SEEING ONESELF AS A SCIENTIST: MEDIA INFLUENCES AND ADOLESCENT GIRLS’ SCIENCE CAREER-POSSIBLE SELVES

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Early adolescence is a critical time for fostering girls’ awareness and interest in science, engineering, and technology careers as they actively construct their identities. Possible selves theory describes the factors that influence adolescent girls as they create current and future identities. Research suggests that media models can influence views of possible selves, including views of future careers. This study investigated adolescents’ academic self-views related to science and the impact of viewing televised scientist characters on these views. This study also assessed adolescents’ future career preferences, in general, and specifically in science. Television images of scientists were selected from programs popular among or likely to have been seen by middle school students. The results of this study found that prior to viewing televised scientist characters, girls had lower views of their current but not future academic science self-views than did boys. Viewing televised scientist characters led to a positive change in both adolescent girls’ and adolescent boys’ future but not current academic science self-views. Adolescent girls were more than twice as likely as boys to list scientific careers as hoped-for future careers; however, adolescent girls also listed scientific careers as feared future careers.

INTRODUCTION

Adolescent girls’ consideration of future careers in science, engineering, and technology (SET) is influenced by an array of factors related to their identity development. As adolescent girls contemplate future careers, they negotiate “multiple identities” (Thompson & Windschitl, 2005, p. 20) that take into account personal relationships, family roles, and cultural values. Adolescent girls are influenced by “views of themselves as individuals in and outside of science and as members of larger social groups” (Thompson & Windschitl, 2005, p. 5). Research indicates, however, that adolescent girls are less likely than adolescent boys to “hold positive images of their future selves as scientists” (Stake & Nickens, 2005, p. 2). Adolescent girls’ perceptions of possible selves as scientists appear to be influenced by gender stereotypes that designate these

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areas as more appropriate for men than for women (Chalk, Meara, Day, & Davis, 2005; Lips, 2004, 2007) and highlight the conflict between SET careers and family (Curry & Trew, 1994). Researchers have attempted to better understand the factors that contribute to the decline in interest in science noticed among girls during adolescence (American Association of University Women, 1998, 2000). More recent research has examined the role of identity in understanding issues of gender and science (Brotman & Moore, 2008).

Adolescent girls’ identities often do not include science career “possible selves” (Markus & Nurius, 1986, p. 954), representations of who they are as well as their “hypothetical images” of who they might become in the future (Strahan & Wilson, 2006, p. 3). Research has examined peer influences (Stake & Nickens, 2005), girls’ work orientations (Curry & Trew, 1994), and girls’ participation in intensive science and math high school programs (Packard & Nguyen, 2003) on adolescent girls’ science career-possible selves. The influence of popular media images of scientists has received less attention. Popular images of scientists, however, particularly those on television, may be influential in not only shaping adolescent girls’ perceptions of scientists, but also in developing science career-possible selves.

Researchers have argued that “[n]o examination of middle childhood environments can be complete without understanding the influences of the mass media” (Huesmann & Taylor, 2006, p. 303). Images on television are important socialization agents and sources of information for adolescents (Behm-Morawitz & Mastro, 2008; Eggermont, 2004; Faber, Brown, & McLeod, 1979). Media models provide “vicarious contact” (Bandura, 2002; Fujioka, 1999) with scientists when direct interaction with human role models is limited or not possible at all. Most children have little personal interaction with actual scientists; yet, many children grow up seeing images of scientists in television and movies (Steinke, Lapinski, Crocker et al., 2007a). In fact, adolescents’ depictions of scientists and scientific workplaces often reflect images seen in movies and on television (Scherz & Oren, 2006). These depictions are typically stereotypical and portray scientists as being middle-aged or old males with unkempt hair and wearing a white lab coat and glasses (Scherz & Oren, 2006).

This study used quantitative and qualitative analyses to better understand adolescents’ consideration of science career-possible selves and to explore gender differences in science career-possible selves. First, this study investigated gender differences in adolescents’ current and future (possible) academic self-views in science. Second, this study assessed the impact of viewing televised images of scientist characters on middle school students’ current and future (possible) academic self-views in science. This study examined adolescents’ academic self-views in science or how well they perceived themselves performing in science classes in school because middle school students’ future career-possible selves in science have been found to be related to greater perceived competence in science (Garcia & Pintrich, 1995). Thus, a positive change in academic self-views in science after viewing scientists on television would be expected to promote the development of future career-possible selves in science. Third, this study examined middle school students’ hoped-for and feared future career-possible selves in order to determine interest in future careers in science relative to other future career choices for adolescents, in general, and for adolescent girls, in particular.
Possible Selves Theory

Several developmental psychology and communication theories (i.e., Albert Bandura’s social cognitive theory, Jean Piaget’s cognitive-developmental theory, and George Gerbner’s cultivation theory) explain how children and young people learn from television content (Scheibe, 2007). These theories, however, do not extend beyond learning from television content to describe specific effects on identity development. Possible selves theory describes the sources of influence that shape children’s identities as they develop their self-concepts. According to this theory, the self-concept “is viewed as a system of affective-cognitive structures or schemas about one’s self” (Markus & Nurius, 1986, p. 955) that includes “possible selves” (Markus & Nurius, 1986, p. 954). These possible selves correspond to both current representations of who one is as well as “hypothetical images” of who one might become in the future (Strahan & Wilson, 2006, p. 3). Possible selves present both hoped-for and feared representations of self (Markus & Nurius, 1986). Possible selves are influential because they motivate behavior (Markus & Nurius, 1986) and also “translate into life choices” (Lips, 2007, p. 51).

Adolescence marks a critical time in the development of possible selves because of the influence of possible selves on future decision making and behavior (Markus & Nurius, 1986). Researchers describe the development that takes place beginning in childhood and throughout adolescence as “a process of acquiring and then achieving or resisting certain possible selves” (Markus & Nurius, 1986, p. 955). Adolescents’ views of who they want to become are influenced by both their perceptions of past, current, and future possible selves (Kerpelman, Shoffner, & Ross-Griffin, 2002; Markus & Nurius, 1986) and their hoped-for and feared possible selves (Markus & Nurius, 1986; Oyserman & Fryberg, 2006). Possible selves motivate behavior related to an array of life goals (Markus & Nurius, 1986; Strahan & Wilson, 2006), including academic achievement (Oyserman, Bybee, Terry, & Hart-Johnson, 2004), lifestyle choices (Markus & Nurius, 1986), and career aspirations (Markus & Nurius, 1986).

Possible selves are shaped by socializing agents and socialization experiences within an individual’s social context (Clements & Seidman, 2002; Markus & Nurius, 1986; Oyserman, Gant, & Ager, 1995), such as social and peer relationships (Kerpelman & Pittman, 2001; Markus & Nurius, 1986; Oyserman et al., 1995), cultural backgrounds (Markus & Nurius, 1986; Rolon-Dow, 2004; Strahan & Wilson, 2006), race (Oyserman et al., 1995), and gender (Fraser & Eccles, 1995; Kemmelmeier & Oyserman, 2001; Knox, Funk, Elliott, & Bush, 2000; Oyserman et al., 1995). Research has documented specific factors in the social context that shape adolescent girls’ possible selves, in particular. These include the organization and social structure of schools (Clements & Seidman, 2002), mother’s perceptions and expectations (Kerpelman et al., 2002; Lobenstein, Pereira, Whitley, Robles, Soto, Sergeant, Jimenez, Jimenez, Ortiz, Cirino, 2001), teachers’ images and expectations of students (Rolon-Dow, 2004), and adult role models (Packard & Nguyen, 2003). Adolescent girls’ views of future possible selves often focus on and are significantly influenced by their interpersonal relationships with others (Knox et al., 2000).

Interventions focused on modifying possible selves have been effective in influencing adolescents’ perceptions and behaviors. One study noted improvements in ur-
ban African-American middle school students’ academic possible selves following an intervention designed to highlight the relevance of school in achieving successful possible selves (Oyserman, Terry, & Bybee, 2002). Another study found that an intervention to improve middle school students’ school-focused possible selves was effective, even in cases of low parent-school involvement (Oyserman, Brickman, & Rhodes, 2007). Interventions involving role models and mentors have inspired the development of new possible selves because visions of possible selves are often created through observations of others in certain roles (Lips, 2007). Mentoring by role models may be critical during career exploration because “adolescents can create, develop, or imagine possible selves through interactions with the significant adults in their environments” (Packard & Nguyen, 2003, p. 261). Friends or peers with a shared interest in science also appear to enhance both girls’ and boys’ visions of themselves as being a scientist in the future, with a positive change in perceptions of possible selves as scientists noted after friendships developed following participation in a summer science intervention program (Stake & Nickens, 2005). Little research has focused on interventions that involve media characters as vicarious role models. Research has suggested that possible selves also appear to be influenced by “models, images, and symbols provided by the media” (Markus & Nurius, 1986, p. 954).

Possible selves theory is a useful framework for this study because it takes gender into account as related to science career-possible selves. Few studies have explored the “gender-related aspects of possible selves” (Knox, 2006, p. 72), which are important in assessing the potential influence of gender on occupational aspirations (Knox, 2006). Gender is an important consideration related to the development of science career-possible selves because as one researcher explains, “possible selves are an important link in the chain of processes that lead women away from careers in natural science and technology” (Lips, 2007, p. 54).

Possible Selves and Perceptions of SET Careers

While increases have been noted in the enrollment of young women in SET disciplines and in the number of women receiving bachelor’s, master’s, and doctoral degrees in SET fields, women are still underrepresented in some fields, particularly in physics, engineering, and computer science (National Science Board, 2008). A recent study found that while overall retention rates were strong in science, technology, engineering, and mathematics (STEM) from college to graduation, from graduation to first job, and from first job and to midcareer levels, retention of high-performing students had declined (Lowell, Salzman, Bernstein, & Henderson, 2009).

Girls appear to less likely to develop possible selves as scientists. A study of high school and college students found that females were less likely than males to see science, technology, mathematics, and business as current or future possible selves, with female college students being even less likely to see themselves with future careers in these areas (Lips, 2004). A study of undergraduate women found that young women limit their occupational choices based on gender stereotypes of certain occupations such as mathematics and science (Chalk et al., 2005). In addition, girls’ and young women’s early consideration of how to balance careers and family appear to influence perceptions of possible selves relative to pursuing SET careers (Curry & Trew, 1994).
indicates that girls make early career choices based on their considerations of multiple life domains that include marriage and family (Curry & Trew, 1994). In addition, girls’ early visions of their future career-possible selves may lead them away from science and mathematics courses that are critical for preparation for future SET careers (Curry & Trew, 1994).

**Television Culture and Possible Selves**

Research on television’s influence on adolescents has documented its effects on adolescents’ cultural learning and the development of identities that include future possible selves (Fisherkeller, 1997). As adolescents move into adulthood, cultural learning through television assists them in finding “specific strategies that can help them flesh out their possible selves and accomplish their quests” (Fisherkeller, 1997, p. 484). Television also helps adolescents “construct specific symbolic links among their current situations, their possible selves, and the ‘good lives’ into which they want to move” (Fisherkeller, 1997, p. 484). Adolescents spend a significant amount of their leisure time watching television (Cherney & London, 2006; Roberts, Foehr, & Rideout, 2005). One study reported that 11- to 14-year-olds watch an average of 3.16 hours of television each day (Roberts et al., 2005), and a recent Nielsen report indicated that U.S. teenagers, on average, watch 3 hours and 20 minutes of television a day (Nielsen, June 2009). Overall, the most popular television genres for teens are evening animation, participation/variety, and drama (Nielsen, June 2009).

The amount of time adolescents spend watching television suggests that they are likely to be influenced, in some way, by the programming they watch. Over 50 years of research on television and children and young people has documented that adolescents do indeed learn from television (Pecora, 2007) and see television as a “primary source of knowledge” (Huston, Bickham, Lee, & Wright, 2007, p. 44). Research focused on television’s influence during the middle school years indicates that “[e]xposure to television has a major impact on children’s behaviors, beliefs, and achievement during middle childhood” (Huesmann & Taylor, 2006, p. 319). Furthermore, the middle school years have been found to be a time when counter-stereotypical portrayals “can effectively influence children, and prosocial portrayals can effectively stimulate lasting prosocial tendencies” (Huesmann & Taylor, 2006, p. 319).

Television’s effects on adolescents are not direct and uniform; in fact, media influences often are subtle and varied, reflecting individual differences in responses to television content (Oliver & Krakowiak, 2009). Research has identified gender differences in both television use (Nathanson, Perse, & Ferguson, 1997) and viewing preferences (Brown & Pardun, 2004; Cherney & London, 2006). A study of children 5 to 13 years of age found that girls’ preferences for television programs became more feminine with age and girls were likely to be exposed to gender-stereotyped television programs as they became older (Cherney & London, 2006). A study of middle school children found gender-motivated television viewing preferences and suggested that “adolescents’ may, indeed, be seeking models with whom they can identify as they develop a sense of themselves in the larger culture” (Brown & Pardun, 2004, p. 275).
Hypotheses and Research Questions

The present study examines (i) gender differences in current and possible (future) academic self-views of science, (ii) the potential of viewing television portrayals of scientists in changing adolescents’ current and possible (future) academic self-views of science, and (iii) gender differences in adolescents’ reports of science careers as future career-possible selves. Based on the literature reviewed above, the following hypotheses and research questions were posed for this study.

H1: Males will have higher current academic self-views in science than females before viewing scientist characters portrayed on television.
H2: Males will have higher possible (future) academic self-views in science than females before viewing scientist characters portrayed on television.

H1 and H2 predict that adolescent boys will be more likely than adolescent girls to have positive views of science as career possibilities both currently and in the future because of existing gender schemas (Bem, 1981) that lead to a tendency to view science as a masculine domain (Kelly, 1985). Additionally, gender differences will be likely because adolescent girls tend to consider career possibilities in terms of their multiple identities that take into account future expectations related to marriage and family (Thompson & Windschitl, 2005), which often are seen as incompatible with scientific careers (Curry & Trew, 1994).

H3: Viewing scientist characters on television will result in more positive current academic self-views in science for both adolescent boys and girls.
H4: Viewing scientist characters on television will result in more positive possible (future) academic self-views in science for both adolescent boys and girls.

H3 and H4 predict that viewing scientists on television will promote more positive current and possible (future) academic self-views in science among adolescents because showing scientist characters to adolescents who seek models from the media that help them “develop a sense of themselves in the larger culture” (Brown & Pardun, 2004, p. 275) will likely promote role modeling. Research also has found that girls with positive attitudes toward science were found to attribute these attitudes, in part, to watching science television programs (Baker & Leary, 1995).

RQ1: Do middle school students’ current academic self-views in science vary by program genre?
RQ2: Do middle school students’ possible (future) academic self-views in science vary by program genre?

RQ1 and RQ2 examine differences by television program genre (cartoon, drama, education) because the portrayals of scientists are very different for each of these genres. Research indicates that adolescents are most likely to watch comedies, movies, children’s, and entertainment/variety programming (Roberts et al., 2005), so it is likely that different program genres would have different effects.
RQ3: Where do science careers rank among the list of most hoped-for future career-possible selves for adolescents?
RQ4: Do differences exist between adolescent girls’ and adolescent boys’ hoped-for future career-possible selves?
RQ5: Where do science careers rank among the list of most feared future career-possible selves for adolescents?
RQ6: Do differences exist between adolescent girls’ and adolescent boys’ feared future career-possible selves?

In addition to examining adolescents’ self-views about science, this study also examined RQ3 through RQ6 to explore adolescents’ interest in future careers in science relative to other careers. Gender differences also were examined related to interest in future careers in science because of gender differences reported in early adolescent girls’ compared with early adolescent boys’ interests and attitudes toward science and scientists (Jones, Howe, & Rua, 2000).

METHOD

Participants and Research Design

Participants for the study were 370, middle school students (mean age = 12.6, SD = .59) enrolled in seventh grade in three southwestern Michigan regional middle schools. Middle school students were selected for this study because research indicates that most girls report a loss of interest in SET around the age of 12 (American Association of University Women, 1998, 2000) and adolescence is a time of active identity development (Erikson, 1968, 1985) and career exploration (Packard & Nguyen, 2003). Participants were primarily male (54%); racial/ethnic distribution included children who identified as Caucasian/white (40.1%), African-American/black (28%), mixed race/biracial (16.8%), Hispanic/Latino (6.7%), and the remaining as other (8%).

Pilot Study

The study was piloted with 44 students from a southwestern Michigan regional middle school that did not participate in the final study. Pilot participants completed the questionnaires before and after seeing video clips. The pilot study was used to determine the time needed to complete the questionnaire, final selection of television programs for the intervention, reliability of the scaled items, and to allow the study facilitator to become familiar with the timing and content of the sessions. Following the pilot, modifications were made to the content of the clips and the questionnaire. The data from the pilot were not included in the final analysis.

Because of the nature of the design, there is substantial missing data for some variables. Degrees of freedom or sample size for each test is reported as appropriate to alert the reader to this issue. The missing data was imputed for measurement analysis because of concerns about the small sample size but not for the final data analysis.
Description of the Media Intervention

Participants viewed a total of 10 television clips that were approximately 2–4 minutes long and featured scientist characters portrayed as lead characters in television programs that were popular or likely to have been seen by middle school students (Steinke, Lapinski, Crocker et al., 2007b). Participants viewed the television clips in a group setting during their regularly scheduled science class time. Participants viewed television clips featuring scientist characters in scenes selected from either cartoon, drama, or educational science programs (Table 1). 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 science 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 available for selection for some program genres.

<table>
<thead>
<tr>
<th>Attributes</th>
<th>Cartoon</th>
<th>Drama</th>
<th>Educational</th>
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<tbody>
<tr>
<td></td>
<td>Character</td>
<td>Program</td>
<td>Character</td>
</tr>
<tr>
<td>Intelligence - Male</td>
<td>Wade</td>
<td>Kim Possible</td>
<td>Warrick Brown</td>
</tr>
<tr>
<td>Intelligence - Female</td>
<td>Dee Dee</td>
<td>Dexter's Laboratory</td>
<td>Sara Sidle</td>
</tr>
<tr>
<td>Dominance - Male</td>
<td>Drakin</td>
<td>Kim Possible</td>
<td>Gil Grissom</td>
</tr>
<tr>
<td>Dominance - Female</td>
<td>Cindy</td>
<td>Jimmy Neutron</td>
<td>Catherine Willows</td>
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<tr>
<td>Alone – Male</td>
<td>Dexter</td>
<td>Dexter's Laboratory</td>
<td>Sheldon Hawkes</td>
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<tr>
<td>Alone – Female</td>
<td>Dee Dee</td>
<td>Dexter's Laboratory</td>
<td>Lindsay Monroe</td>
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<td>Respected – Male</td>
<td>Jimmy</td>
<td>Jimmy Neutron</td>
<td>Danny Messer</td>
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<tr>
<td>Respected – Female</td>
<td>Maddie</td>
<td>Danny Phantom</td>
<td>Calleigh Duquesne</td>
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<td>Caring – Male</td>
<td>Jimmy</td>
<td>Jimmy Neutron</td>
<td>Eric Delko</td>
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<tr>
<td>Caring – Female</td>
<td>Maddie</td>
<td>Danny Phantom</td>
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Previous research identified some of the most frequently occurring character attributes in television portrayals of scientists for programs most likely watched by middle school students; thus, specific scenes and scientists were selected to focus on these character attributes (Steinke, Long, Johnson, & Ghosh, 2008). 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 order to allow for comparisons between feminine and masculine gender-stereotyped character attributes. Descriptions of these character attributes are provided below.

**Intelligence:** 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.

**Dominance:** 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 the scientist was 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).

Ten television clips for each program genre (cartoon, drama, educational) were prepared. Based on the findings of a content analysis of these television programs (Steinke et al., 2008), two television clips were created for each of the five character attributes across each of the three program genres. For each attribute, a television clip was created that focused on a female scientist lead character portraying one of the five character attributes, and another television clip was created that focused on a male scientist lead character portraying one of the five character attributes. Each television clip 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 work-related settings; scenes that focused on scientists working in nonscientific setting were not included.

**Instrumentation and Measurement**

Academic science self-views were assessed with the Lips academic self-view survey (LASS) (Lips, 2004). The LASS contains scales that assess academic self-views. Items ask about participants’ current and possible (future) interests in a variety of academic domains, namely, science, math, the arts, and writing; only the science domain is presented in the current study. The scales as originally reported by Lips (2004) were utilized in the pilot study; Lips (2004) presents evidence for the validity and reliability of the measures with an average coefficient alpha of .66 for the current self scale and .72 for
the possible selves scale with a sample of college students. Although the LASS has been used with high school students, reliability and validity estimates were not reported in Lips’ (2004) second study.

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 participants in this study by changing the wording of several items and modifying the response scale. The response scale for the current study was a four-point scale with “not like me” and “definitely like me” as the anchors for the current academic self-views measures and “not like me in the future” and “definitely like me in the future” as the anchors on the future academic self-views measures. All items were subject to confirmatory factor analysis. Details on these modifications are available from the first author. Table 2 contains the scale mean, standard deviation, and coefficient alpha for each scale.

| Table 2. Sample Size, Coefficient Alphas, Means (M), and Standard Deviations for Each Scale |
|---------------------------------|------------------|------|-------------|------|
| Pretest science current self    | 307              | .85  | 2.7726      | .70944 |
| Pretest science possible self   | 307              | .86  | 2.8782      | .73610 |
| Posttest science current self   | 277              | .85  | 2.8549      | .75115 |
| Posttest science possible self  | 283              | .84  | 2.9767      | .74996 |

Procedures

Participants were recruited during their science classes by members of the research team, and HSIRB-approved procedures for obtaining consent were followed. Participation in the study took place during February and March 2008 in participants’ regularly scheduled science classes over five consecutive days. Students were assigned by school to one of three television clip viewing groups (cartoon, drama, or educational program) using a quasi-experimental, nonequivalent group design. Although a randomized assignment of individual participants would have been a stronger design, the design used for this study was necessary because data was collected in an educational setting where classes were intact before the data was collected (Gall, Gall, & Borg, 1999) and also to minimize the amount of time needed to collect data in this setting.

Prior to viewing clips of television scientist characters, participants completed a questionnaire that assessed their current and possible (future) academic self-views in science and other measures related to interest in science that are reported elsewhere. After the questionnaire was completed, students viewed the 10 television clips featuring compilations of images of scientist characters from television programs that focused on a character exhibiting one of five character attributes (intelligence, caring, respected, alone, dominant). After viewing all 10 video clips for a particular program genre, stu-
Students completed a second questionnaire that measured their current and possible (future) academic self-views of science. The items on this second questionnaire were identical to those on the first questionnaire, but also included five, open-ended questions to assess future career-possible selves. These items asked students to (i) describe what they hoped they would be like in the future, (ii) list jobs or careers that they wanted in the future, (iii) describe why they wanted the jobs or careers they listed, (iv) list jobs or careers that they did not want in the future, and (v) describe why they did not want the jobs listed as undesirable. On the fifth day, students participated in focus groups. These findings are reported elsewhere.

**Coding of Open-Ended Future Career-Possible Selves Measures**

A coding scheme was created by reviewing the data and compiling the most common responses given to the open-ended questions about future career-possible selves. Two trained coders worked independently to code a randomly selected sample of 10% of the questionnaires. Scott’s pi (Scott, 1955) and Cohen’s kappa (Cohen, 1960) were used to determine intercoder reliability. Intercoder reliabilities calculated using Scott’s pi ranged from .71 to .87, with an overall reliability of .80; intercoder reliabilities calculated using Cohen’s kappa ranged from .72 to .87, with an overall reliability of .80. One coder analyzed the remaining questionnaires (N = 288) using the coding scheme.

Future hoped-for and future feared career-possible selves were coded into one of 25 categories. Reasons for wanting future jobs were coded into one of eight categories. Reasons for not wanting a particular job were coded into one of nine categories (Appendix 1). Interest in a future career as a scientist was assessed by coding whether students listed a science job first, listed a science job second, or did not list a science job at all. Frequencies were run for all questions using SPSS. Cross tabs were run to determine responses by gender and race.

**RESULTS**

**Current and Possible (Future) Academic Science Self-Views**

The first two hypotheses predicted differences in boys’ and girls’ current and possible (future) academic science self-views before viewing television clips of scientist characters. The data were consistent with H1. Males (M = 2.88, SD = .70) exhibited higher current academic science self-views prior to seeing television clips than females; M = 2.63, SD = .71; t (300) = 3.13; p = .002. Examination of the means for H2 indicated that they were in the predicted direction, but did not reach the levels of conventional statistical significance. Males (M = 2.94, SD = .72) did not exhibit significantly higher possible (future) academic science self-views prior to the intervention than females; M = 2.78, SD = .77; t (301) = 1.86; p = .06.

Hypotheses 3 and 4 made predictions about changes in participants’ current and possible (future) academic science self-views after watching televised scientist characters. Hypothesis 3 predicted that participants would be more likely to describe themselves as having a higher current academic science self-view after viewing images of
television scientist characters than before viewing these images. Paired sample t-tests comparing pretest and posttest academic science self-views indicated there was not a significant change in current academic science self-views from pretest ($M = 2.80$, $SD = .71$) to posttest ($M = 2.87$, $SD = .75$); $t (242) = 1.84$, $p = .07$. Paired sample t-tests comparing pretest and posttest possible (future) academic self-views indicated there was a significant change in possible (future) academic self-views from pretest ($M = 2.88$, $SD = .74$) to posttest ($M = 2.99$, $SD = .76$); $t (250) = 2.88$, $p = .004$.

As an additional test of H3 and H4, gender differences were tested by comparing boys’ and girls’ academic science self-view posttest scores while controlling for the pretest scores after watching televised scientist characters. Examination of the estimated marginal means for posttest current academic science self-view scores indicated males ($M = 2.87$, $SE = .04$, 95% CI =2.79–2.95) and females ($M = 2.85$, $SE = .05$, 95% CI =2.76-2.94) did not differ at posttest $F (1, 233) = .139$, $p = .71$. Similarly, when controlling for pretest possible (future) academic science self-view scores, males ($M = 2.99$, $SE = .046$, 95% CI =2.90–3.08) did not exhibit significantly higher possible (future) academic science self-views than females; $M = 2.99$, $SE = .05$, 95% CI =2.89–3.09; $F (1, 243) = .03$, $p = .95$.

Research questions 1 and 2 addressed the influence of genre on posttest current and possible (future) academic science self-views. These questions were tested via ANCOVA, controlling for academic science self-views pretest scores. These analyses indicated that genre did not have an effect on current academic science self-views; $F (2, 239) = .77$, $p = .46$. Similarly, there was no significant effect for genre on possible (future) academic science self-views; $F (2, 247) = 1.44$, $p = .24$.

**Future Career-Possible Selves**

The top three hoped-for future career-possible selves for boys and girls overall were athlete/coach, scientist/engineer, and doctor/dentist (see Table 3). The top three occupations listed by girls were doctor/dentist, scientist/engineer, and veterinarian. For girls, 22.2% listed top three careers that involve science and mathematics as compared

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**Table 3. Percent of Top 10 Future Hoped-for and Feared Career-Possible Selves by Gender**

<table>
<thead>
<tr>
<th>Job</th>
<th>Total</th>
<th>Females</th>
<th>Males</th>
<th>Job</th>
<th>Total</th>
<th>Females</th>
<th>Males</th>
</tr>
</thead>
<tbody>
<tr>
<td>Athlete/coach</td>
<td>14.9</td>
<td>3.1</td>
<td>11.8</td>
<td>Teacher/professor</td>
<td>16.3</td>
<td>7.3</td>
<td>9</td>
</tr>
<tr>
<td>Scientist/engineer</td>
<td>12.2</td>
<td>8.7</td>
<td>3.5</td>
<td>Fast-food worker</td>
<td>10.4</td>
<td>4.5</td>
<td>5.9</td>
</tr>
<tr>
<td>Doctor/dentist</td>
<td>11.8</td>
<td>9.7</td>
<td>2.1</td>
<td>Scientist/engineer</td>
<td>7.3</td>
<td>5.2</td>
<td>2.1</td>
</tr>
<tr>
<td>Artist/designer</td>
<td>5.6</td>
<td>2.4</td>
<td>3.1</td>
<td>Doctor/dentist</td>
<td>4.9</td>
<td>3.5</td>
<td>1.4</td>
</tr>
<tr>
<td>Lawyer</td>
<td>5.6</td>
<td>3.5</td>
<td>2.1</td>
<td>Janitor/housekeeper</td>
<td>4.5</td>
<td>2.1</td>
<td>2.4</td>
</tr>
<tr>
<td>Musician/band member</td>
<td>5.6</td>
<td>2.8</td>
<td>2.8</td>
<td>Garbage collector</td>
<td>4.2</td>
<td>2.4</td>
<td>1.7</td>
</tr>
<tr>
<td>Veterinarian</td>
<td>5.6</td>
<td>3.8</td>
<td>1.7</td>
<td>Plumber</td>
<td>3.8</td>
<td>2.1</td>
<td>1.7</td>
</tr>
<tr>
<td>Teacher/professor</td>
<td>4.9</td>
<td>3.5</td>
<td>1.4</td>
<td>Retail/store clerk</td>
<td>3.8</td>
<td>1.7</td>
<td>2.1</td>
</tr>
<tr>
<td>Do not know</td>
<td>4.2</td>
<td>2.4</td>
<td>1.7</td>
<td>Writer/author</td>
<td>3.5</td>
<td>0.3</td>
<td>3.1</td>
</tr>
<tr>
<td>Police/detective/law</td>
<td>3.1</td>
<td>0.7</td>
<td>2.4</td>
<td>Construction worker/laborer</td>
<td>2.8</td>
<td>1.4</td>
<td>1.4</td>
</tr>
<tr>
<td>enforcement</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
with only 7.3% of boys who listed these careers. Girls also were more likely than boys to list a greater range of career-possible selves. The top three occupations listed by boys were athlete/coach, scientist/engineer, and musician/band member. A high percentage of boys (11.8%) reported wanting future careers as athletes or coaches.

The top three feared future career-possible selves for boys and girls overall were teacher/professor, fast-food worker, and scientist/engineer (see Table 3). The top three feared occupations listed by girls were teacher/professor, scientist/engineer, and fast-food worker. The top three feared occupations listed by boys were teacher/professor, fast-food worker, and writer/author. For girls, 8.7% listed a career that involved science and mathematics as feared career-possible selves, while only 3.5% of the boys reported these careers as feared career-possible selves. Girls and boys responded similarly in the range of responses listed for feared career-possible selves.

Middle school students stated that they chose hoped-for careers because they perceived these careers as interesting or addressing subjects they liked (see Table 4). To a lesser extent, students reported being good at these careers or these careers being fun or exciting as important in selecting these careers.

<table>
<thead>
<tr>
<th>Reason</th>
<th>Total</th>
<th>Females</th>
<th>Males</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interesting/cool subject/like subject</td>
<td>50.7</td>
<td>29.2</td>
<td>21.5</td>
</tr>
<tr>
<td>I am good at it</td>
<td>11.8</td>
<td>4.5</td>
<td>7.3</td>
</tr>
<tr>
<td>Fun/exciting</td>
<td>10.1</td>
<td>3.5</td>
<td>6.6</td>
</tr>
<tr>
<td>Helps people/makes world a better place</td>
<td>7.6</td>
<td>4.9</td>
<td>2.8</td>
</tr>
<tr>
<td>Other</td>
<td>7.6</td>
<td>2.8</td>
<td>4.9</td>
</tr>
<tr>
<td>Profitable/good money</td>
<td>4.9</td>
<td>1.4</td>
<td>3.5</td>
</tr>
<tr>
<td>Do not know</td>
<td>4.5</td>
<td>1.7</td>
<td>2.8</td>
</tr>
</tbody>
</table>

Middle school students reported not wanting feared careers for a range of reasons; they reported that they perceived these careers as not being interesting to them personally, as being uninteresting or boring careers, as not being lucrative careers, or as being difficult or dirty jobs that were beneath them (see Table 5).

Over three-fourths of the students listed careers other than science careers as future hoped-for career-possible selves (see Table 6). A higher percentage of males than females listed science careers as a first or other choice as a future hoped-for career-possible self.

An analysis was conducted to determine whether the race/ethnicity of the middle school students influenced responses about future career-possible selves as scientists. The following percentages of students by race/ethnicity reported science as being a future hoped-for career-possible self: Native American (50%), Asian/Pacific Islanders (45%), Caucasian (31%), Hispanic/Latino (25%), mixed race/biracial (17%), African-American (16%). The sample sizes of middle school students for Native Americans and
Asians/Pacific Islanders were small. For African-American students, scientist/engineer was the second most reported future feared career-possible selves after teacher/professor. For Caucasian students, scientist/engineer was listed only as the fourth most reported future feared career-possible selves followed by teacher/professor, fast-food worker, and writer/author as future feared career-possible selves.

Table 5. Percent of Reasons for Future Feared Career-Possible Selves by Gender

<table>
<thead>
<tr>
<th>Reason</th>
<th>Total</th>
<th>Females</th>
<th>Males</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not interested/not for me</td>
<td>31.6</td>
<td>17</td>
<td>14.6</td>
</tr>
<tr>
<td>Boring/not interesting/not cool</td>
<td>14.9</td>
<td>5.9</td>
<td>9</td>
</tr>
<tr>
<td>Not profitable</td>
<td>13.2</td>
<td>4.9</td>
<td>8.3</td>
</tr>
<tr>
<td>Dirty/difficult/bad/beneath me</td>
<td>8</td>
<td>5.2</td>
<td>2.8</td>
</tr>
<tr>
<td>Other</td>
<td>8</td>
<td>4.9</td>
<td>3.1</td>
</tr>
<tr>
<td>Do not know</td>
<td>5.9</td>
<td>1.7</td>
<td>4.2</td>
</tr>
<tr>
<td>Not good at it/not smart enough</td>
<td>5.6</td>
<td>3.1</td>
<td>2.4</td>
</tr>
<tr>
<td>Too challenging/complicated</td>
<td>5.6</td>
<td>2.4</td>
<td>3.1</td>
</tr>
<tr>
<td>Dangerous/risky</td>
<td>3.5</td>
<td>2.1</td>
<td>1.4</td>
</tr>
</tbody>
</table>

Table 6. Percent of Future Science Career-Possible Selves Selection by Gender

<table>
<thead>
<tr>
<th>Science listed as future hoped-for career-possible self</th>
<th>Total</th>
<th>Females</th>
<th>Males</th>
</tr>
</thead>
<tbody>
<tr>
<td>Science as first choice</td>
<td>11.8</td>
<td>3.5</td>
<td>8.3</td>
</tr>
<tr>
<td>Science as other choice</td>
<td>10.4</td>
<td>4.2</td>
<td>6.3</td>
</tr>
<tr>
<td>Science not chosen</td>
<td>77.8</td>
<td>41</td>
<td>36.8</td>
</tr>
</tbody>
</table>

DISCUSSION

This study assessed gender differences in adolescents’ academic self-views of science and then examined the impact of viewing televised scientist characters on their academic self-views related to science. Results indicated that before viewing televised scientists, adolescent girls had lower current views of themselves as being good at science than did adolescent boys, but no differences were found in adolescents girls’ and boys’ possible or future views of themselves as being good at science. However, results showed that viewing televised scientist characters led to change for both adolescent girls and adolescent boys related to more positive views of being good at science in the future, although no change was noted in more positive views of being good at science at the
current time. Findings showed that the genre of the television program viewed did not affect changes in current and future academic self-views in science.

The finding of gender differences in adolescents’ current academic self-views of science prior to viewing televised images of scientists was similar to findings from other studies that indicate, in general, adolescent boys and adolescent girls differ in their attitudes toward science and perceptions of science courses and careers (Jones et al., 2000). Adolescent boys report more interest in physical science and participate in more extracurricular science activities (Jones et al., 2000). Adolescent boys’ greater interest and confidence in their scientific abilities may be related to traditional gender schemas that designate science as more appropriate for males (Chalk et al., 2005; Lips, 2004, 2007). Studies show that adolescent girls’ views of academic subjects often are in line with gender stereotypes, which may close them off from careers that are inconsistent with traditional stereotypes such as SET careers (Lips, 2004, 2007). In fact, research shows that high school and undergraduate female students are less likely than males to rate themselves as strong in science and mathematics (Lips, 2004). Research indicates that girls and boys also have different motivations for studying science (DeBacker & Nelson, 2000). Girls may first need to see science as relevant to their future identities in order to be engaged in science and to see “the possibilities for who they can become” (Thompson & Windschitl, 2005, p. 20).

The other finding from this study related to academic self-views of science prior to viewing televised images of scientists showed no differences in adolescent boys’ and adolescent girls’ views of their future ability in science. This finding suggests that both adolescent girls and adolescent boys may find it difficult to conjecture about their future academic ability in science. This finding lends support for future intervention for both adolescent girls and adolescent boys in order to develop confidence in their future abilities in science. This is especially important since adolescents’ perceived confidence in science is related to the development of future career-possible selves in science (Garcia & Pintrich, 1995).

The research findings related to academic self-views of science after viewing televised images of scientists were mixed. The current study found a positive change for adolescents’ future academic self-views of science, but not for current academic self-views of science. However, the finding of positive change in the adolescents’ future views of their abilities in science suggests the effectiveness of media interventions in changing attitudes toward science. Few studies are available with which to compare these findings. However, one study found that middle school students who watched clips of stereotyped and counterstereotyped television and movie portrayals of women SET professionals and received instruction on the inappropriateness of gender stereotypes of scientists were less likely to agree that women are accurately portrayed in the media than students who did not watch the clips (Steinke et al., 2007b). Finding a positive change after watching scientists on television in adolescents’ views about their future abilities in science suggests that media interventions that feature televised role models of scientists could be important for developing middle school students’ interest in SET careers.

A possible alternative explanation for the lack of positive change in current academic science self-views is that after viewing scientists who were predominantly shown with attributes that portrayed intelligence and competence in science, students may have felt less confident in their own scientific abilities. An analysis of the television
programs most likely watched by middle school students found that most scientists on these programs are overwhelmingly portrayed as being intelligent (Steinke et al., 2008). Viewing scientists on television who are almost always portrayed as being smart may hinder the development of positive current academic self-views in science for adolescents who find science to be challenging.

In addition to assessing gender differences in academic self-views in science and the impact of viewing televised role models of scientist characters on television on academic self-views in science, this study also explored how adolescent girls and boys ranked science careers relative to other careers. Adolescents’ reports of hoped-for and feared future career-possible selves also focused on examining gender differences in the ranking of science careers. Interestingly, scientist/engineer appeared among the top three ranked careers as both a hoped-for future job and a feared future job for both adolescent girls and boys. For adolescent girls, a career as a scientist/engineer was ranked second as a hoped-for future job, closely following the top choice of doctor/dentist with veterinarian as a third choice. For adolescent boys, a career as a scientist/engineer also was ranked second as a hoped-for future job, but preferred much less than the top choice of athlete/coach. In this study, adolescent girls were more than twice as likely as adolescent boys to list being a scientist/engineer as a hoped-for future career, and adolescent girls’ top three career choices all involved science and mathematics.

The findings from the qualitative analysis differ from those found in the previous research on adolescents’ interest in SET careers. One study showed that boys were more likely than girls to choose science and mathematics careers (Morgan, Isaac, & Sansone, 2001). Another study found that only one-fourth of adolescent girls cited teaching or nursing occupations as career-possible selves and mentioned jobs as scientist or vet less frequently (Shepard & Marshall, 1999). One possible explanation for the difference found in the current study is that viewing televised portrayals of women scientists (students viewed an equal number of women and men scientists in the clips) influenced adolescent girls’ hoped-for career-possible selves in science. That is, viewing televised images of women scientists encouraged the development of future or hoped-for future science career-possible selves for girls by first increasing their future academic self-views in science. This explanation is worth future study, but is speculative because specific changes in girls’ career-possible selves prior to and after viewing television images of scientist characters were not directly assessed in the current study. Nonetheless, this finding underscores the importance of considering multiple variables related to attitudes toward science and perceptions of scientists on adolescent girls’ science career decision making and their development of science career-possible selves. Additional research now needs to consider the pathway by which this change occurs.

While a career as a scientist/engineer was listed as the second most hoped-for career-possible self, it is important to also note that a career as a scientist/engineer also was listed as the second most feared career-possible self for girls but not for boys. This finding suggests individual and group differences among girls related to interest in future science careers and indicates that science careers are still viewed as undesirable by some middle school girls. Determining what these differences are among girls and the reasons for these differences is important in developing interventions to foster all girls’ interest in science. This finding also calls for further examination of the potential influence of girls’ gender schemas and girls’ sensitivity to social norms as related to their
perceptions of gender roles, views of work and family balance, perceptions of careers in SET, and views of women in SET careers. This research is especially important because studies indicate that girls appear to be more susceptible to contextual influences and also very aware of “social norms about appropriate gender roles in adulthood” (Oyserman & Fryberg, 2006, p. 31).

Differences were noted in hoped-for science career-possible selves by race and ethnicity. Native American, Asian-Americans/Pacific Islanders, and Caucasian students were more likely to report wanting to be scientists or engineers than African-American students. The generalizability of these findings are limited, however, because of small sample sizes for Native American and Asian Americans/Pacific Islanders middle school students in this study. Further research is needed in this area for adolescents, in general, and adolescent girls, in particular, because other studies have noted the influence of race and ethnicity on adolescents’ views of possible selves (Kerpelman & Pittman, 2001; Lobenstine et al., 2001), as well as the potential influence cultural expectations of gender have on girls’ possible selves (Knox, 2006).

Adolescence is a time of active identity formation (Erikson, 1968, 1985) during which career exploration occurs and career aspirations are likely to shift (Packard & Nguyen, 2003). For girls, in particular, adolescence is a time for creating awareness, encouraging consideration, and dispelling gender stereotypes of nontraditional careers such as science careers because adolescence is the time when girls are establishing their identities related to career, marriage, and parenthood (Kerpelman & Pittman, 2001). The findings from the current study call for more studies on interventions that seek to increase girls’ interest in science careers using media role models because research indicates that “[a] future possible self which feels psychologically close is more motivating than a future possible self which feels psychologically distant” (Strahan & Wilson, 2006, p. 12). Moreover, research in this area is important for broadening participation in the SET workforce since research also indicates that adolescents’ career aspirations predict adult occupational attainment (Schoon & Parsons, 2002).

Limitations of the Research

One of the limitations of this study was the focus on changes in only one measure (academic self-views) of students’ attitudes toward SET and SET careers. Future research needs to assess additional measures like interest in science, attitudes toward science and scientists, views of women in SET careers, perceptions of gender roles, and perceptions of future work/family balance goals. The findings from the qualitative assessment of students’ hoped-for career-possible selves highlight the need for more research that examines whether viewing of television scientist characters directly or indirectly influences adolescent girls’ hoped-for science career-possible selves. In addition, while the current study used a self-concept-type measure of science aptitude (do well in science classes), another measure of science career-possible selves may be a more accurate measure of this variable. For example, a measure that asks how likely future events are to occur related to work and home if one were to have a career as a scientist in the future (Stake & Nickens, 2005).

Another limitation of the current study was the short amount of time that adolescents viewed television clips of scientist characters. It is important to note that other
Interventions, like the current study, have noted changes and even positive gains in adolescents’ career exploration for interventions delivered in a short time frame (Turner & Lapan, 2005). Additionally, researchers have noted that small to moderate effect sizes are typical for studies of media effects and often reflect variances attributed to individual differences in television viewers’ responses to television content (Oliver & Krakowiak, 2009). However, because gender stereotypes of scientists may be so strong for adolescents, stronger effects may be detected when television clips are viewed for a longer duration of time.

This current study assessed the influence of viewing media role models of scientists on students’ current and future academic self-views or how well they perceived themselves to be doing academically in science. It is unclear from the findings if middle school students perceived a connection between academic performance in science and the possibility of future science careers. Discussions of how academic performance translates into career choices may be important in encouraging middle school students to consider future careers in SET. This is especially important in light of the finding of the qualitative assessment that showed a high percentage of girls reporting interest in careers that involve science and mathematics.

The change in future academic self-views of science after watching televised scientist characters along with adolescent girls’ reporting of hoped-for science and science-related career-possible selves underscores the need for research focused on the efficacy of media interventions in both developing and maintaining science career-possible selves of adolescent girls. Research has found that imagining the possibility of a scenario occurring has been even more effective in influencing behavior than persuasive messages (Gregory, Cialdini, & Carpenter, 1982). Research also has noted that adolescents are open to feedback counter to their visions of possible selves related to career, marriage, and parenthood (Kerpelman & Pittman, 2001). Additional research is needed to assess the specific influence of television models of scientists focused on the issues of career, marriage, and parenthood as related to girls’ science career-possible selves. As noted in a study of the influence of peer relationships and friends’ attitudes toward science on adolescent girls’ possible self as scientists: “The possible personal self as scientist would be the imagined personal life of the adult self should the individual choose to have a career in science and would include expectations pertaining to personal relationships and the balance of family and work” (Stake & Nickens, 2005). Future research in this area would more completely take into account the role of identity that is becoming more recognized as being central to issues of gender and science (Brotman & Moore, 2008).

Integrating media and popular culture into classroom instruction has been used in English (Trier, 2006), literacy education (Norton-Meier, 2005), and health education (Diez, Pleban, & Wood, 2005) classes. These educators have cited the effectiveness of integrating media and popular culture in promoting awareness, discussion, critical thinking, and understanding. Further research is needed to inform the design of teaching units and curricula incorporating popular television images of scientists to determine how these can best be used to create greater awareness of scientific professions, promote discussions about the reality of scientific research, teach science content, and address the pervasive gender stereotypes and stereotypes of scientists’ attributes and lifestyles that adolescents often report (Steinke et al., 2007a).
REFERENCES


**APPENDIX 1**

**List of Hoped-for and Feared Careers**

Accountant
Artist/cartoonist/painter/actor/director/designer
Actor/director/producer/movies/film
Athlete/gymnast/sports player/dancer/coach
Construction worker/laborer
Coctor/ pediatrician/ dentist/ surgeon
Farmer
Fast-food worker
Firefighter/rescue worker
Garbage collector/waste management
Hair dresser/stylist/cosmetologist/makeup
Janitor/housekeeper
Lawyer
Military
Musician/band member/instrumentalist/singer
Nurse
Plumber
Police officer/detective/law enforcement/FBI/CIA
Scientist/engineer/chemist/geologist
Store or retail clerk
Teacher
Veterinarian
Writer/author
Other
Do not know

Reasons for Hoped-for Careers

Job is fun/exciting
Job is interesting/cool/like subject
Job helps people
Job makes world a better place
Job makes money/profitable/good paying
Job makes me successful/accomplished
I am good at it
Other
Do not know

Reasons for Feared Careers

Job is not profitable/not enough money
Job is boring/not interesting/not fun/not cool
Job is dirty/nasty/difficult/bad job/beneath me/low class
Job is dangerous/risky
Job is too challenging/complicated/hard to achieve
I’m not interest in job/not for me/not like me/does not fit with personality
I’m not good at it/not talented at it/not smart enough for it
Other
Do not know