Do I Belong?: Gender, Peer Groups, and STEM Achievement

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ABSTRACT

Women's under-representation in many STEM fields is due to a combination of individual and socio-cultural factors. Among these, the peer group is one potentially powerful force reviewed in this article. First, I describe key processes associated with group belonging. The social identities associated with group belonging can shape individuals' task and interpersonal values. Second, I consider how the values reinforced in many girls' and women's peer groups may conflict with their perceptions of STEM. In addition, girls and women may experience rejection and hostility from their male peers regarding STEM achievement. Conversely, when important peer groups value and support STEM, they may validate girls' and women's sense of belongingness in STEM fields. Next, I highlight some strategies for reducing peer sexism and fostering STEM belonging. Finally, I close with some recommendations for future research.

KEYWORDS

Gender; social identity; peer relations; belonging; academic achievement; occupational aspirations; sciences; technology; engineers; mathematics.

The Open University

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This paper reviews how peer groups can hinder or help girls' and women's sense of belongingness in science, technology, engineering, and mathematics (STEM). I have been conducting studies on the developmental and social psychology of gender for over 30 years. However, my first research studies did not address either gender or STEM. They focused on pragmatic aspects of children's language development and language disorders. In the mid-1980s, I turned my attention to the study of language and gender. Gender roles were changing in society, and I started investigating ways that gender was enacted through language in social interactions. Then, approximately 15 years ago, one of my former graduate students proposed looking at gender-related variations in parents' teaching talk during science tasks (see Tenenbaum & Leaper, 2003). That work sparked my interest in gender and STEM. In subsequent studies, I also began to consider processes besides language. Most notably, I am concerned with sexist attitudes and behaviors in children, adolescents, and adults. In recent studies with colleagues and students (described later), we have documented associations between STEM motivation and youths' experiences with STEM-related gender bias.

THE GENDER GAP IN STEM

The gender gap in science, technology, engineering, and mathematics (STEM) has narrowed over the last 50 years in North America, Europe, and many other parts of the industrialized world (see Leaper, 2015; National Science Foundation, 2013). Nonetheless, women remain under-represented in many STEM fields – with the largest disparities occurring in the physical sciences, computer science, and engineering (UNESCO, 2012). Also, these differences tend to increase with age. In many countries, girls are attaining equivalent (or higher) average grades in STEM subjects compared to boys during childhood and adolescence (Voyer & Voyer, 2014). However, significant declines in STEM motivation among many girls and women begin in adolescence. The gender gap in STEM achievement widens with each step in the professional pipeline – from high school to college to graduate school, and into the ranks of academia or industry (Rosser, 2012). The reasons for these declines in women's STEM achievement are a complex combination of individual and socio-cultural factors (see Leaper, 2015). The peer group is one potentially powerful force that I shall review in this Perspectives article. Below I begin by describing the processes associated with group belonging. I then explain how these processes may shape girls' and women's values regarding STEM. I also highlight strategies for reducing peer sexism and fostering STEM belonging. I end the paper with a few recommendations for future research.

GROUP BELONGING AND IDENTITY

According to social identity theory (or self-categorization theory), individuals' identities are shaped by their affiliation with important social groups such as friendship cliques, school classrooms, academic clubs, work colleagues, ethnic groups, or gender (see Ellemers & Haslam, 2012). People commonly have multiple social identities (e.g., a girl who identifies with her gender, her Mexican heritage,

her friendship group, and her computer club membership). Each social identity confers its own unique set of experiences. Therefore, the intersection of social identities complicates the impact of a particular social identity (Cole, 2009). For example, the experience of being a member of the computer club may differ for a girl versus a boy or for an American girl who identifies with her Mexican heritage versus an American girl who identifies with her European heritage.

When individuals identify with a social group, a set of intragroup and intergroup processes commonly occur (see Ellemers & Haslam, 2012; Harris, 1995). Group members tend to demonstrate in-group bias (i.e., favoritism) toward individuals and characteristics associated with the in-group. Also, group members tend to encourage assimilation (i.e., conformity) with the in-group's values. Assimilation can result when individuals compare their attitudes and behaviors to those of other group members. Also, group members reinforce assimilation through evaluative feedback to individuals who conform to or diverge from the group's norms. In general, higher esteem is associated with perceiving oneself as a typical member of a group and experiencing low conformity pressure (e.g., Greenwald, Banaji, Rudman, Farnham, Nosek & Mellott, 2002; Tobin, Menon, Menon, Spatta, Hodges & Perry, 2010).

Group belonging can additionally lead to various intergroup processes. Individuals may enhance their view of their in-group by exaggerating their differences with out-group members (i.e., between-group contrast) and stereotyping out-group members as similar (i.e., out-group homogeneity effect). When competing over resources, people may denigrate out-group members (i.e., out-group hostility). As highlighted in Bigler and Liben's (2007) developmental intergroup theory (based partly on social identity theory), these intergroup processes underlie prejudice and discrimination.

Social identity processes are highly relevant to understanding some of the reasons for women's under-representation in STEM fields. As reviewed below, the values reinforced in many girls' and women's peer groups may conflict with those they associate with STEM. Furthermore, girls and women may experience rejection and hostility from their peers regarding STEM achievement. As a consequence, many girls and women may not view certain STEM fields as places where they belong.

IN-GROUP VALUES AND STEM ACHIEVEMENT

According to Eccles' expectancy-value theory, people are most strongly motivated to achieve in domains that they value and in which they feel competent (see Eccles, 2011; Eccles & Wigfield, 2002). For instance, individuals who see themselves as likely to fail in a particular subject (e.g., math) are less motivated to persist than those who expect to succeed. In addition, people are usually less driven in subjects or fields that they don't find interesting, consider useful, and associate with few costs. There is ample evidence that many girls devalue mathematics or other STEM subjects despite doing well in them (see Eccles, 2011; Leaper, 2015).

The expectancy-value model stipulates several individual and social factors that shape the development of values (see Eccles & Wigfield, 2002). One potentially important social influence is the peer group – such as classmates, friendship cliques, extracurricular program members, or professional colleagues. Research guided by social identity theory has highlighted how belonging to a group commonly leads to assimilation and internalization of shared norms (see Harris, 1995). As reviewed below, the kinds of task value (e.g., interest in science) and interpersonal value (e.g., communal concerns) reinforced in girls' and women's peer groups may affect their STEM achievement.

Task Values

Task values refer to the interest and the importance that individuals associate with particular domains, such as specific STEM subjects. Based on various studies (with adolescent samples from mostly North American or European countries), boys are somewhat more likely than girls on average to value mathematics, physical sciences, computers, and technology (see Leaper, 2015). In contrast, girls are more likely than boys to value reading, writing, and the arts. Studies suggest that girls place similar (or possibly higher) value on the biological and health sciences compared to boys (see Leaper, 2015).

Peer groups inform and reinforce values. Accordingly, researchers have documented associations between adolescents' academic values and those of their friends. First, students who belong to friendship groups that value academic achievement are themselves more likely to value mathematics, science, and other subjects (e.g., Crosnoe, Riegle-Crumb, Field, Frank & Muller, 2008; Jones, Audley-Piotrowski & Kiefer, 2012; Nelson & DeBacker, 2008; Robnett, 2013). Additional research suggests that the impact of peer academic values may be subject-specific (e.g., Riegle-Crumb, Farkas & Muller, 2006; Robnett & Leaper, 2013). For example, Robnett and Leaper (2013) observed that American high-school students were more likely to express interest in possible science careers when they also viewed their friendship group as valuing STEM – even after controlling for the individuals' grades, academic values, and expectancies. In contrast, there was no corresponding association between students' interest in science careers and perceptions of friends' support of English. Given that girls and women are more likely to excel in both math-related and language-related subjects than are boys and men (Ceci, Williams & Barnett, 2009), it may be particularly important for girls and women to experience friendship groups that are supportive of their interest in STEM. Otherwise, they may consider non-STEM occupational pathways. (As reviewed later, many girls and women may view their interpersonal values as more compatible with non-STEM than STEM occupations.)

Whereas perceived peer support is positively associated with girls' STEM achievement motivation, experiences with STEM-related discrimination are negatively related to achievement (see Leaper & Brown, 2014). In Leaper and Brown's (2008) survey of American adolescent girls, 52% of participants reported hearing negative comments about girls' abilities in science, math, or computers. The most common perpetrators were male peers (cited by 31%) and female peers

(cited by 21%). Thus, discrimination may come from in-group as well as out-group members. Other girls may offer these comments as a way of enforcing in-group conformity regarding desirable and undesirable task values. Boys may make these comments to disparage out-group members who are seen as bridging domains that they associate with their in-group.

In additional analyses, Brown and Leaper (2010) found that more frequent experiences with sexist comments about science, math, and computers negatively predicted high-school girls' valuing of math and science (controlling for math and science grades). The results from these studies are complemented by other reports. For example, Boehnke (2008) noted in samples of 14-year-olds in Germany, Canada, and Israel that girls were more likely than boys to report diminished motivation in mathematics to avoid peer pressure and rejection – especially from boys. Also, in a study of German middle-school students, Kessels (2005) observed (1) many boys reported disliking girls who expressed interest in physics and (2) girls who excelled in physics tended to report feeling unpopular with boys. Given most heterosexual girls' increasing concern with romantic appeal during adolescence, viewing STEM achievement as incompatible with male popularity could become a powerful disincentive. In sum, following repeated experiences of STEM-related discrimination (e.g., hearing sexist comments about girls in STEM), many girls may gradually devalue these subjects.

The challenges that male peers pose to many girls in academic settings may be seen as justification for single-gender schooling (e.g., Sax, 2005). However, two comprehensive meta-analyses comparing the educational outcomes of students in single-gender and coeducational schools revealed no meaningful differences (Pahlke, Hyde & Allison, 2014; Signorella, Hayes & Li, 2013). Moreover, there is evidence that gender segregation in schools may actually increase gender stereotyping (see Martin, Fabes & Hanish, 2014). Hence, single-gender schooling does not appear to be an effective solution for reducing sexism (see Bigler, Hayes & Liben, 2014). As I review later, alternative approaches include directly addressing gender discrimination and fostering cross-gender cooperation in coeducational schools.

Interpersonal Values

Interpersonal values reflect the relative importance that individuals place on communal or dominance goals in social interactions and relationships. Many girls' and boys' same-gender peer groups both reflect and reinforce gender-typed differences in interpersonal goals. On average, girls' peer groups tend to place more emphasis on communal goals and less importance on dominance goals than do boys' peer groups (see Rose & Rudolph, 2006). In turn, peer norms regarding these values may affect students' motivation in STEM subjects.

Prioritizing communal goals may affect the occupations that many girls and young women find most appealing. First, girls and women are more likely than boys and men to favor occupations with helping or person-oriented goals (Ceci et al., 2009; Su, Rounds & Armstrong, 2009). This may be one reason that some adolescent

girls and young women lose interest in certain STEM subjects such as physics, computer science, and engineering (Diekman, Brown, Johnston & Clark, 2010; Lee, 1998; Weisgram, Bigler & Liben, 2010). In contrast, adolescent girls tend to express a similar (if not greater) average interest compared to boys in life sciences and medicine, which have manifestly clearer helping applications (see Leaper, 2015). However, in-group norms may affect these associations. In an analysis of a national study of first-year college students in the United States, Sax and Bryant (2006) noted that women were more likely to favor traditionally feminine-stereotyped careers (e.g., nurse, teacher, counselor) when they attended colleges where their peer group scored high in communal values ("empathic tendencies").

Another communal value related to girls' and women's occupational choices is the desire to balance family and work goals (e.g., Schoon, 2010). Many young women expect that success in some STEM fields will be incompatible with attaining a good work–family balance (Ceci et al., 2009; Hayes & Bigler, 2013; Morgenroth, Peters & Ryan, 2014). Furthermore, as women advance through the career pipeline, their sense of belonging may be affected by perceptions of the professional peer group (i.e., colleagues) in their field as being family-friendly. This was illustrated in Ülkü-Steiner, Kurtz-Costes, and Kinlaw's (2000) comparison of graduate students in male-dominated programs (i.e., average 83% male faculty) or gender-balanced programs (i.e., average 52% male faculty) in the United States. Women in male-dominated programs were more likely than women in gender-balanced programs to experience insensitivity toward family issues. Moreover, perceived sensitivity to family issues was independently associated with women's career commitment (controlling for self-concept and social support). When professional colleagues are insensitive and unsupportive about work–family issues, the environment may undermine women's sense of belonging in the organization. These findings are pertinent given that the STEM fields in which women are least represented by definition have male-dominated faculty at most universities (see Rosser, 2012).

REDUCING PEER SEXISM AND FOSTERING STEM BELONGING

I have previously reviewed some of the intergroup and intragroup processes that can undermine girls' and women's STEM achievement. For example, sexist comments may send the message that women don't belong in STEM fields. Also, some girls and women may perceive STEM fields as unfavorable environments for realizing their values. Fortunately, researchers have highlighted promising interventions that may help to counteract these negative influences. Below I review some of these strategies for reducing peer sexism and promoting STEM belongingness.

Reducing Peer Sexism

Several specific interventions have been identified that may be effective in reducing gender prejudice and discrimination among peers in schools (see Leaper & Brown, 2014). First, teachers can provide students with lessons about gender discrimination. Pahlke, Bigler, and Green (2010) conducted an experiment with American middle-school students in coeducational classrooms in which students

either did or did not learn about historical gender discrimination. Six months after the intervention, significantly greater awareness of gender discrimination was seen among girls and boys who had experienced the intervention. In general, awareness of sexism is considered an important step toward monitoring one's own biases (e.g., Blair, 2002) as well as recognizing and challenging others' sexist behaviors (e.g., Leaper & Brown, 2008; Leaper, Brown & Ayres, 2013). As a result, this type of intervention may mitigate the sexist attitudes and comments occurring in girls' and boys' peer groups.

Another approach involves training girls and boys to challenge incidents of peer sexism when they arise. Lamb, Bigler, Liben, and Green (2009) demonstrated that this could be successfully done in an experiment with American elementary-school children. Children in one condition practiced making verbal challenges to peers' sexist remarks, whereas those in another condition read stories about other people who made verbal retorts to sexism. Participation in the behavioral practice condition (vs. the story condition) led to significantly greater increases in children's verbal challenges. Furthermore, at a six-month follow-up, girls who had been in the behavioral practice condition demonstrated less gender stereotyping than those in the comparison condition; boys in the two conditions did not differ in stereotyping at the follow-up. Perhaps a sustained training program during the school year that combines learning about sexism and challenging sexism would have more lasting effects with boys (and girls).

Through the implementation of these strategies and other policies, school administrators and teachers can establish a school climate wherein most students view sexism regarding particular school subjects and other forms of discrimination as inappropriate and unacceptable. When the school climate is affected in these ways, research indicates that prejudice and discrimination become less likely among boys and girls (see Espelage & Poteat, 2012).

Fostering STEM Belonging

Research psychologists have identified successful ways of fostering and enhancing people's sense of belonging to a group and its corresponding social identity. In turn, by gaining a sense of belonging to a group, individuals may incorporate its values into their personal identity. Thus, for girls and women to form a STEM-based occupational identity it can be helpful to foster a sense of belonging to STEM-based social groups such as cliques, extramural clubs, or graduate programs. Researchers point to various ways that educators and parents might help. Four examples are described below.

First, girls and boys can be encouraged to collaborate in STEM activity settings. In STEM classrooms, teachers can place girls and boys in mixed-gender cooperative learning groups. In addition, parents and teachers can encourage youth to get involved in extracurricular STEM programs. Extensive research points to the potential benefits of intergroup contact in cooperative settings for reducing peer prejudice (Paluck & Green, 2009; Pettigrew & Tropp, 2006). Accordingly, mixed-gender extracurricular science programs in the United States (e.g., Stake, 2003)

and Taiwan (Hong, Lin & Veach, 2008) significantly reduced sexist attitudes among adolescent boys. Furthermore, extracurricular STEM programs offer girls and boys the opportunity to form a common in-group identity and sense of belonging that affirms their shared interest in STEM (e.g., Stake & Nickens, 2005; also see Gaertner & Dovidio, 2000).

Second, positive contact with in-group experts can help strengthen girls' and women's STEM self-concepts. This was demonstrated in a longitudinal study with American women in a college calculus class (Stout, Dasgupta, Hunsinger & McManus, 2011). Women who had contact with female (vs. male) STEM experts (e.g., advanced peers) were more likely to identify with the experts and to demonstrate more positive self-concepts and stronger career commitment in STEM. In this manner, the same-gender mentors may have helped these women gain a feeling of belongingness in STEM.

Third, high schools and colleges can implement programs designed to affirm girls' and women's sense of belonging in STEM. Walton, Logel, Peach, Spencer, and Zanna (in press) found this type of intervention significantly improved undergraduate women's motivation and achievement in an engineering program in Canada. The belongingness intervention emphasized learning ways to cope with adverse experiences related to being taken seriously and fitting into a predominantly male peer culture. As a result, women in the intervention were more likely than those in control conditions to view adversities as manageable, to form friendships with male engineers, and to raise their engineering grades.

Finally, educators can help to reframe students' perception of the goal affordances associated with certain STEM fields. As noted earlier, many girls and women do not view some STEM subjects as adequate means of satisfying their communal goals. To address this problem, researchers in Germany (Häussler & Hoffmann, 2002) found they could increase girls' interest in physics and other sciences when they regularly highlighted altruistic applications in the year-long curriculum. Research in the United States suggests that similar interventions may prove successful with college students (Diekman, Clark, Johnston, Brown & Steinberg, 2011). Thus, by viewing STEM subjects as compatible with communal goals, girls and women may become more likely to be supportive of STEM achievement with one another.

CONCLUSIONS AND FUTURE DIRECTIONS

As I have reviewed, peer processes appear to have an important influence on girls' and women's STEM achievement. In particular, I have argued that many individuals look to members of their in-group to evaluate the task and interpersonal values that they prioritize. When important peer groups are viewed as valuing and supporting STEM, it may validate girls' and women's sense of belongingness in STEM fields. Conversely, when peers disparage females' achievement in STEM, the perceived costs of pursuing STEM may outweigh the benefits.

Attaining gender equity among STEM faculty and employees in other STEM occupations will be one of the most effective ways to increase girls' and women's

STEM motivation. Studies find women's sense of belongingness is significantly lower in STEM departments with proportionally few female faculty (e.g., Ülkü-Steiner et al., 2000). This effect is most likely compounded when faculty or colleagues foster a culture that is insensitive to many women's concerns with balancing work and family (e.g., Ülkü-Steiner et al., 2000). Furthermore, even the physical decor of the work environment (e.g., posters with masculine-stereotyped content on the walls) may have subtle effects on one's sense of belongingness (see Cheryan, Plaut, Davies & Steele, 2009).

More longitudinal research and experiments are needed to test the possible causal relationships linking peer social networks and individual academic values. I suspect there is a reciprocal influence whereby (a) students select their friends partly based on shared interests and (b) these peer affiliations can strengthen (or weaken) students' interests (e.g., see Martin & Fabes, 2001; Ryan, 2001).

Another recommendation for future research is to clarify the conditions when girls and women maintain their STEM achievement despite facing obstacles from peer groups. One moderator implicated in past studies is the importance of the peer group to the individual (e.g., see Robnett & Leaper, 2013). Also, having at least one significant social identity associated with STEM (e.g., belonging to an STEM club) may mitigate the impact of peer groups that devalue STEM (e.g., other classmates). Furthermore, relationships other than peer groups may buffer or compound any negative influences of peer groups on STEM achievement. These include family members, teachers, dyadic friendships, romantic relationships, and role models in media (see Leaper, 2015).

Although I have focused on peer processes and female STEM achievement, it is worth adding that peer group processes affect boys and young men. Researchers find that peer support (vs. teasing) is related to boys' school success (see Farkas & Leaper, 2015). Traditional gender values among boys during adolescence may possibly steer some young men away from attending college (see Farkas & Leaper, 2015) or from pursuing non-traditional college majors such as literature or psychology (e.g., Leaper & Van, 2008). Thus, rigid gender-conformity pressures can limit the opportunities of men as well as women. (However, the occupations in which women are under-represented, such as engineering, generally hold higher status and pay in society than those in which men are under-represented.)

To end on an optimistic note, I want to reiterate that a variety of programs can potentially increase girls' and women's sense of belonging in STEM. First, these include strategies aimed at reducing sexism toward girls and women in STEM. Second, girls (and boys) can be encouraged to participate in STEM-oriented groups in classrooms or extracurricular programs that might help sustain their interest in STEM. Finally, educators and parents can reframe the value affordances offered in STEM fields. More girls and women may consider STEM as "for me" when they consider these fields as avenues for fulfilling communal goals, such as helping others or balancing work and family. In a similar manner, universities and businesses can take proactive steps toward making their work environments supportive of these goals for women (and men).

ACKNOWLEDGEMENTS

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