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ORIGINAL ARTICLE

Matching Abilities to Careers for Others and Self: Do Gender Stereotypes Matter to Students in Advanced Math and Science Classes?

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Abstract Interest in STEM (science, technology, engineering, and mathematics) careers falls off more quickly for young women than for young men over adolescence, and gender stereotypes may be partially to blame. Adolescents typically become more stereotypical in their career interests over time, yet they seem to become more flexible in applying stereotypes to others. Models of career interest propose that career decisions result from the alignment of self-perceived abilities with occupation-required skills and that gender stereotypes may influence this process. To investigate the discrepancy between applying stereotypes to self and others, we examined if these models can be applied to perceptions of others. Focusing on students from fifth grade through college enrolled in advanced STEM courses, we investigated how STEM occupational stereotypes, abilities, and efficacy affect expectations for others' and own career interests. U.S. participants (n = 526) read vignettes describing a hypothetical male or female student who was talented in math/science or language arts/social studies and then rated the student's interest in occupations requiring some of those academic skills. Participants' self-efficacy, interest, and stereotypes for STEM occupations were also assessed. Findings suggest that ability beliefs, whether for oneself or another, are powerful predictors of occupational interest, and gender stereotypes play a secondary role. College students were more stereotypical in their ratings of others, but they did not manifest gender differences in their own STEM self-efficacy and occupational interests. Experiences in specialized STEM courses may explain why stereotypes are applied differentially to the self and others.

Keywords Gender stereotypes · Occupation stereotypes · Career interest · Development of career interest

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"What do you want to be when you grow up?" Understanding how some children answer this question with "nurse" and others "engineer" has been the focus of over 25 years of research on gender differences in educational experiences and career choices. Female adolescents in the United States are exhibiting greater interest and participation in high school math and science classes than ever before, but career intentions continue to show significant gender disparities (National Science Foundation, National Center for Science and Engineering Statistics 2015). From childhood to early adulthood, interest in STEM (science, technology, engineering, and mathematics) careers falls off more quickly for females than for males (Bernstein and Russo 2008), and women with STEM academic skills are less likely to pursue a STEM career than their male counterparts. The increasing influence of gender stereotypes over the course of development may help explain women's and girls' lower STEM interest relative to men's and boys' (Correll 2004; Eccles and Wigfield 2002; Hill and Lynch 1983). However, some research suggests that with maturation, students might actually become more tolerant of stereotype-incongruent behaviors in others (Bartini 2006; Katz and Ksansnak 1994; Liben and Bigler 2002). The contradiction between increasing adherence to occupation stereotypes for self-reported interests and decreasing expectations for stereotype adherence in others is the focus of the present study with students from fifth grade to college.

Three aspects of our study contribute to both its theoretical and practical importance for understanding the STEM gender gap. First, to close the gender gap in STEM occupational interests, it is necessary to understand how stereotypes influence both self-reported occupational interests and expectations for others' career interests because the two are intertwined. For example, classmates who hold very traditional gender stereotypes may create a less supportive environment for students whose abilities run counter to these stereotypes. Classmate support is associated with STEM interest and self-efficacy (Holland and Barth 2016; Leaper et al. 2012; Rice et al. 2013), and the academic interests of friends influence students' own academic choices (Crosnoe et al. 2008; Robnett and Leaper 2013).

Second, because the students we studied were in four grade levels between fifth grade and the first year of college and all were eligible for advanced math and science classes at their schools, the findings from our study may be especially relevant for understanding the widening STEM gender gap over the course of development. To our knowledge, no study has focused on a similar sample of high ability math and science students across such a wide age range. Third, a key theoretical contribution lies in the application of models used to predict individuals' career interest (that include self-reported abilities and gender) to examine judgments of others' career interests. This resulted in a new methodological approach to studying gender stereotypes of career interest. This theoretical extension provides the basis for our research design and is used to identify the key aspects of stereotypes that are examined in our study.

Models of Academic Achievement and Occupation Choice

Social cognitive models of students' academic and career pursuits identify students' ability beliefs and occupation-relevant skills as the two most relevant components for predicting academic and career outcomes (Bandura et al. 2001; Eccles and Wigfield 2002; Lent et al. 1994), but less is known about the factors that influence perceptions of others' career interests. Social cognitive models propose that self-perceived ability or competence (e.g., self-efficacy, self-concept), rather than actual competence (e.g., grades, achievement scores), are the better predictors of academic and occupation outcomes (Bandura et al. 2001; Eccles and Wigfield 2002; Lent et al. 1994). The alignment between self-perceived abilities and perceptions of occupational skill requirements (e.g., task demands) is increasingly important in determining career interests over development (Wilk et al. 1995). Additionally, students' understanding of the importance of this alignment is likely to increase as they encounter STEM courses that become more selective over schooling. Yet self-perceived abilities, self-efficacy, and perceptions of the skills needed to succeed in a career may be also affected by gender socialization and gender stereotypes (Bandura et al. 2001; Eccles and Wigfield 2002). For example, girls and women tend to underestimate their math and science abilities and report lower self-efficacy compared to boys and men, even when objective measures of their abilities indicate otherwise (Bandura et al. 2001; Cordero et al. 2010; Kurtz-Costes et al. 2008).

Extrapolating from models of individual career interest, we examine how gender stereotypes influence judgments of others' interest when information about a person's gender and academic abilities are provided in addition to the skills required for the occupation. An important aspect of our study is that we introduce a systematic approach to assessing how expectations of others are affected when a person's abilities are consistent or inconsistent with gender stereotypes. Specifically, we presented participants with the academic strengths (math, science, language arts, and social science) of hypothetical male and female students and asked to assess those students' interest in occupations that varied in whether they matched the target's academic strengths and gender stereotype. Because academic strengths are clearly articulated and equivalent for male and female targets in the research design, there should be no systematic differences in the interest ratings for them, unless raters are influenced by gender stereotypes. Similar hypothetical frameworks have been used in previous gender-stereotype research (e.g., Bradbard et al. 1986; Liben et al. 2001; Martin 1989) and are ideal because they efficiently manipulate gendered information while holding other conditions constant. (See Martin 1989, for an example related to children's judgments of gender stereotypical toys and Moss-Racusin et al. 2012, and Reuben et al. 2014, for studies of biased hiring decisions.)

In addition to assessing the application of stereotypes to others' career interests based on gender, abilities, and occupation-required skills, we examined the influence of occupational stereotypes and occupational ability beliefs (i.e., self-efficacy) on self-reported career interests, applying the social cognitive models we described here. Age differences across the four grade levels we studied (fifth grade, eighth grade, high school, and college) for both types of ratings (self and other) may depend on the degree to which adherence to gender stereotypes for oneself and for others are subject to developmental changes.

Academic and Occupation Stereotypes over Development

Children's exposure to gender stereotypes in their culture is inevitable, but awareness of gender stereotypes is conceptually distinct from endorsing stereotypes for oneself and expecting adherence in others (Blakemore 2003; Galdi et al. 2014; Signorella et al. 1993; Signorella and Liben 1985). Knowledge of the stereotype that math is a masculine subject and that boys should perform better and like it more than girls is observed as early as five years of age (del Rio and Strasser 2013) and in first through sixth graders (Cvencek et al. 2011; Liben and Bigler 2002), as well as in college students (Liben and Bigler 2002). The masculine stereotype for science (Finson 2002, Liben and Bigler 2002) and the feminine stereotype for reading, language arts, and English (Liben and Bigler 2002; Kurtz-Costes et al. 2014) also are evident in elementary school and college-aged students. (It should be noted that in some studies, for example, Lummis and Stevenson 1990, gender egalitarian views or own-gender biases dominate children's responses. See Signorella et al. 1993, for a discussion of how methodological variations in assessing stereotypes influence findings related to changes over development.)

Knowledge of occupation gender stereotypes emerges even earlier, between two-and-a-half and five years of age (Blakemore 2003; Gettys and Cann 1981; Hilliard and Liben 2010). It substantially broadens, adding more occupations at age six (Blakemore 2003; Levy et al. 2000) and continually grows through the elementary school years (Levy et al. 2000; Martin 1993; Serbin et al. 1993). Because knowledge accrues, college students are aware of even more occupation stereotypes (Glick et al. 1995; Liben and Bigler 2002; Spencer et al. 1999). For example, Liben and Bigler (2002) were able to include 27% more masculine occupations in the college version of their measure of gender stereotype attitudes than in the sixth grade version. Relevant for our study, both the sixth grade and college student versions include six common STEM occupations for masculine stereotypes.

Evidence that older students are more knowledgeable of stereotypes does not necessarily mean that they will be more influenced by stereotypes than less knowledgeable younger students are. Some well-supported theories offer conflicting views regarding how gender stereotypes influence attitudes and behavior throughout development. The socialization perspective proposes that children grow increasingly aware of cultural stereotypes as they age, and the influence of stereotypes increases such that they come to personally endorse them, as well as expect others to adhere to them (Katz and Ksansnak 1994; Kurtz-Costes et al. 2008). For example, according to the gender intensification theory (Hill and Lynch 1983), with pubertal changes there is increased social pressure on children to conform to traditional gender roles. Similarly, the circumscription and compromise theory of career interest (Gottfredson 1981; Gottfredson and Lapan 1997) proposes that gender stereotypes become increasingly important as students mature, resulting in greater adherence to occupational gender stereotypes during adolescence and beyond.

In contrast, the cognitive-developmental approach proposes that with maturation, children understand that gender stereotypes do not apply to every member of a particular gender group or on every occasion. Thus, as they age, students should apply gender stereotypes less rigidly in their assessments of themselves and others (Garrett et al. 1977; Katz and Ksansnak 1994), which we refer to as flexibility. More flexible people would be more likely to believe that men and women could have the same career interests (Alfieri et al. 1996). There is evidence to support each view.

Supporting the cognitive-developmental theory, adherence to gender stereotypes is most rigid between ages five and seven (Signorella et al. 1993; Trautner et al. 2005) and thereafter becomes increasingly flexible throughout childhood and adolescence (Ruble et al. 2006). Negative reactions to gender norm transgressions in occupations have been observed even before the typical rigid phase (3–4 year-olds, Levy et al. 2000). Seminal research by (Liben and Bigler 2002) examined if "sex typing of others" (i.e., whether men or women *should* perform a particular activity and referred to as gender-typing in the present study) changed from sixth to seventh grade. Gender-typing decreased over their yearlong study, indicating increased flexibility with increased maturity, a finding that has been replicated (with sixth and seventh graders; Bartini 2006) and also found in other grade comparisons (first through fifth grades: Garrett et al. 1977; third through twelfth grades: Katz and Ksansnak 1994). However, this change may depend on the particular gender transgression (e.g., clothes and occupations: Blakemore 2003, or personality traits: Alfieri et al. 1996) and on whether adolescents have recently transitioned to junior high school (increasing after the transition and then decreasing throughout junior high; Alfieri et al. 1996). Some studies report more flexibility in evaluating women than men (Clow et al. 2015; DiDonato and Strough 2013; Garrett et al. 1977; Wilbourn and Kee 2010) and that women are more flexible than men applying stereotypes (Clow et al. 2015; DiDonato and Strough 2013).

There is mixed evidence regarding changes in the stereotypicality of self-reported interests over development. Regardless of age, people usually show more favorable attitudes toward and interest in occupations that are same-gender stereotyped than other-gender stereotyped (e.g., for preschoolers: Levy et al. 2000; for college students: DiDonato and Strough 2013). Liben and Bigler (2002) and Bartini (2006) reported little change in the gender stereotypes of self-reported interests from sixth to seventh grade. However, Katz and Ksansnak (1994) found that self-reported interests became less stereotypical from third grade to high school, following the same pattern as flexibility for the gender-typing of others as we discussed previously.

To summarize, whereas knowledge of stereotypes accrues with age, the developmental pattern of stereotype endorsement for self and others is more complicated. Flexibility in attitudes toward others seems to increase during adolescence, consistent with the cognitive-developmental perspective. Self-reported academic abilities and occupational interests tend to align with gender stereotypes prior to adolescence and most, but not all, evidence suggests that they remain so as students mature, consistent with a socialization perspective. Systematically examining the interactive effects of gender, abilities, and occupation skills may shed light on why different patterns are observed. An important question addressed in our study is whether patterns evident in previous research will hold true for students in specialized STEM classes.

Stereotype Endorsement for High Ability STEM Students

For students in specialized STEM classes, gender may become a less salient marker for who is likely to do well in a STEM career. For example, Christensen et al. (2014) reported that high school students enrolled in STEM-specialty schools had more favorable dispositions toward math and science than their peers in traditional high schools did. Within these specialty schools, young women actually had greater interest in some STEM careers than boys did, although some of the gender differences disappeared over time. Because ability grouping of students for math and language arts in most U.S. schools becomes more selective over time, students may become more aware of the relation between their academic talents and career aspirations. In addition, because the grade levels in our study represent different developmental periods in STEM school experiences, attention to how abilities align with career interests may increase with age. The fifth graders all took the same math and science courses, eighth graders were subject to some tracking, high school students had taken advanced STEM courses beyond those required for a diploma, and college students were selectively enrolled in courses required for STEM majors. These considerations are important for whether our findings will generalize to other students. However, this group of students, who are in the STEM pipeline, is highly relevant for understanding the gender gap in STEM.

The Present Investigation

In the present study we seek to clarify the differential influence of gender stereotypes on self-reported career interests and the expectations for others' interests throughout childhood and adolescence. We aim to do so by using a systematic approach that applies models of self-reported career interest, which disambiguate the influences of gender, perceived abilities, and occupation-required skills to the perceptions of others' career interests, substituting information about a hypothetical person's abilities for self-perceptions. By focusing on high ability math and science students across a wide range of ages, our findings will inform efforts to close the gender gap in STEM career interests.

There are two parts to our study. To assess their application of stereotypes to others, participants responded to a series of hypothetical vignettes. Based on target students' gender and academic abilities, participants were asked to predict the targets' interests in multiple careers with different skill requirements, either in math and science (masculine stereotyped) or in language arts and social studies (feminine stereotyped). In addition, to predict their own interest in STEM careers, participants completed traditional assessments of their own science and math career efficacy and occupational stereotypes.

The models of career interest lead us to expect that hypothetical students' (HS) gender and HS ability, as well as occupation required skills, will influence interest ratings (three-way interaction). Grade-related differences are expected in that HS abilities should play a greater role in the judgments of older students compared to younger students due to the accumulation of experiences in advanced courses and to the greater likelihood of flexibility in applying stereotypes, according to the cognitive-developmental model. The critical test of this prediction is whether male and female HS with the same abilities are rated differently when their abilities match occupational skill requirements (e.g., a girl versus a boy with high science abilities being rated on a science career). In these cases, older students are predicted to make less stereotypical judgments, relying more on the abilities of the HS.

Consistent with previous research, gender differences are expected in self-efficacy for and interest in STEM occupations. Self-efficacy should be the chief predictor of occupational interest, and occupation stereotypes should play a secondary role. Based on Liben and Bigler (2002) and Bartini (2006), grade-level changes are not expected for the prediction of self-interest from occupational stereotypes.

Method

Participants

Non-College Student Sample

Three hundred thirty-nine students (185 female and 154 male) were included in the sample. Participants were part of a larger sample of fifth, eighth, and high school students who were recruited to take part in a study on the influence of math and science attitudes and beliefs on career choices. The nine U.S. schools from which the students were recruited were predominantly non-Hispanic White (school average of 72%, range 42% to 94%), but had a significant percentage of Black students (school average 24%, range 4% to 51%). The average free/reduced lunch rate was 45% (range 27% to 73%). In the last half of the spring semester, students carried a letter home to their parents that explained the purpose of the project, and informed them that their school would receive a $5 donation for their participation. Parents were also asked to indicate if their child was interested in participating in a second career survey (the source of data for the present study) and earn $15 (fifth graders) or $20 (eighth graders and high school students) for themselves. Consent forms were returned to the school. The initial response rate was 46.6% of the 1511 potential students and included 290 fifth graders, 207 eighth graders, and 207 high school students. These students completed the author-developed Math, Science, and Technology Questionnaire that included questions on math- and science-related attitudes, interest, beliefs, and goals.

From the set of participants whose parents indicated an interest in the second study, we identified those students who were placed in advanced math or science classes based on information from teachers and guidance counselors. The elementary schools did not use ability grouping in their math and science classes, so fifth graders whose teachers recommended them for advanced sixth grade math in middle school were invited. In the middle schools (covering sixth through eighth grade) students taking advanced eighth grade math (pre-algebra) were invited to participate. Because calculus is a gateway course for STEM majors, we targeted high school students who would be "calculus-ready" if they continued on to college. This included 11th grade (third year of high school) students who had taken pre-calculus or planned to take pre-calculus or calculus the following year. High school students who had taken or planned to take physics or an Advance Placement (AP) science class were also invited, but this student population overlapped with those identified using the math criterion.

Not all of the participating high schools followed our guidelines for distributing the letters and some eligible students did not receive information about the study. Consequently we were unable to get precise return rates for these schools. In this case we used a conservative estimate based on the number of participating students divided by the number enrolled in advanced classes. Taking this correction into account, 341 students returned consent forms, resulting in an overall return rate of over 90% for those invited to participate in the second survey. Two students did not answer all of the questions on this second survey and were not included in the analyses, resulting in a final sample size of 339 for this group of participants. This included 123 fifth graders ($n = 62$, 50.4%, female), 102 eighth graders ($n = 47$, 45.6%, female), and 115 high school students ($n = 76$, 66.1%, female). The mean ages for each grade level were 10.8 years for fifth grade (range = 10–12), 13.9 years for eighth grade (range = 13–15), and 16.7 years for high school students (range = 16–17). The sample was predominately non-Hispanic White ($n = 241$, 71.1%), but also included 24.2% ($n = 82$) Black, 2.1% ($n = 7$) Asian, .6% ($n = 2$) Hispanic, and 2.1% ($n = 7$) another race or unreported.

College Student Sample

Similar to the other sample, participating college students completed two separate questionnaires on different days. Approximately 1640 college students (based on enrollment) in entry level engineering, calculus, physics, chemistry, and geology courses (required for majors in these fields) were approached on the first day of class in the fall term. A member of the research team went to each class and explained the purpose of the study and read a consent statement. Students wishing to participate stayed after class to complete one questionnaire and indicated if they were interested in participating in a second study for $20. Fully 988 students (60%) provided complete questionnaires for the first survey.

Participants who indicated an interest in completing the second questionnaire and were first year students ($n = 326$) were contacted by phone, email, and additional classroom announcements over the next 3 weeks. We attempted to recruit equal numbers of men and women. This strategy resulted in a final sample of 187 first-year college students (88 female, 99 male). The median age was 18 years for both men and women (range = 17–19). The racial make-up was predominantly non-Hispanic White ($n = 154$, 82.4%), followed by Black ($n = 16$, 8.6%), Asian ($n = 8$, 4.3%), and Hispanic ($n = 5$, 2.7%), with the remainder another race or unspecified ($n = 4$, 2.1%). Although not all of the students identified a major, the breakdown of those who did ($n = 179$) resulted in the following numbers for different STEM majors: 115 (52 women) in Engineering, 17 (13 women) in Biology, 14 (4 women) in pre-professional health (e.g., pre-med, pre-dentistry), 13 (9 women) in Chemistry, 8 (0 women) in Computer Science, 2 (both women) in Mathematics, and 10 (6 women) in non-STEM majors.

To gauge participants' readiness to pursue a STEM major or career, they were asked to indicate the STEM courses they had taken in high school from a list provided. (A space was provided to write in courses not in the list.) The mean number of high school STEM courses beyond required high school algebra, biology, and introductory physical science was approximately 4 (range 0–9) Over half of the students had taken at least one AP science or math course. High school GPA was self-reported by selecting from six possible ranges, with a 4.0 being the highest GPA possible. The majority (114, 61%) indicated that their high school GPA was 3.75 or higher, followed by 21% ($n = 39$) indicating a GPA between 3.5 and 3.7, 12% ($n = 22$) indicating a GPA between 3.0 and

3.4, and 2% ($n = 4$) indicating a GPA between 2.5 and 3, with the remaining students not responding. Importantly, a MANOVA comparing men and women with complete data on the number of high school STEM courses, number of AP STEM courses, and high school GPA was not significant. Together this information indicated that this sample was largely STEM majors and had a reasonably high level of experience with STEM courses in high school.

Procedure and Measures

Our Math, Science, and Technology Questionnaire (MST) was administered in a classroom setting. Students first listened to a statement that included a brief description of the questions, their right to withdraw, and assurance of confidentiality. Non-college participants were also informed that their school would receive a $5 donation for their participation in the study. After questions were addressed, participants completed the paper-and-pencil measure on their own, typically completing it in 15–20 min. Question booklets were provided and students recorded their answers on a separate machine-readable answer sheet. This questionnaire included the occupation stereotypes measure.

Students completed the Factors in Career Decision-Making Questionnaire (FCD), which included the stereotypes and abilities, STEM occupation efficacy, and STEM occupational interest measures, 3–5 weeks later. (Both the MST and FCD could not be administered at the same time due to time constraints imposed by instructors.) For the non-college sample, the FCD was administered in groups at the schools. College students were administered the FCD outside of class at a convenient time. Some sessions were in small groups and others were completed individually. Students first listened to a statement that included a brief description of the FCD, their right to withdraw, assurance of confidentiality, and notice that they would receive $15 (fifth graders) or $20 (all other participants) for participating in the study. (Fifth grade students were paid less to be in line with other research projects conducted in the schools.) Researchers briefly went over the different types of questions on the FCD and answered any questions. Question booklets were provided and students recorded their answers on a separate machine-readable answer sheet. Students worked through the FCD on their own, generally taking 20–30 min.

Self–Report of STEM Occupational Stereotypes, Interest, and Self-Efficacy

Measures for these three constructs were based on ratings on a common set of 18 occupations. Students were presented the occupation title and a brief description, similar to the approach used by Bandura et al. (2001). Eight of the occupations were in STEM fields (computer software programmer, environmental engineer, bio-mechanical engineer, computer designer, chemical engineer, forensic chemist, engineer for a relief agency, and astronomer). The remaining occupations were non-STEM and masculine-stereotyped (e.g., police officer) or feminine-stereotyped (e.g., nurse). An additional study was conducted with Psychology 101 students ($n = 92$) to further validate the gender stereotype of each occupation. These participants rated who typically held each of the occupations on a scale from 1 (*most often held by men*) to 7 (*most often held by women*). Comparisons to the neutral point on the scale (4) using one-sample *t*-tests indicated that each occupation was significantly different from neutral and in the expected direction (*p*s < .001).

STEM occupation efficacy was assessed by asking students to rate "How well do you think you could LEARN to do each of these jobs if you really wanted to?" on a 5-point scale from 1 (*not at all well*) to 5 (*very well*). This is comparable to the approach used by Bandura et al. (2001) to assess occupation self-efficacy in which students rated their belief that they could learn to perform successfully the functions required by different occupations. Ratings were averaged across the eight STEM occupations to create a score for each student. The reliability of the scale was acceptable for the sample as a whole, $\alpha = .87$, and ranged from .83 to .88 across the different grade levels.

STEM occupational interest was assessed by students rating "How interested you are in actually doing each occupation?" from 1 (*not at all interested*) to 5 (*very interested*). Interest scores were created by averaging responses over the eight items. Reliability was acceptable for the sample as a whole, $\alpha = .81$, and ranged from .79 to .84 for the different grades. This occupational interest rating scale is similar to those used in previous research on occupation stereotypes (e.g., Katz and Ksansnak 1994).

Occupational stereotypes were assessed by having students rate "How many men and women usually do this work" on a 5-point scale from 1 (*almost all men*) through 2 (*more men than women*), 3 (*about equal men and women*), 4 (*more women than men*) to 5 (*almost all women*). This is similar to the scale used by Blakemore (2003) for assessing gender stereotypes. Responses were averaged to create a STEM stereotype score. Comparable scores were calculated for the masculine and feminine occupations. Reliability was modest for the sample as a whole, $\alpha = .69$, and ranged from .59 for fifth graders to .80 for high school students. To further assess the validity of the stereotype measures, single sample *t*-tests were conducted comparing the STEM, feminine- and masculine-stereotype occupation scores to 3, the midpoint indicating equality. Each was significant (*p*s < .05) and in the expected direction. Furthermore, the validation study cited previously with an independent set of college students confirmed the gender stereotype of each occupation. Consequently, although the internal consistency was modest, each STEM occupation had been reliably rated as being predominantly held by men.

Stereotypes and Abilities Vignettes

The stereotypes and abilities instrument is an author-developed measure designed to assess the extent to which participants perceived that a hypothetical student's career interests would more likely align with occupational gender stereotypes or align with their academic abilities. Participants rated how interested they thought eight HS (half female) targets would be in each of four occupations on a 5-point scale from 1 (*not at all interested*) to 5 (*very interested*), resulting in a total of 32 ratings. The instrument systematically manipulated the characteristics of the HS and occupations as described in the following.

Hypothetical student characteristics were manipulated by creating brief profiles for eight HS. Four types of HS profiles were created by crossing HS Gender (2 levels) and HS Academic Ability (2 levels: math/science or language arts/social science). Two HS were created for each of the four profile types (total of 8 HS). Academic ability was manipulated by indicating that each HS was either (a) good in math and science (M/S) and average in language arts and social studies (L/SS) or (b) average in M/S and good in L/SS. Social studies, which is gender-neutral, was paired with language arts so that each set had two characteristics. An example of a profile for a high math-science ability female HS [with the changes for a high math-science ability male in brackets] is: "Debra [Marc] is attending Washington High School. She [he] does okay in language arts and social studies, but her [his] highest grades are in Math and Science. How interested do you think Debra [Marc] would be in these occupations?"

Eight occupations**,** four associated with M/S skills (researcher for satellite technology, computer technician for an automaker, energy engineer, high school math teacher) and four associated with L/SS skills (entertainment correspondent for a news show, adoption advocate for children, human resources manager, public relations consultant) were included. Each occupation was described with (a) the duties associated with the occupation, (b) the educational strengths associated with people who typically hold the occupation (either M/S or L/SS), and (c) information of the gender ratio in the occupation. The educational strengths and gender ratio information overlapped such that all M/S occupations were predominantly male and all L/SS occupations were predominantly female. Although counterbalancing the gender rates with the occupational skills would clearly be desirable, we could not find a sufficient number and variety of STEM occupations that were predominantly female. Consequently, gender rates and occupation skills are redundant, but this reflects reality in STEM occupations. Participants rated the probable interest of each HS in two M/S and two L/SS occupations. To avoid confounds between the HS profile types and occupations, each of the four profile types was rated on each of the eight occupations. Two examples of occupation descriptions are:

1. Adoption Advocate for Children [High L/SS]: An adoption advocate for children helps find out if people who want to adopt children will be good parents. Most adoption advocates are women, but some men choose this career too. It requires four years of college after high school. Adoption advocates usually had good grades in Language Arts and Social Studies in high school.
2. Researcher for Satellite Technology [High M/S]: Researchers for satellite technology develop ways to use satellite signals to create images for maps and guide airplanes, cars and other vehicles. There are some women in this occupation, but it's mostly men who choose this career. You must complete four years of college to start in this field. People who go into this field usually have done well in Math and Science classes in high school.

(The complete instrument is available in an online supplement.)

An additional study was conducted with Psychology 101 students ($n = 110$) to further validate the gender stereotype of each occupation. Participants rated who typically held each of the occupations on a scale from 1 (*most often held by men*) to 7 (*most often held by women).* Comparisons to the neutral point on the scale (4) using one-sample t-tests indicated that each occupation was significantly different from neutral and in the expected direction ($ps < .001$), except for high school math teacher, which was not significantly different from the midpoint. The manipulation of gender stereotype information in the occupation descriptions was achieved by explicitly indicating the gender ratio of each occupation, which served to counteract potential alternative beliefs about the gender stereotype of an occupation. As a result, math teacher was retained in our measure.

To summarize, the stereotypes and abilities instrument incorporated a 2 (HS Gender) × 2 (HS Ability: in M/S or L/SS) × 2 (Occupation Skill: in M/S or L/SS) research design, and all three factors were manipulated within-subjects. The eight occupations were counterbalanced across conditions so that occupations were not confounded with the HS profile types. Respondents who base occupational interest primarily on the HS gender should rate interest in M/S occupations higher for male HS and interest in L/SS occupations higher for female HS, regardless of the HS academic strengths. Stereotype flexible respondents who base occupational interest primarily on the match of academic abilities to occupation skill requirements rather than gender should rate interest in M/S occupations higher for HS who perform better in M/S regardless of HS gender, and likewise for L/SS occupations.

Results

Changes in Judgments of Others' Career Interests

The first set of analyses examined how HS Gender, HS Ability, and Occupation Skill influenced different age groups' ratings of others' career interest. A three-way interaction was expected among Occupation Skill, HS Gender, and HS Ability. Compared to younger students, we also expected that older students' ratings would rely more on the match between HS Ability and Occupation Skill than the match between HS Gender and occupation stereotypes.

A 2 (HS Ability: M/S or L/SS) × 2 (HS Gender) × 2 (Occupation Skill: M/S or L/SS) × 4 (Grades: 5, 8, 11, college) mixed design ANOVA (repeated measures on the first three factors) was conducted. (See Table 1 for descriptive statistics.) Only interaction effects that include Occupation Skill are presented (see Table 2) because these are the ones germane for understanding the influence of ability matching and gender stereotypes. Although previous research has sometimes found that females are less likely to endorse some gender stereotypes, this issue was not of central concern to our study. (However, these results are presented in an online supplement as Online Resource 2.) For ease of interpretation, the interactive effects of Occupation Skill with HS Ability and HS Gender are presented first, and grade level effects are considered after that. Simple effects were decomposed using a Bonferroni correction.

Both the HS Ability x Occupation Skill and the HS Gender x Occupation Skill two-way interactions were significant (Table 2). The HS Ability x Occupation Skill effect was explained by higher interest ratings for M/S occupations when the target was described as being high in M/S ($M = 4.23$, $SD = .51$) than when the target was high in L/SS ($M = 2.27$, $SD = .76$), $p < .001$, $\eta p^2 = .78$. A comparable relationship was found for L/SS occupations ($M = 4.09$, $SD = .58$ for L/SS ability; $M = 2.45$, $SD = .68$ for M/S ability), $p < .001$, $\eta p^2 = .73$. For the HS Gender x Occupation Skill interaction, interest ratings were higher when HS Gender and the Occupation Skill were matched according to gender stereotype (for M/S Occupation Skill, $M_{\text{HS Male}} = 3.34$, $SD_{\text{HS Male}} = .46$ and $M_{\text{HS Female}} = 3.15$, $SD_{\text{HS Female}} = .49$, $p < .001$, $\eta p^2 = .11$; for L/SS Occupation Skill, $M_{\text{HS Male}} = 3.13$, $SD_{\text{HS Male}} = .05$ and $M_{\text{HS Female}} = 3.41$, $SD_{\text{HS Female}} = .47$; $p < .001$, $\eta p^2 = .19$). These results suggest that participants generally believed that HS would be more interested in occupations that aligned with their ability or that were stereotypical for their gender. Importantly, the effect size for the Occupation Skill x HS Ability interaction was much greater than for the Occupation Skill x HS Gender interaction, suggesting that participants weighed ability more than gender (Table 2). The three-way interaction among these factors was not significant for the sample as a whole.

Grade-Related Differences

The three-way HS Ability x Occupation Skill x Grade and the four-way HS Ability x Occupation Skill x HS Gender x Grade interactions were significant (see Tables 1 and 2). We first examined the three-way HS Ability x Occupation Skill x Grade effect to evaluate the prediction that HS Ability will play a greater role in occupational interest ratings for older compared to younger students. Simple effect comparisons were made across the four grades for each of the four HS Ability x Occupation Skill combinations. See Fig. 1. Results indicated no significant differences among the four grades when Occupation Skill and the HS Ability were compatible (top two solid lines in

Table 1 Means and standard deviations for interests of others for each vignette type

Vignette characteristics			Grade								All	
HS ability	Occupation skill	HS gender	5		8		11		College			
			(*n* = 123)		(*n* = 102)		(*n* = 114)		(*n* = 187)		(*n* = 526)	
			M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
M/S	M/S	Male	4.46	.55	4.34	.59	4.30	.59	4.28	.53	4.34	.56
		Female	4.03	.67	4.16	.71	4.04	.64	4.14	.55	4.10	.64
	L/SS	Male	2.50	.81	2.40	.83	2.37	.77	2.07	.67	2.30	.77
		Female	2.74	.80	2.63	.81	2.54	.80	2.39	.58	2.55	.74
L/SS	M/S	Male	2.55	.90	2.29	.82	2.39	.84	2.07	.75	2.30	.84
		Female	2.42	.88	2.35	.95	2.18	.85	1.88	.71	2.16	.86
	L/SS	Male	4.01	.71	4.00	.74	3.92	.61	3.82	.67	3.92	.69
		Female	4.29	.70	4.11	.70	4.25	.67	4.24	.68	4.23	.69

HS Hypothetical Student, *M/S* Math/Science, *L/SS* Language Arts/Social Science

Table 2 Significant interactions that include occupation skill predicting interests of others

Significant effects	Wilk's λ	*F*	df	*p*
Two-way Interactions				
HS Ability x Occ. Skill	.220	1835.65	1, 518	<.001
HS Gender x Occ. Skill	.819	114.57	1, 518	<.001
Interactions with Grade				
HS Ability x Occ. Skill x Grade	.971	5.15	3, 518	.002
HS Ability x Occ. Skill x HS Gender x Grade	.974	4.59	3, 518	.003

See Online Resource 1 for information regarding the participant gender effects

HS Hypothetical Student, *Occ.* Occupation

Fig. 1). However, when Occupation Skill and the HS Ability were incompatible (bottom two dashed lines in Fig. 1), college students' ratings were significantly lower than the other three age groups' (for M/S occupations and HS high in L/SS, $p < .001$ for fifth grade, $p = .001$ for eighth grade, $p = .002$ for high school, $\eta p^2 = .08$; for L/SS occupations and HS high in M/S, $p < .001$ for fifth grade, $p = .003$ for eighth grade, $p = .036$ for high school, $\eta p^2 = .05$). This lends some support for the hypothesis that ability-occupation skill matching would be more important for older compared to younger students.

We also predicted that older students would be more flexible than younger students when taking into account HS gender. Thus, we expected that interaction effects involving HS Gender and Occupation Skill should be weaker for the older participants compared to the younger ones. This hypothesis was examined in two ways. First, analyses were re-run for each grade level to examine if the HS Gender x Occupation Skill interaction was significant. Means are presented in Table 1. Inconsistent with predictions, results indicated that the two-way interaction was significant at each grade level and that the pattern of means was comparable for all grade levels (for fifth grade: $F(1, 121) = 35.29$, $p < .001$, Wilk's $\lambda = .774$; for eight grade: $F(1, 100) = 5.74$, $p = .018$, Wilk's $\lambda = .946$; for high school: $F(1, 112) = 33.51$, $p < .001$, Wilk's $\lambda = .770$; for college students: $F(1, 185) = 70.22$, $p < .001$, Wilk's $\lambda = .725$).

Second, as we noted previously, a critical test of this prediction is whether male and female HS with the same abilities are rated differently when HS Ability and Occupation Skill are aligned. The HS Ability x Occupation Skill x HS Gender x Grade interaction was decomposed to examine differences in ratings for male and female HS in two conditions: HS with M/S ability rated on M/S occupations and HS with L/SS ability rated on L/SS occupations. (Table 1 presents the means.) *t*-tests comparing male and female HS in these two conditions generally revealed significant differences at each grade level, suggesting that participants rated interest higher when HS gender was stereotype congruent (for M/S occupations and HS with M/S ability, female HS < male HS and for L/SS occupations and HS with L/SS ability, female HS > male HS; $p < .001$ for each comparison for all grades except eighth grade where $p = .010$ for M/S occupations and $p = .240$ for L/SS occupations).

Summary of Findings for Judgments of others

Participants generally thought the hypothetical students would be more interested in occupations that aligned with their abilities and that each gender would be more interested in occupations that were stereotypical for their gender than those that were not. Grade level effects indicated that college students discounted HS interest more compared to other grade levels when HS Ability and Occupation Skill were not aligned. Results did not support the hypothesis that older students

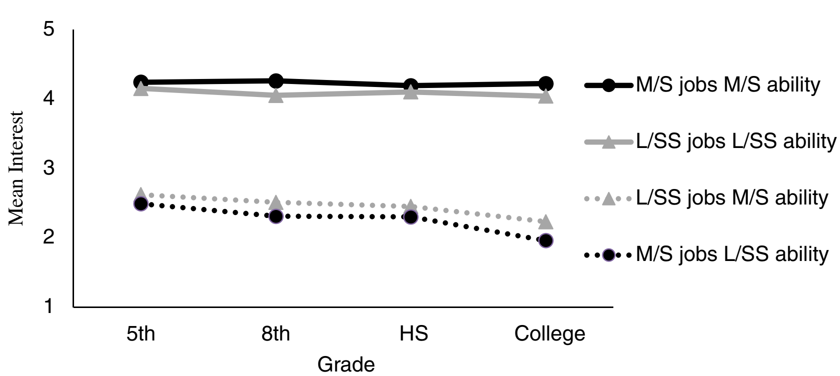

Fig. 1 Hypothetical students' ability x occupation skill x grade interaction. M/S = math and science; L/SS = language arts and social studies; HS = High School

would be more flexible (i.e., less stereotypical) in their application of gender stereotypes to others compared to younger students.

Self-Reported STEM Occupational Stereotypes, Interest, and Self-Efficacy

Gender and grade level differences were first examined and then regression analyses were conducted to predict STEM career interest from self-efficacy and occupation stereotypes. To examine gender and age related changes for STEM occupational interest, efficacy, and stereotypes, three separate ANOVAs were calculated that included Gender (2 levels) and Grade (4 levels) as the two independent between-subjects variables. Results for each measure are presented in Table 3, and descriptive Statistics are presented in Table 4. For STEM occupational interest and efficacy, significant effects were found for Grade, Gender, and the interaction between the two. As expected, males reported greater interest than females, but simple effect comparisons indicated that the gender difference was no longer significant among the college students (for fifth grade: $p < .001$, $\eta p^2 = .07$; for eighth grade: $p < .001$, $\eta p^2 = .05$; for high school: $p < .001$, $\eta p^2 = .04$; for college students: $p = .067$, $\eta p^2 = .01$). Although males' interest ratings were stable across the grades, females' interest ratings increased from eight grade onward, with female college students reporting higher interest ratings than all other age groups, $F(3, 520) = 18.16$, $p < .001$, $\eta p^2 = .10$.

Examination of STEM occupation efficacy similarly showed that males reported higher levels of efficacy than females in grades five through high school, but not in college (for fifth grade: $p < .001$, $\eta p^2 = .05$; for eighth grade: $p < .001$, $\eta p^2 = .03$; for high school: $p < .001$, $\eta p^2 = .05$; for college: $p = .581$, $\eta p^2 = .001$). Efficacy increased for female students, and female college students reported higher levels than all other age groups, $F(3, 518) = 24.46$, $p < .001$, $\eta p^2 = .12$.

For occupational stereotypes, the only significant effect was for gender. Although both males and females believed that men were more likely to hold STEM occupations than were women (scores below 3, see Table 4), females gave significantly lower scores, suggesting that they believed that the gender imbalance favored men to a greater degree.

Predicting Interest in STEM Occupations

Interest scores were regressed on Gender, Grade, the Gender x Grade interaction, STEM occupation stereotypes, STEM occupation efficacy, and the interactions of Gender and Grade with efficacy and stereotypes. Each variable was entered in a separate step so that the increase in variance explained could be examined. The Gender and Grade interaction effects with efficacy and stereotypes did not significantly increase the amount of variance explained, so for the sake of parsimony they are not included in the results presented in Table 5. Each of the remaining steps significantly contributed to the model, explaining 42% of the variance overall. Grade level was not a significant predictor after the Gender x Grade interaction was entered into the equation (which evidenced the pattern described previously). Interestingly, for both male and female students, having less

Table 3 Gender x grade ANOVAs for self-reported STEM occupational interest, efficacy, and stereotypes

Effect dependent variable	*F*	df	*p*	ηp^2
Gender				
Interest	84.85	1, 520	<.001	.140
Efficacy	64.93	1, 518	<.001	.111
Stereotypes	7.20	1, 499	.008	.014
Grade				
Interest	13.99	3, 520	<.001	.075
Efficacy	20.54	3, 518	<.001	.106
Stereotypes	.30	3, 499	.829	.002
Gender x Grade				
Interest	6.09	3, 520	<.001	.034
Efficacy	7.67	3, 518	<.001	.043
Stereotypes	.95	3, 499	.415	.006

Table 4 Descriptive statistics for self-reported STEM occupational interest, efficacy, and stereotypes

Grade participants'	Interest			Efficacy			Stereotypes		
Gender	*M*	*SD*	*n*	*M*	*SD*	*n*	*M*	*SD*	*n*
5th									
Male	3.20	.75	61	3.67	.81	60	2.51	.42	61
Female	2.23	.82	62	2.86	.97	61	2.48	.48	62
Total	2.71	.92	123	3.26	.98	121	2.50	.45	123
8th									
Male	2.98	.84	55	3.74	.71	55	2.57	.41	55
Female	2.08	.94	48	3.02	1.09	48	2.35	.45	44
Total	2.56	.99	103	3.40	.97	103	2.47	.44	99
High School									
Male	3.10	.77	38	4.05	.60	38	2.51	.44	38
Female	2.34	.94	77	3.18	1.03	77	2.42	.47	76
Total	2.59	.95	115	3.47	1.00	115	2.45	.46	114
College									
Male	3.26	.78	99	4.00	.70	99	2.49	.39	90
Female	3.03	.91	88	3.93	.73	88	2.41	.41	81
Total	3.15	.85	187	3.97	.71	187	2.45	.40	171
All									
Male	3.16	.79	253	3.87	.73	252	2.52	.41	244
Female	2.49	.98	275	3.32	1.03	274	2.42	.45	263
Total	2.81	.95	528	3.59	.94	526	2.47	.43	507

Scales range from 1 to 5 with higher scores indicating greater interest, higher self-efficacy, and more stereotypical beliefs (i.e., more men are in the STEM fields)

Table 5 Regression predicting STEM occupational interest from gender, grade, occupation stereotypes, and STEM self-efficacy

Predictors	Model 1	Model 2	Model 3	Model 4	Model 5
Grade	.18***	.18***	.03	.04	−.04
Gender		−.34***	−.70***	−.68***	−.35***
Gender x Grade			.42***	.42***	.21***
Stereotypes				.17***	.14*
STEM Self-Efficacy					.52***
R^2 Δ	.03***	.12***	.02***	.03***	.22***
F Δ	16.83	69.14	14.83	18.81	191.04
Total R^2	.03***	.15***	.17***	.20***	.42***

Entries are beta coefficients for each predictor. Gender was entered as 0 = male, 1 = female. Final model statistics: $F(4, 499) = 73.56$, $p < .001$

* $p < .05$

*** $p < .001$

stereotypical views of who holds a STEM occupation was associated with greater interest.

Summary of Findings for Self-Ratings

With respect to gender differences, the findings generally supported previous research in that male students were more interested in STEM occupations and reported greater self-efficacy for STEM occupations. However, gender differences in interest and self-efficacy decreased over the grade levels and were not evident among college students. The regression results supported the prediction that self-efficacy would be the best predictor of interest in STEM, but holding less stereotypical beliefs was associated with greater interest for both male and female students.

Discussion

The aims of the present study were to further the understanding of how gender stereotypes contribute to gender differences in STEM career interest by addressing existing, conflicting findings in the pattern of developmental changes in the application of occupational gender stereotypes to self and others. Appropriate for these aims, participants included students from fifth grade through college who were participating (or eligible to participate) in advanced or specialized courses that feed the STEM pipeline. A unique aspect of our study is that information on both gender and abilities was included in judgments of others' career interests. A major conclusion is that ability beliefs, regardless of whether they are for oneself or another, were powerful predictors of occupational interest, and occupational gender stereotypes played a secondary role. This conclusion holds across all age groups in our study, suggesting that the relations between abilities and occupational interest are apparent from early adolescence onward. Despite their relatively weaker role, the effects of gender stereotypes were tenacious, but somewhat contrary to the expected developmental patterns. Although gender differences in self-reported interest and efficacy for STEM careers decreased with development, there was little evidence of grade-level differences in the application of stereotypes in rating others' career interests.

Gender Stereotype Influences over Development

Occupational gender stereotypes were a factor for interest ratings for both self and others, but there were contrasting patterns across grade levels depending on the target of the interest ratings. Consistent with past research suggesting that awareness of both ability and occupational gender stereotypes occurs early in childhood (Cvencek et al. 2011; Levy et al. 2000; Serbin et al. 1993), self-reported beliefs of occupational stereotypes were similar across age groups. Additionally, there was a tendency across all grade levels to rate a hypothetical student (HS) target's interest higher when both HS Gender and Occupation Skill were stereotypically aligned compared to when they were not. However, contrary to previous research and inconsistent with predictions based on the cognitive-developmental hypothesis, there was little evidence that older students were more flexible than younger students were in the application of gender stereotypes to others.

For self-reported interests, the conclusions regarding stereotypes are less straightforward. On the one hand, regression analyses indicated that STEM occupational stereotypes were negatively related to STEM career interests and the effects were similar for all age groups, supporting predictions. On the other hand, college students, unlike other age groups, did not show the expected gender differences in STEM career interest and efficacy. Furthermore, female students' interest in and self-efficacy for STEM occupations increased with age, counter to the socialization hypothesis. Thus, older students seem as stereotypical as younger age groups in their judgments of others, but at the same time appear less stereotypical than younger students in their self-reported interests and self-efficacy.

To reconcile these findings, some consideration should be given to the experiences of this particular sample, which was drawn from advanced science and math classes. Bronfenbrenner and Evans' (2000) social ecological perspective proposes that over development, children's experiences in microsystems (e.g., families, schools, classrooms) interact with larger societal beliefs (macrosystem level influences), resulting in unique social and behavioral outcomes for children. In our particular study, students' experiences with advanced STEM courses (microsystem influences) may have reinforced the connection between their own specialized abilities and specific occupations. Although these students are highly knowledgeable of STEM occupational stereotypes (macrosystem), these microsystem experiences may buffer them against applying gender stereotypes to themselves. Female college students enrolled in STEM courses may have STEM self-efficacy and interests that are on par with their male classmates because of their experiences in the classroom, at home, and in extracurricular activities that afford them some protection against applying STEM gender stereotypes to themselves. The younger female students in our study differed from the college students in both their experience with specialized courses and their commitment to a STEM career. Thus, the age-related effects reported in our study are best viewed as being descriptive of students in the STEM pipeline.

Interestingly, for both male and female students of all ages, having *less* stereotypical views of who holds STEM occupations was associated with greater interest in STEM occupations. Whereas the explanation of this finding is self-evident for young women, it is counterintuitive for young men because STEM gender stereotypes favor males. Perhaps, other negative stereotypes associated with STEM being a male-dominated field (e.g., being socially awkward around girls and women) may drive male students away from STEM careers.

A significant contribution of our research is that it provides a new approach to studying the effects of occupational stereotypes. Although valuable in their own right, other commonly used measures tend to assess normative beliefs, but they do not provide much information as to the basis of those beliefs. For example, the commonly used assessment from Liben and Bigler (2002) asks who *should* do a particular job, and Katz and Ksansnak (1994) asked participants how much they would like to see men and women engaged in a particular job. The current approach suggests that stereotypical responses to such measures might be primarily based on assumptions about gendered abilities because HS Ability had a far greater effect on ratings than HS Gender did.

Using Ability Information over Development

The importance placed on HS abilities parallels the importance placed on self-reported abilities in models of career interest (Lent et al. 1994), which was replicated in our study. Regardless of age, the best predictor of self-reported interest in STEM occupations was students' self-efficacy, consistent with predictions. Although grade-level differences were not evident for the importance of ability beliefs for predicting self-rated interest, there was a grade level difference for judgments of others. A grade level change was evident in the *degree* to which interest was discounted when Occupation Skill and HS Ability were mismatched, with college students rating interest lower than all other grades did, although no other grade-level differences were apparent. This is consistent with the prediction that older students would place greater importance on HS Ability than would younger students. In the current sample, college students were primarily first-year STEM students. The match between academic abilities and future majors and careers might be more relevant for this group because of the academic prerequisites for entering into specific courses, majors, and colleges. Although high school and middle school students experienced academic prerequisite requirements for specialized courses, the consequences of not having particular skills for a future career may have been less salient.

Implications for Future Research

An interesting avenue for future research will be to assess young women's perceptions of their classmates' gendered beliefs about STEM abilities as they advance into more specialized STEM courses. Students' perceptions of the STEM-related norms in their friendship group might affect their own attitudes and performance in STEM (Nelson and DeBacker 2008; Robnett and Leaper 2013). Peers might influence adolescents' career interests and academic choices by validating or invalidating them by expressing their general expectations for males and females. Classmates' stereotypical beliefs could promote an unfavorable classroom environment for female students talented or interested in math and science. Understanding how classroom climate factors affect the pursuit of STEM majors and careers may help to further refine models of career decision making.

Although the effect of gender stereotypes was weaker than that of abilities, it is undeniable that gendered experiences, rather than actual gender differences in abilities, must be contributing to girls' and women's career choices (Ceci et al. 2009). Stereotypes clearly impact career interests and choice through self-perception of abilities (Correll 2004; Eccles and Wigfield 2002; Lent et al. 1994), as well as through the classroom climate (Leaper et al. 2012) as previous research and models suggest. Academic abilities of the HS targets in our study were clearly stated, but stereotypes may play a more critical role when ability is mediocre or represented in an ambiguous way. Future research using different ability levels may provide a better understanding of the role of stereotypes in career interest of self and others. The instrument developed for our study could be adapted to address these issues.

Finally, although the present study did not find many age differences in factors that affected occupational interest ratings, there is some evidence that the weights given to other components that determine occupational interests may change with age (e.g., status and stereotypes; Teig and Susskind 2008). Future research should also explore factors that may contribute to boys' and girls' career interest at younger ages.

Practice Implications

The findings for students' perceptions of others' occupational interest suggest that it would be effective to invest in classroom-level interventions that build a climate that encourages students to support one another's academic and career interests regardless of gender. Because girls perform as well as boys in math and science in grade school, teachers might find a way to point out that boys and girls perform equally, helping students rely less on stereotypes when they evaluate interest in or eligibility for STEM occupations. Typical career counseling at secondary schools mainly focuses on students' personalities, interests, and preferences (e.g., the RIASEC model; see Nauta 2010, for a review). Additionally, it would be useful to present a profile that connects academic strengths to occupations and careers. Such an approach would expose students to diverse occupations that require skills matching their abilities that they might not have considered otherwise.

Career interests start forming at an early age, and it becomes more difficult to change them later in life, especially toward careers that are not stereotyped for one's own gender (Gottfredson 1981; Gottfredson and Lapan 1997). Thus, to minimize the influence of gender stereotypes on career interests, interventions should focus on exposing children at an early age to a wide range of occupations and helping them understand how different academic subjects are important for different occupations. The grade-related findings of the present study suggest that interventions could be similar across a wide range of ages. Reinforcing a similar message repeatedly across different grade levels may help children adopt the message more readily.

However, emphasizing ability without paying attention to self-efficacy may not be effective in increasing girls' interest in STEM (Bandura et al. 2001). Although not a novel recommendation, our research supports the idea that interventions should focus on increasing female students' self-efficacy, particularly in the areas of math and science. In addition, many STEM careers require skills that are not usually associated with STEM, such as writing. Another way to encourage female students' participation in STEM might be to increase their awareness that some stereotypically feminine skills are also important for success in these careers.

Limitations

The use of a special population of high ability math and science students influences whether our findings are generalizable to other populations. Yet, it is also a strength of our study. Our findings are highly applicable to diversifying STEM fields because these are the very students whom educators are encouraging to pursue STEM occupations. In addition, although participants were identified as being high in math or science abilities, many of these students may also have excelled in language arts or social studies. The school system in which we collected the non-college participants' data did not track students for language arts until high school. In the future, it will be interesting to examine the interests and attitudes of students who have high abilities in both math/science and language arts/social studies. Also, our cross-sectional design constrains the developmental interpretation of our results, and more longitudinal research is needed to follow students from middle school through college as they make career decisions.

Another limitation is that only one aspect of an occupation was examined, ignoring other occupational features that contribute to the observed gender disparity in occupational interest. For example, STEM occupations compared to traditionally feminine occupations are thought to be more thing- than people-oriented (Yang et al. 2015) and considered to be aligned with traditionally masculine agentic goals compared to feminine communal goals (Barth et al. 2015; Diekman and Steinberg 2013). Manipulating several different aspects of STEM occupations in future research may further the understanding of students' occupational interests and decisions.

Conclusions

As society becomes more technology-reliant, it is imperative that women in the labor pool are encouraged to join, rather than avoid, STEM professions. Based on our study's findings, an important next step to reach this goal will be to develop school-based interventions that help students accurately understand their own and others' academic abilities and the importance of the match between academic ability and skills needed for success in an occupation. Focusing on objectively evaluated abilities is expected to minimize the effects of gender stereotyping that drive talented female students away from STEM occupations.

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Compliance with Ethical Standards We have followed the ethical standards of the American Psychological Association.

The University of Alabama's Institutional review board approved this research.

Conflict of Interest There are no potential conflicts of interest.

Informed Consent Informed consent was provided by all participants

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