interaction: Program genre (cartoon, drama, educational), character attribute (A = alone, C = caring, D = dominance, I = intelligence, R = respected), and gender of character (F = female, M = male)
The findings of the first interaction addressed the relationships among the gender of participant/television viewer, gender of the character, and character attribute. The adjusted mean WID scores for the three-way interaction are presented in Table 7. Table 8 provides the character attribute and program genre simple-simple effect tests for WID by gender of participant.

Table 7. Adjusted Mean WID Scores for the Three-Way Interaction of Character Attribute, Gender of Participant, and Program Genre

<table>
<thead>
<tr>
<th>Character Attribute</th>
<th>Boys</th>
<th>Girls</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cartoon</td>
<td>Drama</td>
</tr>
<tr>
<td>Alone</td>
<td>2.14</td>
<td>2.92</td>
</tr>
<tr>
<td>Caring</td>
<td>2.24</td>
<td>2.90&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Dominant</td>
<td>1.94</td>
<td>2.94&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Intelligent</td>
<td>2.07</td>
<td>2.99</td>
</tr>
<tr>
<td>Respected</td>
<td>2.23</td>
<td>3.07&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Note: WID = wishful identification. Means that share the same superscript are statistically significantly different within the column, Bonferroni Type I error–adjusted α = .0167 (see Table 8 for p values).

Table 8. Character Attribute and Program Genre Simple-Simple Effect: Testing WID by Gender of Participant

<table>
<thead>
<tr>
<th>Character Attribute-Program Genre</th>
<th>t(290)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alone-cartoon</td>
<td>0.36</td>
<td>.7188</td>
</tr>
<tr>
<td>Alone-drama</td>
<td>-2.35</td>
<td>.0195</td>
</tr>
<tr>
<td>Alone-educational</td>
<td>1.64</td>
<td>.1015</td>
</tr>
<tr>
<td>Caring-cartoon</td>
<td>0.05</td>
<td>.9635</td>
</tr>
<tr>
<td>Caring-drama</td>
<td>-3.04</td>
<td>.0026*</td>
</tr>
<tr>
<td>Caring-educational</td>
<td>-0.77</td>
<td>.4418</td>
</tr>
<tr>
<td>Dominant-cartoon</td>
<td>-0.35</td>
<td>.7279</td>
</tr>
<tr>
<td>Dominant-drama</td>
<td>-3.05</td>
<td>.0025*</td>
</tr>
<tr>
<td>Dominant-educational</td>
<td>2.11</td>
<td>.0359</td>
</tr>
<tr>
<td>Intelligent-cartoon</td>
<td>-1.30</td>
<td>.1947</td>
</tr>
<tr>
<td>Intelligent-drama</td>
<td>-2.37</td>
<td>.0183</td>
</tr>
<tr>
<td>Intelligent-educational</td>
<td>-2.01</td>
<td>.0449</td>
</tr>
<tr>
<td>Respected-cartoon</td>
<td>-0.19</td>
<td>.8515</td>
</tr>
<tr>
<td>Respected-drama</td>
<td>-2.41</td>
<td>.0164*</td>
</tr>
<tr>
<td>Respected-educational</td>
<td>2.88</td>
<td>.0043*</td>
</tr>
</tbody>
</table>

Note: WID = wishful identification. Bonferroni Type I error–adjusted α = .0167 was used to determine statistically significant comparisons (p values marked with an asterisk).

The findings of the first interaction addressed the relationships among the gender of participant/television viewer, gender of the character, and character attribute...
attribute. This interaction revealed that adolescent boys and girls reported gender differences in wishful identification for some of the selected character attributes depending on whether they viewed male or female scientist characters. Overall boys showed more wishful identification for male than for female scientist characters portrayed on television. Furthermore, male scientist characters portrayed on television as dominant elicited greater wishful identification for boys, while female scientist characters portrayed as
dominant on television yielded greater wishful identification for girls. Boys showed wishful identification significantly less than girls with female scientist characters shown on television as intelligent.

The findings for wishful identification for the first interaction found in this study, which focused specifically on scientist television characters, differed from those found in previous studies of wishful identification that focused on television characters in general. Previous studies of young adults found wishful identification for males with male television characters perceived as successful, intelligent, and violent and for females with female television characters perceived as successful, intelligent, attractive, and admired (Hoffner & Buchanan, 2005). However, the findings from the first interaction differed from this previous research in several ways. First, unlike previous studies showing that children exhibit wishful identification with television characters depicted as intelligent, boys’ wishful identification with male and female scientist characters portrayed as intelligent was relatively lower than with scientist characters portrayed with most of the other attributes (e.g., respected, alone, and dominant). Second, while girls’ wishful identification was greater with male scientist characters portrayed as intelligent than with male scientist characters portrayed with any of the other attributes, it was greater for female scientist characters portrayed as being dominant or shown as working alone than for female characters portrayed with any other character attributes, including intelligent.

Interestingly, previous research has found that the television programs featuring scientist characters that are most likely watched by middle school students are much more likely to depict scientist characters as being intelligent than as exhibiting any of the other selected character attributes examined in this study (Long et al., 2010). Yet the findings of this study showed that only adolescent girls expressed wishful identification with male scientist characters displaying this character attribute but not with female scientist characters and only with male scientist characters in educational programs.

It is important to highlight the relevance of the findings from the first, significant three-way interaction for television producers interested in promoting middle school students’ interest in science and science careers. These findings interaction suggest that wishful identification, for girls as well as for boys, with scientist characters having specific scientist character attributes depends on whether they are watching female or male characters. When watching either male or female scientist characters, adolescent boys are most likely to show wishful identification with scientist characters portrayed as being respected than with those portraying all the other character attributes examined in this study. When watching female scientist characters,
adolescent girls are most likely to show wishful identification with female characters portrayed as being dominant than with those portraying all the other character attributes examined in this study. Television producers of television science programs interested in maximizing viewers’ identification with scientist characters also need to carefully consider all three of these variables (gender of the viewer, gender of the scientist character, and character attribute) when developing scientist characters for television.

Another significant finding from this first interaction that is important for producers of television science programs is the finding that when female scientist character role models are absent, adolescent girls were most likely to show wishful identification with male scientist characters portrayed as being intelligent or being respected than with those shown with the other character attributes examined in this study. This finding suggests that adolescent girls are likely to show some wishful identification with scientist characters shown on current television programs even with the dearth of female scientists that exists in these programs (Long et al., 2010).

An additional important finding from this first interaction indicated that adolescents were not likely to show wishful identification with scientist characters portrayed on television as intelligent. This finding was noted for both adolescent girls and boys. Findings did indicate that for adolescent girls, this character attribute promoted more wishful identification with male scientist characters than with female scientist characters. One explanation for this difference is that girls show more flexibility in wishful identification and will show wishful identification with male as well as female characters (Lonial & Van Auken, 1986), possibly because they are used to a media environment in which female characters are underrepresented. However, most of the current television programs that feature scientist characters and are likely to be watched by adolescents portray scientist characters as being intelligent (Long et al., 2010): a character trait that this first interaction suggests is not likely to encourage adolescents to want to be like scientists.

The second three-way interaction focused on differences in wishful identification for character attributes as a function of television program genre and the gender of the scientist characters. The statistically significant findings from this interaction were numerous; however, gender was not a variable in this three-way interaction. Although gender differences were not relevant for this interaction, an interesting finding to note was that adolescents’ wishful identification with scientist characters on television is related in some way to all of the variables examined in this study. Another important finding from this second interaction of relevance to television producers is that drama programs were favored by adolescent viewers, both boys and girls, over cartoon
and educational programs. Consistent with our findings that drama television programs yielded more wishful identification than the cartoon and educational television genres, drama theory (Kincaid, 2002) and research on entertainment-education (Slater & Rouner, 2002) would suggest that it is the narrative nature of dramatic content that develops identification with characters. The drama clips used in this study were from CSI programs and suggest it is possible that the dramatic features of this show may have an influence on wishful identification even when students viewed relatively short clips from these programs.

An additional finding from this second interaction provides helpful information for producers of television programs for middle school students. Middle school student’s wishful identification with scientist characters in educational programs appeared to be greater with those characters depicted with traditionally masculine attributes such as dominance as opposed to traditionally feminine attributes such as caring. This finding may be a manifestation of the students’ gender stereotyping of scientists as being male and having masculine attributes and traits or may be attributed to seeing mostly male characters on the television programs they are most likely to view. This is an interesting finding given the underrepresentation of female scientist characters in television programming (Long et al., 2010; Steinke & Long, 1996).

The third three-way interaction focused on wishful identification for specific character attributes for boys and girls as related to the television program genre viewed. These findings also revealed gender differences in wishful identification related to these three variables. Specifically these findings noted that characters depicted as being dominant, respected, and caring promoted wishful identification in adolescent girls when watching drama television programs, while scientist characters depicted as being respected promoted wishful identification in adolescent boys when watching educational television programs. These findings suggest the importance of considering wishful identification with television characters as related to the television program genre, and, similar to the findings of the second interaction, indicate both adolescent boys and adolescent girls prefer drama programs.

In conclusion, the findings of these three, statistically significant interactions provide additional insight on adolescents’ wishful identification with televised scientist characters. Most importantly, these findings indicate that wishful identification with scientist characters differs for adolescent girls and adolescent boys. Overall, adolescent boys are most likely to show wishful identification with male characters portrayed as dominant and with male characters portrayed as respected in educational programs. Whereas,
adolescent girls are most likely to show wishful identification with female characters portrayed as working alone or portrayed as dominant, respected, or caring in drama programs.

Given current trends in television programming, adolescent boys are most likely to be exposed in classroom settings to television programs that depict scientists in ways they are likely to wishfully identify with (i.e., *Bill Nye the Science Guy*, *Mythbusters*; see Long et al., 2010). Adolescent girls, however, are not as likely to be exposed in classroom settings to television programs that depict scientists in ways they are to wishfully identify with (i.e., *CSI* programs), most likely because these television programs are known to show violent and mature content. The television programs that feature scientists shown to promote wishful identification in adolescent boys are educational programs that are more likely to be shown in the classroom. While these educational science programs may advance science learning in specific content areas, they are not likely to promote adolescent girls’ interest in future science careers. Presenting female televised scientist characters with specific traits and in specific television genres known to promote wishful identification for adolescent girls may be critical for developing their interest in science, particularly since girls of this age show a decline in interest in science as they enter middle school and in their senior year in high school (Tracey & Sodano, 2008).

The findings from this research also revealed that individual viewers’ variables, attitudes toward women in science and attitudes toward science, were factors related to wishful identification. This finding supports other research that has included personality characteristics of viewers (Chory-Assad & Cicchirillo, 2005; Nabi & Riddle, 2008; Persegani et al., 2002) in media effects research. Because television viewers’ individual characteristics may have an influence on the extent to which the behaviors of television models are imitated (Eyal & Rubin, 2003), it is important to consider television viewers’ individual characteristics and attitudes as mediators of the effects of television content.

Understanding wishful identification with television characters is complex and involves a careful examination of multiple variables related to the television viewers, attributes of television characters, and programmatic features of television content. The findings from this study advance our understanding of middle school students’ wishful identification by documenting the relevance of multiple factors that are present in the television viewing context when considering wishful identification with television characters. Furthermore, the findings from this study provide important theoretical contributions by underscoring the importance of investigating a collective array of environmental influences and personal factors of viewers as described by
social cognitive theory (Bandura, 2009) when assessing wishful identification with television characters.

**Limitations and Directions for Future Research**

One of the limitations of this study is that a limited number of character attributes were examined. This study focused on five character attributes, four of which previous research indicated (Long et al., 2010) were among the most frequently occurring attributes in portrayals of scientists for the television programs examined in this study. This study provides a foundation for future research to determine how to best portray scientist characters on television to promote wishful identification for adolescents in order to foster future interest in science and dispel gender stereotypes of scientists. However, future research needs to include a broader range of other character attributes in television portrayals. Some character attributes previously shown to promote wishful identification, such as attractiveness (Hoffner & Buchanan, 2005; Miller & Reeves, 1976), humor (Hoffner, 1996) and success (Hoffner & Buchanan, 2005), were not included in the current study because the only character attributes examined in this study were attributes that were manifest in the program content and did not require the researchers to conjecture about television viewers’ responses or interpretations of program content. Future studies could utilize television clips for which a group of adolescents have predetermined the attractiveness, humor, and success of the characters before assessing wishful identification with the characters in these television clips with a larger sample of adolescents.

Another limitation of this study related to the selection of character attributes is that although the selected character attributes were emphasized and repeated in the television clips, other character attributes or traits were not completely controlled. This is a limitation related to using television clips from actual television programs being broadcast in order to add to the experimental realism of the study. Future research could create stimuli where characters are created for the television clips, rather than using characters as currently shown on television. To address this limitation and still allow for use of television clips from actual television programs, future research also could specifically assess participants’ reaction to the television clips that featured specific character attributes prior to measuring wishful identification in order to ensure that participants actually recognized the character attribute featured. Determining the full range of specific attributes of scientist characters on television that promote wishful identification for adolescent girls also
is needed to determine the best way to provide role models in television programming to encourage adolescent girls’ interest in science careers.

Although it is beyond the scope of this research to examine how other covariates influenced wishful identification, this should be addressed in future research. Future research also should consider a broader way of individual characteristics viewers bring to the television viewing context that may influence their wishful identification with television characters.

Another limitation of this study is that viewers’ preexisting wishful identification with the scientist characters shown in the interventions was not assessed prior to the interventions. Future research can account for viewers’ preexisting wishful identification with characters from their television viewing in order to determine if the effects on wishful identification stemmed from immediate viewing of these characters with these attributes or from more lasting wishful identification relationships with the characters that may have developed over time.

Although carefully accounted for in the statistical analyses employed in this study, school site and program genre were confounded in this study. This was a necessary limitation of the research design because of its complexity and our variables of interest. Future research needs to include more school sites across treatment groups in order to prevent this confound.

Additional research should focus on the effectiveness of interventions that feature specific character attributes of televised portrayals of female scientist known to promote wishful identification for adolescent girls and other underrepresented groups in science, engineering, and technology. This is particularly important in light of the reported gender differences in wishful identification with male and female scientist characters for the different attributes found in this study. The popularity and ubiquitous nature of television provide an opportunity to present positive portrayals of female scientists to large, diverse, and geographically scattered audiences. Such research is also important to determine the most effective media models for encouraging girls and other underrepresented groups to consider future careers in science, engineering, and technology.

Longitudinal research would help determine whether interventions that involve viewing of televised scientist characters known to promote wishful identification does indeed encourage adolescents’ future interest in science, engineering, and technology careers, especially among adolescent girls and other underrepresented groups. Adolescence is a critical time for fostering interest in science, engineering, and technology careers because of the “crucial role that education plays in identity development during the middle school years” (Clements & Seidman, 2002, p. 148) and because specific career choices typically are selected during late adolescence (Yowell, 2002).
Such interventions are critical for advancing science literacy (National Science Board, 2010) and building and diversifying the future science, engineering, and technology workforce (National Science Foundation, 2011).

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**Notes**

1. Because of the nature of the design, there were substantial missing data for some variables. Degrees of freedom or sample size for each test is reported as appropriate. The missing data were imputed for measurement analysis because of concerns about the small sample size but not for the final data analysis.
2. These programs were selected from a total of 14 television programs based on data from a content analysis that indicated which programs showed scientist characters with the selected attributes of interest (Long et al., 2010).
3. Other measures to assess students’ perceptions of gender roles also were included in the questionnaires. These findings are presented elsewhere.
4. Despite the face validity of the scale, personal communication with Frank Misti indicates that the Misti et al. (1991) article may be the only place where this scale has been used in print. There are a number of possible reasons the factor structure they reported could not be confirmed in these data (e.g., sample size, sample differences, etc.).
5. Analysis of the pilot data indicated that the participants had difficulty completing the items and the reliabilities were generally below acceptable ranges (alphas ranging from .52 to .81). The items were modified to make them appropriate
for the middle school age participants in this study by changing the wording of several items and modifying the response scale.

References


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