Social Issues and Policy Review

Social Issues and Policy Review, Vol. 9, No. 1, 2015, pp. 52–88

New Routes to Recruiting and Retaining Women in STEM: Policy Implications of a Communal Goal Congruity Perspective

Amanda B. Diekman*
Miami University

Erica S. Weisgram
University of Wisconsin – Stevens Point

Aimee L. Belanger
Miami University

Despite advances within a wide range of professional roles, women remain a minority in science, technology, engineering, and mathematics (STEM) degrees and occupations. The gender gap in mathematics and science performance has converged, and so it is important to consider the motivational reasons that might underlie the differential STEM pursuits of women and men. The goal congruity perspective contends that a fundamental cause of gender gaps in STEM pursuits is the gender difference in communal motivation (i.e., an orientation toward others). STEM fields may be particularly likely to deter communally oriented individuals because these fields are thought to impede goals of directly benefitting others, altruism, or collaboration. In this review, we examine how the communal goal perspective might address the challenges of gender gaps in STEM pursuits from childhood through adulthood. We review the logic and evidence for the goal congruity perspective, and we examine two other deterrents to women in STEM—work-family challenges and stereotyping—from the perspective of this framework. We then examine particular recommendations for policy actions that

*Correspondence concerning this article should be addressed to Amanda B. Diekman, Psychology Building 320, Miami University, Oxford, OH. Tel: +1-513-529-2402 [e-mail: diekmaa@miamioh.edu].

might broaden participation of women and girls, and communally oriented people generally, in STEM.

What Is the Problem? Gender Gaps in STEM Pursuits

Despite advances within a wide range of professional roles, women remain a minority in science, technology, engineering, and mathematics (STEM) degrees and occupations. Although women hold nearly half (48%) of all jobs in the U.S. economy, they hold under a quarter (24%) of STEM jobs—that is, occupations in physical and natural sciences, technology, engineering, and mathematics (Beede et al., 2011). This shortage of women in STEM is troubling because these fields are projected to grow more than other fields, and STEM occupations are among the highest paid (Langdon, McKittrick, Khan, & Doms, 2011; U.S. Congress Joint Economic Committee, 2012). Although the problem is acute in the United States, European countries face similar demands for highly skilled STEM workers (e.g., Business Europe, 2011). Moreover, the United States is becoming less competitive globally in terms of sustaining a highly qualified STEM workforce (National Science Board, 2012; U.S. Congress Joint Economic Committee, 2012), and thus it is problematic that even talented women select out of STEM for other fields.

Psychological theory and evidence can play a central role in understanding STEM pursuits (Newcombe et al., 2009), and particularly in understanding why women opt out of STEM career paths. As we review below, evidence suggests that the gender gap in mathematics and science performance has converged, and thus it becomes crucial to consider the motivational reasons that might underlie the differential STEM pursuits of women and men. The *goal congruity* perspective contends that a fundamental cause of gender gaps in STEM pursuits is the gender difference in communal motivation (i.e., an orientation toward others; Bakan, 1966) rather than gender differences in ability or achievement motivation. As we outline later, STEM fields may be exceptionally likely to deter communally oriented individuals because these fields are thought to impede goals of directly benefitting others, altruism, or collaboration (Diekman, Brown, Johnston, & Clark, 2010; Diekman & Steinberg, 2013; Weisgram, Bigler, & Liben, 2010). These beliefs are important to consider because communal goals are often highly valued, although this endorsement tends to be especially strong for women. In this review, we examine how the communal goal perspective might address the challenges of gender gaps in STEM pursuits from childhood through adulthood.

In the communal goal congruity framework, the orientation toward others can include two distinct aspects of *collaboration* (i.e., working with others) and *helping* (i.e., working to benefit others; Diekman & Steinberg, 2013). These aspects of communal behavior might be pursued simultaneously, but they also can be pursued separately. For example, a scientist might work independently to find a cure for cancer, or a research group might work collaboratively to advance the reputation and stature of the individuals in the group. Although these components are conceptually distinguishable, much of the evidence so far suggests that individuals' endorsements of these two aspects of communal goals tend to align with each other, and thus we focus on the broader construct of communal goals in this review.

Gender Disparities Throughout the STEM Pipeline

The "leaky pipeline" metaphor describes the greater likelihood of women and girls to leave STEM fields at every point, relative to men and boys. Gender disparities occur both in *recruitment*—that is, who chooses to enter a STEM pathway—as well as *retention*—that is, who chooses to persist in a STEM major or occupation. In addition, women who persist in STEM careers are less likely than men to reach top levels of leadership in those careers.

To trace gender differences and similarities in STEM pursuits, we start with science and mathematics activities in childhood. The evidence suggests that both boys and girls pursue science and mathematics, but they do so in different ways, and these differences emerge through actions of both children and adults. Although both girls and boys report engagement in science-related activities, the content of these activities differs along traditionally gender-stereotypic lines. For example, boys tend to report more experiences with tools (e.g., batteries, fuses, microscopes), whereas girls tend to report more experiences with planting seeds and bread-making (M. G. Jones, Howe, & Rua, 2000). Parents also provided more frequent opportunities to learn about science to boys than girls aged 4–6 (Alexander, Johnson, & Kelley, 2012). This study also found that girls' science learning opportunities were strongly determined by their early levels of interest, whereas boys' science learning opportunities were provided regardless of individual differences in interest. Finally, an observational study of children's engagement at an interactive science museum found that boys and girls approached, manipulated, and spent time with the exhibits at an equal rate; however, parents were three times more likely to explain scientific concepts to boys rather than girls (Crowley, Callanan, Tenenbaum, & Allen, 2001). Through differential exposure to science and math informal learning environments, then, boys and girls develop different levels of engagement and interest. In early adolescence, gender differences emerge, with boys engaging more than girls in science-related extracurricular activities (G. Jones, 1991).

Adolescence is a distinctly important point in the STEM pipeline. First, engagement and identification with STEM may become more stable as adolescents are forming their identities and exploring possible selves (Eccles, 2009). Second, high school presents opportunities to become more involved in STEM and prepared for STEM careers through choosing Advanced Placement classes, electives, and STEM-related extracurricular activities (Riegle-Crumb, Moore, & Ramos-Wada, 2011; Sadler, Sonnert, Hazari, & Tai, 2012). Third, high school is the first time that students can opt out of mathematics and science classes (though recent changes in curriculum may be curbing this trend in the United States and Canada, but not Australia; Watt et al., 2012). During this developmental period, gender differences in attitudes and interest in science and mathematics tend to increase (Sadler et al., 2012). The activities of high school students can thus provide a critical point to encourage exposure, build skills and confidence, and initiate identification with STEM fields.

Gender differentiation of STEM pursuits emerges even more strongly in the context of higher education. Among all college graduates, women are less likely to enter STEM majors (Chen & Weko, 2009). According to 2009 U.S. graduation data (National Science Board, 2012), women are distinctly underrepresented in the number of bachelor's degrees earned in engineering (18%), physics (19%), and computer science (18%). At the doctoral level, women are underrepresented in the proportion of degrees conferred, earning fewer degrees than men in engineering (25%), physical sciences (33%), and mathematics and computer science (26%).

Examining gendered patterns of employment reveals that women and men with STEM degrees enter different types of occupations, with women more likely to enter non-STEM fields such as education or medicine. Of the 6.7 million male STEM degree holders in the United States, 48% hold an engineering degree and 31% a physical and life sciences degree. In comparison, of the 2.5 million female STEM degree holders, 57% hold a physical and life sciences degree, and only 18% an engineering degree (Beede et al., 2011). Also illuminating are the gendered patterns that emerge for those STEM degree holders who work outside of STEM fields: Of the 2.5 million female STEM degree holders, only 26% held a job in a STEM occupation, whereas 14% were in education occupations and 19% in healthcare occupations. In contrast, of the 6.7 million male STEM degree holders, 40% held a STEM occupation, compared to only 6% in education and 10% in healthcare (Beede et al., 2011). Although women earn bachelor's degrees on par with men in chemistry (50%) and biology (59%; National Science Board, 2012), these graduates often leave the STEM pipeline for work in the communally oriented fields of pharmacy and medicine, which are fairly gender-equal in their representation (e.g., women are 48% of medical school graduates; Jolliff, Leadley, Coakley, & Sloane, 2012; women are 54% of pharmacists; U.S. Department of Labor, 2013). Thus, many women who have earned degrees within the STEM pipeline ultimately pursue careers in different fields than men.

Even among women who earn advanced degrees in STEM fields, attrition continues. For example, a large-scale study by the National Academy of Sciences (National Research Council, 2010) found that women were better represented among degree recipients than among applicants for research-intensive tenure-track positions in each of the six disciplines studied. This attrition was most pronounced for biology and chemistry, which had the largest shares of women represented as degree earners. In addition, an analysis of retention of STEM faculty at research-oriented institutions (Kaminski & Geisler, 2012) revealed that for most fields, female faculty were hired at lower rates than men; however, male and female faculty were promoted and tenured at similar rates once they were hired. Mathematics was the exception to this pattern; here, female faculty were both less likely to be hired and more likely to leave than their male counterparts. For academic positions, then, the key issue seems to be one of recruitment into the field and into research-focused positions, rather than retention once those faculty are in place.

Even in STEM fields with relative gender parity at entry levels, men tend to advance to positions of leadership more frequently and more quickly than do women. Although certainly women continue to be underrepresented at the highest levels of leadership generally (e.g., Eagly & Carli, 2007), it is also true that women have made much greater progress in leadership of non-STEM domains than STEM domains. For example, a survey of the Association of American Universities department chairs found that women chaired only 2.7% of engineering departments, 5.9% of math or physical science departments, and 12.7% of life science departments, whereas they chaired 23.4% of business departments and 31.5% of humanities departments (Niemeier & González, 2004).

Although the issues of advancing talented women are not limited to the STEM fields, the problem may be exacerbated because of fewer women in these fields initially. Moreover, the women who persist in STEM may face a double bind. On the one hand, women in STEM may face exclusion and penalties because of their minority status in a male-dominated field. On the other hand, women in STEM may be targeted for service and administrative duties because of their rarity in the field. For example, one ironic effect of MIT's (1999) greater attention to gender equality among science faculty was that women subsequently reported very high levels of requests to serve on and chair committees, compared to men (Bailyn, 2003). Certainly, seeking representation by women is important, but the result may be unwieldy burdens for female STEM faculty relative to male STEM faculty.

Women as an Underutilized Pool of STEM Talent

These gender disparities in entry, participation, and advancement in STEM suggest that one promising avenue to increase the quantity and quality of the STEM workforce is to increase the participation of women and girls. Certainly, one of the first questions that must be answered is whether women and girls indeed represent a pool for STEM talent—that is, do women and girls have the mathematical and scientific abilities to contribute substantially in the STEM fields? Further, do they have interest in pursuing STEM career paths?

Questions about gender differences in ability have long surrounded debates about the participation of women and girls in STEM (e.g., Benbow, Lubinski, Shea, & Eftekhari-Sanjani, 2000). As detailed below, the scientific evidence overwhelmingly shows converging or eliminated gender gaps in mathematics and scientific performance, leading researchers to conclude that innate gender differences in ability are not the major cause of current gender gaps in STEM career pursuits (Ceci, Williams, & Barnett, 2009; Halpern et al., 2007; Spelke, 2005). Although women and girls tend to report less *interest* in math and science careers, they certainly demonstrate the *ability* to pursue these careers.

Gender similarity in ability. Current meta-analytic evidence shows that gender gaps in math performance have closed over time, and girls tend to outperform boys in most mathematics courses (Hyde, Fennema, & Lamon, 1990; Lindberg, Hyde, Petersen, & Linn, 2010). Furthermore, small gender differences in math performance favoring girls tend to emerge across nations (ranging from $d = -.06$ in Central/South America and Mexico to $d = .21$ in Africa; Lindberg et al., 2010). A large-scale review of the literature concluded that although girls tend to show small advantages in verbal abilities and boys in quantitative abilities, girls tend to do better than boys in quantitative classes in a school context (Halpern et al., 2007). In a meta-analysis of math performance from 1990 to 2007, overall effect sizes were $d = .05$ in published studies and $d = .07$ in nationally representative samples of U.S. adolescents, suggesting similarity between girls and boys (Lindberg et al., 2010). In addition, analyses of three nationally representative cohorts from 1982 to 2004 in the United States found that gender differences in prior achievement in high school accounted for only a slim proportion of gender differences in declaring a physical science or engineering major (Riegle-Crumb, King, Grodsky, & Muller, 2012).

An interesting development in recent research is that *verbal* ability, in relation to mathematical ability, is emerging as an important factor in explaining gender differences in STEM decisions. Students of both sexes with high abilities in both verbal and mathematics tend to choose non-STEM fields, and girls are more likely than boys to be among those with high scores in both verbal and mathematics domains (Wang, Eccles, & Kenny, 2013). Thus, it is not simply lack of mathematic ability among girls that leads them to opt out of STEM careers, but the reality that they have a greater choice of fields to enter. Examining the factors that underlie these choices brings us to the systematic study of what girls and women want, whether STEM fields are perceived as affording those goals, and what policy steps might be taken to foster such goal pursuit opportunities.

Gender differences in interest. Although studies of gender differences in ability or performance tend to show convergence in the gender gap over time, gender differences in attitudes and interest toward math and science have shown greater stability. Among children aged 4–6, parents report that boys displayed more science interest than did girls (Alexander et al., 2012). However, overall science interests as reported by students themselves have not shown consistent gender differences for children in first to sixth grade (Wigfield et al., 1997). Beginning in young adolescence, gender differentiation of interests emerges more consistently, with boys showing more interest than girls (Weisgram & Bigler, 2006a). Adolescence, and high school in particular, is a developmental period in which gender differences in STEM positivity and interests increase (Sadler et al., 2012). Consistent with this meta-analytic evidence is some of our own primary research, which finds that gender differences in interest in science careers are moderate among middle school students ($d = .23$) and high school students ($d = .18$) and become larger among college students ($d = .38$; Weisgram & Diekman, in preparation). These interests are important to consider, because longitudinal studies have demonstrated that STEM interests in high school predict actual STEM career choices in adulthood (Benbow, 2012; Wang et al., 2013).

These gender differences in interest in STEM-related topics are critical for increasing participation in STEM fields. Ample research and theory (e.g., Sansone & Harackiewicz, 2000) demonstrates that across a wide range of tasks and individuals, intrinsic motivation (i.e., pursuing a task for the rewards inherent to the task) leads to greater persistence and performance than extrinsic motivation (i.e., pursuing a task for reasons other than the task itself). Self-determination theory, for example, posits that autonomy is a fundamental need (Ryan & Deci, 2000). Because autonomy needs are subverted in the pursuit of extrinsic goals, extrinsic goal pursuit is less likely to persist over time. Cultivating girls' interest in math and science as worthwhile is thus a central aspect of increasing their persistence in STEM.

Theories of motivation have clarified that the value attached to success in a field is a strong predictor of achievement and performance. For example, within expectancy-value frameworks (e.g., Eccles, 1994), achievement in math and science domains is predicted both by expectancy of success in the domain, as well as beliefs about whether that success is important. Different kinds of beliefs about subjective task values have been identified (e.g., Chow, Eccles, & Salmela-Aro, 2012; Eccles, 1994; Harackiewicz & Hulleman, 2010), such as intrinsic value (e.g., do I enjoy it?); attainment value (e.g., is this task important?); utility value (e.g., is this task useful?), and cost (e.g., is there a downside to it?). In a striking demonstration of the impact of utility value, Hulleman and Harackiewicz (2009) found that high school students who expected to do poorly in science, but who wrote about the usefulness of course materials for their own lives, were more likely to show increases in interest and higher grades than similar students who wrote a summary of course material. Indeed, in the utility condition, the low-expectation students' interest and course grades were similar to those of high-expectation students.

Two key conclusions emerge from the evidence reviewed here: First, as students move into adolescence and emerging adulthood, girls are less likely than boys to report interest in STEM-related activities; second, interest in these activities is vital for entry and persistence in STEM fields. The question that remains, then, is how best to increase interest in STEM fields: What are the kinds of activities that persuade students—particularly girls—that STEM activities are enjoyable, useful, and important? As we detail below, emphasizing the ways in which STEM fields facilitate highly valued communal goals may prove distinctly impactful.

Need for Effective Interventions

The need for greater quantity and quality of scientifically and mathematically talented individuals, especially in the United States, requires effective interventions to increase STEM interest and persistence. Given the large gender gaps in recruitment, women represent a broad pool of potential STEM talent. Thus, interventions that effectively increase women's interest in STEM and persistence throughout all levels of STEM careers are necessary. Given the evidence of gender convergence in math and science ability, explanations of gender gaps in STEM participation that focus on lesser ability among girls and women are no longer tenable, and interventions focused on improving ability are unlikely to provide substantial gains.

Effective interventions to increase interest in STEM, however, have proven challenging. As Bigler (1999) noted with regard to interventions to reduce gender stereotyping in children, many interventions result in nonsignificant effects, and many of these nonsignificant effects are underreported. STEM interventions reflect this pattern, with some interventions resulting in nonsignificant effects (e.g., Haussler & Hoffmann, 2002; Jayaratne, Thomas, & Trautmann, 2003; Sharp, Carey, Frechtling, Burgdorf, & Westat Inc., 1994; Stake & Mares, 2001) or even in *decreased* interest among girls (e.g., Weisgram & Bigler, 2006b; Ziegler & Stoeger, 2004). Even when interventions succeed at elevating girls' self-efficacy in science, similar improvements are often not obtained in girls' interest in science careers (e.g., Reid & Roberts, 2006; Weisgram & Bigler, 2006a, 2007 standard intervention conditions). Interventions that are considered effective may have little impact in the long term (e.g., Jarvis & Pell, 2004), or among girls who are initially low in STEM interest or identification (Betz & Sekaquaptewa, 2012; Ziegler & Stoeger, 2004).

Given the extremely mixed results of intervention efforts, careful analysis of the theoretical frameworks and their empirical evidence is needed. Investments of money, time, and energy are most likely to yield benefits when interventions draw from converging evidence and theory. To this end, we first outline the logic and evidence of the communal goal congruity framework, and we then examine how communal goal processes can be integrated with other evidence about deterrents to women in STEM.

Elevating STEM Interest through Communal Goal Congruity

Logic of the Goal Congruity Perspective

The goal congruity perspective posits that STEM fields in particular deter communally oriented individuals because these fields are perceived as unlikely to involve the communal goals of working with others or helping others. Because women especially endorse communal goals, women especially tend to select out of STEM career paths. Notably, communal goal orientation negatively predicts interest in STEM, even when controlling for individual differences in self-efficacy and experience in math and science (Diekman et al., 2010). Understanding the communal goal processes involved in STEM decisions thus offers a new vantage point to increase the representation of women (and communally oriented people generally) in STEM.

Communal goals are highly valued. One reason to attend in particular to communal goals is that the motivation to care for and work with others has been recognized as one of the fundamental human motivations. Bakan (1966) posited that two orientations characterize human experience: *agentic* motivations describe an orientation to the self, whereas *communal* motivations describe an orientation to others. These two dimensions have subsequently been described as fundamental to social judgment, including both beliefs about the self and others (Abele & Wojciszke, 2007; Fiske, Cuddy, & Glick, 2007; Judd, James-Hawkins, Yzerbyt, & Kashima, 2005). Furthermore, some evidence suggests that communal information about others is prioritized in social interactions (Abele & Bruckmüller, 2011). In addition, communal traits are highly valued in both men and women, even though gender norms distinctly value these qualities in women (e.g., Diekman & Goodfriend, 2006; Prentice & Carranza, 2002).

The high priority attached to communal attributes is consistent with the argument that close relations with others is a fundamental human motive. Belonging is posited as a universal, core social motive (Baumeister & Leary, 1995; Fiske, 2004). Hierarchical approaches to motives likewise place a high value on affiliative motives, placing them just beyond safety or self-protective motives (Kenrick, Griskevicius, Neuberg, & Schaller, 2010; Maslow, 1943). Our own primary data tend to show the high importance that individuals attach to communal goals. For example, communal goals were endorsed more highly than agentic goals by college-aged participants (Diekman et al., 2011, Experiment 3).

Even though the female gender role emphasizes communal aspects more than does the male gender role, it is clear that men as well as women value and are valued for communal attributes. For example, men as well as women who displayed warmth along with dominance received highly positive evaluations, principally along interpersonal dimensions (Diekman, 2007). The recognition of the importance attached to communal motives among *both* men and women has implications for increasing broader participation in STEM. This gender similarity may be important because the challenge in STEM fields is not only to recruit more women, but to recruit and retain more individuals of either sex, given the increasing demands and dwindling supply of qualified individuals (U.S. Congress Joint Economic Committee, 2012). The value accorded to communal goals generally suggests that communally oriented men as well as women might be attracted by greater congruity between STEM and communal goals.

Women particularly value communal goals. Although communal goals are highly valued generally, women especially endorse these goals as important. Social role theory suggests that this gender difference originates from the distribution of women and men into social roles (Eagly, 1987; Eagly & Wood, 2011; Eagly, Wood, & Diekman, 2000). Because women have traditionally occupied caregiving roles, the female gender role emphasizes communal traits, such as being nurturing and kind. Similarly, because men have traditionally occupied provider and leadership roles, the male role emphasizes agentic traits, such as being competitive and assertive. Meta-analyses indicate that women report more communal personality traits than men do: For example, women report more warmth, nurturance, and tender-mindedness (Costa, Terracciano, & McCrae, 2001; Feingold, 1994).

One of the primary reasons underlying a focus on communal goals as an explanation for the STEM gender gap is quite simply that the gender difference in agentic traits has decreased from the 1970s through the late 1990s, while the gender difference in communal traits has remained relatively stable (Eagly & Diekman, 2003; Twenge, 1997). Furthermore, attributing women's lack of STEM pursuits to less motivation to achieve is problematic given women's increasing presence in other high-power fields, such as law or medicine. Given that the gender gap in STEM participation has not been attenuated by women's increasing levels of agency, it is important to consider communal motivations.

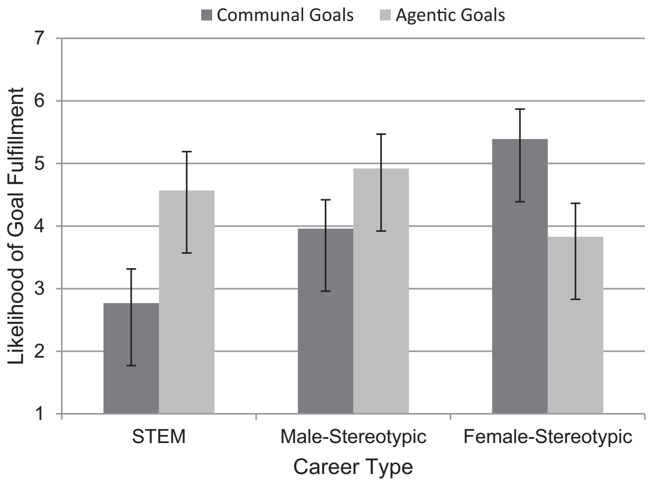
Causes of gender differences in communal orientation. As outlined in the biosocial theory of gender differences and similarities (Wood & Eagly, 2012), gender roles produce differences in the behavior of women and men through different pathways. Of particular interest to understanding gender differences in communal goal endorsement are social normative processes and self-regulatory processes.

With regard to *social normative* processes, the relationship between men's and women's roles in society and observed gender differences is mediated by the formation of gender roles that contain information about what men and women ought to do and what they typically do. Generally, beliefs emphasize the importance of communal traits for women (e.g., warm, sensitive, and cooperative), whereas such prescriptions are relaxed for men (Prentice & Carranza, 2002). Women thus elicit positive rewards for enacting behaviors that are congruent with the communal expectations of the female gender role (Diekman & Eagly, 2008).

Gender roles also produce *self-regulatory* effects, in that men and women internalize the societal expectations for their gender. Each gender thus places value on aligning the self with specific standards, some of which are derived from cultural expectations about gender (Diekman & Eagly, 2008). Processes of aligning the self with gender-typical standards and receiving both external and internal rewards for doing so begins early and continues throughout development (e.g., Bussey & Bandura, 1999; Martin & Ruble, 2004). Rewards for aligning with traditional gender roles are most pronounced among individuals who personally endorse gender roles, as shown through naturalistic diary data (Witt & Wood, 2010), or in contexts when traditional gender roles are made salient, as shown through experimental data (Wood, Niels, Hebl, & Rothgerber, 1997). There is clear evidence that communal aspects are an important part of women's self-standards. Women tend to report more communally oriented goals than do men (Pohlmann, 2001). Moreover, women endorse communal goals more highly than do men, with smaller or no gender difference in agentic goal endorsement (Diekman et al., 2011, Experiments 1a and 3). In addition, women more than men desire their jobs to have communally oriented attributes such as working with people, helping others, and an opportunity to make friends (see Konrad, Ritchie, Lieb, & Corrigall, 2000, for a meta-analysis of U.S. participants). Even early in development, girls and young women are more likely than boys and young men to say that an important aspect of their future jobs will be to "help other people" (M. G. Jones et al., 2000, for children; Weisgram et al., 2010, for adolescents).

Each of these mechanisms suggests that involvement in other-oriented roles from an early age can serve to elicit and reward communal orientations. Although communal orientations are particularly valued among girls and women, such other-oriented behavior is functional and valued for all individuals living in a world requiring sustained cooperative relationships. It is thus not surprising that individuals in turn seek professional and personal roles that allow them to fulfill highly valued goals. As we review below, STEM fields are thought to be decidedly lacking in communal opportunities.

STEM fields are perceived as impeding communal goals. One of the contributions of the goal congruity perspective is to document the ways in which STEM occupational roles are thought to afford opportunities to meet particular goals. Across a range of samples and paradigms (Diekman et al., 2010; Diekman, Clark, Johnston, Brown, & Steinberg, 2011), we have found evidence of robust stereotypes that STEM occupations do not afford collaborating with or helping others.



Note. From reference A. B. Diekman et al. (2010).

Fig. 1. STEM careers are perceived less likely to afford communal goals.

Compared to occupations such as law, medicine, nursing, or teaching, STEM fields are considered less likely to offer opportunities for communal goal pursuits (see Figure 1). Although STEM fields are sometimes considered less likely than other occupations to provide opportunities for agentic goal fulfillment, the larger difference is in perceptions of communal goal opportunities. Thus, STEM fields are perceived as uniquely deficient in affording communal goals, both relative to other fields and relative to agentic goals.

These goal affordance stereotypes show evidence of generalizability. For example, even sixth grade students were relatively unlikely to see science as "helping the poor" (30% of boys and 14% of girls), whereas they were likely to associate science with power (58% of boys and 44% of girls; M. G. Jones et al., 2000). Likewise, college students perceived careers in the physical and mathematical sciences as less likely to involve other people than careers in education/social services or careers in medicine (Morgan, Isaac, & Sansone, 2001). Stereotypes that STEM fields impede communal goals are evident using both explicit and implicit measures, and these stereotypes hold across participant sex and STEM or non-STEM major (Diekman et al., 2011). Thus, although women and non-STEM majors show more extreme stereotypic responses in some samples, the perception of STEM as less communal than other fields holds even among STEM majors and men.

Communal goal incongruity decreases interest in STEM. Together, communal goal endorsement and communal goal affordances are important predictors of

STEM interest. Given the strong stereotypes about STEM as impeding communal goals, individuals who especially value communal goals are especially unlikely to report interest in STEM careers; further, the gender difference in communal goal endorsement partially mediates the gender gap in STEM career interest (Diekman et al., 2010). Other research provides support for the causal role of communal goal endorsement in STEM career preferences. For example, when communal goals are situationally activated, both women and men demonstrate decreased interest in the STEM fields, suggesting that, when present, communal goal incongruity affects women and men similarly (Diekman et al., 2011, Experiment 2).

The tendency to believe that STEM fields afford communal goals is a robust predictor of positivity toward STEM careers. Individual differences in beliefs that STEM affords communal goals are robust predictors of positivity toward STEM (E. R. Brown, Thoman, Smith, & Diekman, in review). Consistent with this pattern is evidence that the perception that careers involve other people strongly predicts interest across careers in physical/mathematical sciences, education/social services, and medicine (Morgan et al., 2001). The perception that science affords the specific goal of helping others predicts positivity toward a science career across middle school, high school, and college students (Weisgram & Diekman, in preparation). Other evidence of goal congruity processes is that occupations thought to afford opportunities to work with or to interact with others tend to show greater representation by women. For example, women's interest in pursuing genetic counseling was uniquely predicted by the extent to which genetic counseling was perceived to afford opportunities to work with or help others, even compared to other important perceptions, such as the extent to which the field presents moral challenges (Kopesky, Veach, Lian, & LeRoy, 2011). Finally, the causal role of communal perceptions in influencing positivity toward STEM is demonstrated by experimental evidence in which participants express greater positivity toward a career in science after learning about a scientist who performs collaborative tasks versus one who performs independent tasks (Diekman et al., 2011, Experiment 3).

This culmination of evidence, across multiple methodologies assessing both naturalistic and experimental relationships, thus provides support for the idea that STEM interest is influenced by the perceived congruity between the communal goals held by the individual and the opportunities to fulfill those goals afforded by the environment. The goal congruity perspective highlights two important causal forces that contribute to goal congruity: communal goal endorsement and perceived communal goal affordances. Influencing either of these levers is predicted to change STEM interest. However, in terms of intervention possibilities, we argue that the key to increasing STEM interest, especially among girls and women, is to increase the perception and the reality that STEM fields afford communal goals. Although this framework suggests that one route to increasing STEM interest via increased goal congruity would be to decrease communal goal endorsement, such decrements in communal goal endorsement would be extremely undesirable in principle or in practice. As we reviewed above, communal goals are highly valued by both men and women across different contexts, and communal orientations are highly functional in our rich social world. It would be neither feasible nor desirable to decrease the valuing of these other-oriented priorities. Instead, given that communal goals are highly valued and highly valuable, we suggest that a crucial route to increasing interest and engagement in STEM is to clarify how these fields allow the pursuit and fulfillment of communal goals. Understanding the sources of perceived communal affordances can thus be an important lever for increasing STEM interest among a broader population of qualified individuals.

Integrating Communal Goal Processes with Other Frameworks

From the perspective of the communal goal congruity framework, a core element in understanding gender differences in STEM pursuits is to understand how women perceive opportunities to fulfill valued communal goals within this occupational role. In this section, we explore how the focus on communal goal processes can be integrated with other well-documented deterrents to women in STEM—namely, work-family challenges and gender stereotypes about STEM.

Work and family. Much attention has been paid to the obstacles that women in STEM face in terms of connections between their professional and private lives. As others have noted, women at the highest levels of STEM fields incur penalties for children that men do not (Mason, 2014; Williams & Ceci, 2012). From a communal goal congruity perspective, understanding the impact of family pressures on STEM career decisions is even more critical, because engagement with family roles may be a fundamental way that people meet communal goals.

Across childhood, adolescence, and adulthood, girls and women indicated that they desire a job that allows them to spend time with their family (Weisgram et al. 2010), a value endorsement that negatively predicted their interest in masculine occupations (see also Evans & Diekman, 2009). Importantly, Weisgram and Diekman (in preparation) demonstrated that adolescents and emerging adults perceive STEM careers to afford family values less than other values such as money, power, and altruism. In their longitudinal work, Frome, Alfeld, Eccles, and Barber (2008) found that desiring a family flexible job in 12th grade predicted women changing their career aspiration from a masculine field to a feminine field by age 25.

Family goals may have particular implications for high-level STEM pursuits because the timing of parenthood and the timing of a research career may conflict more than the timing of other career trajectories. Scientific research requires dedicated time in graduate school, postdoctoral work, and as a junior faculty member, and these years typically co-occur with the years of women's greatest fertility. In one study of scientists who had children as postdoctoral fellows, 41%

reported that they had become less likely to pursue an academic research career (Mason, 2012). In addition, a study of scientists at the graduate, postdoctoral, and faculty levels found that women were more likely than men to report having fewer children than desired (45% of female faculty vs. 25% of male faculty; Ecklund & Lincoln, 2011). Among graduate and postdoctoral students, having fewer children than desired was a unique predictor of seeking a career outside of STEM. A study of highly talented individuals showed that men and women evince different lifestyle preferences, with women less than men likely to say that they would want to work 50+ hours in their current job, or 60+ hours in their ideal job (Robertson, Smeets, Lubinski, & Benbow, 2010). Within two cohorts that were followed up in their mid-30s, scientifically talented women were more likely than their male counterparts to value community and relationships along with work (Ferriman, Lubinski, & Benbow, 2009).

Another aspect of work-life connections that has particular implications for women in STEM is being part of a dual-career couple. Although navigating the demands of two careers is challenging in any domain, this problem is more prevalent among female scientists because they are more likely to be married to other scientists than are male scientists (who are more likely to be married to part-time workers; Mason, 2014). In a survey of physics faculty, McNeil and Sher (1999) found that among married female physicists, 50% were married to other physicists and 29% to other scientists. In contrast, among married male physicists, 7% were married to other physicists and 11% to other scientists—leaving 82% married to nonscientists. Likewise, Xie and Schauman (2005) found that female scientists and engineers (14.69%) are more likely to be married to scientists than are male scientists and engineers (2.74%). Resolving the "two-body" problem has particular potential to benefit women in science.

For these reasons, family concerns are likely a contributing factor to women's opting out of research-intensive tracks in science, mathematics, or engineering. However, this reason does not account for why women would opt out of the multitude of other STEM avenues available, including masters-level work or industry work. Instead, family concerns may join with other factors—both internal and external to the STEM occupational role—that suggest that STEM fields are not inhospitable to communally oriented goals. Consideration of communal goal processes, however, leads to the novel prediction that fulfillment of communal goals in nonoccupational domains might actually be beneficial to STEM pursuits. If communal needs are met through family activities or through community service, for example, there may be less emphasis on meeting these needs through the occupational role. Thus, communal goal congruity might be achieved through a more expansive consideration of the variety of roles that can contribute to goal pursuit. Strong benefits might result from moving from a model of "work-family conflict" to "work-family resources," in which both occupational and family domains provide resources as well as incur costs (e.g., Greenhaus & Powell, 2006; ten

Brummelhuis & Bakker, 2012). In particular, considering family roles as potentially facilitating STEM pursuits, given the proper supports, leads to the conclusion that STEM fields might distinctly benefit from advancing progressive work-family policies.

Stereotypes about STEM. Stereotypes relevant to gender and STEM include beliefs about who is in STEM as well as what kind of work is involved in STEM (Cheryan, 2011). A wide range of evidence suggests strong stereotypes that pair men, more than women, with math and science. These gender stereotypes are prevalent among children, adolescents, adults, and even scientists themselves. In a classic study, Chambers (1983) found that of nearly 5,000 drawings of scientists by children, only 28 were of female scientists, and all of these were drawn by girls. In addition, such drawings contain many stereotypes about the work involved in science, such as the lone, nerdy scientist in a lab coat and eyeglasses, chemistry equipment, and a representation of a "mad scientist" (among children, Chambers, 1983; among emerging adults, Thomas, Henley, & Snell, 2006). Children endorse stereotypes of science, especially physical science, as a male-dominated field (Andre, Whigham, Hendrickson, & Chambers, 1999; Liben & Bigler, 2002), and they perceive men as liking science more and being better at science than are women (J. Steele, 2003). In addition, implicit associations that pair men with math have been documented in children as young as seven years old (Cvencek, Meltzoff, & Greenwald, 2011 in United States; Cvencek, Meltzoff, & Kapur, 2014 in Singapore).

Some evidence suggests that gender stereotypes about STEM might abate with age and over time, but other evidence suggests that these stereotypes continue to persist. In adolescence and young adulthood, individuals may endorse more egalitarian beliefs about women in STEM fields as individuals' use of gender stereotypes decreases overall (Martin & Ruble, 2004; Signorella, Bigler, & Liben, 1993). For example, both boys and girls expressed relatively egalitarian attitudes about women in science, although girls more than boys were positive about women having jobs as scientists (Weisgram & Bigler, 2006a). However, more subtle measures continue to show gender stereotypes. For example, the Draw-A-Scientist task continued to show drawings of men far more than women even 20 years after the original research (Finson, 2002; J. Steele, 2003). Research on implicit stereotypes shows that although many individuals express low levels of stereotyping on explicit measures, many men and women hold implicit gender-math stereotypes that more strongly associate men than women with math (Nosek et al., 2002).

Stereotypes pairing STEM fields with men may also affect individuals' perceptions of the communal goals afforded by these fields. Evidence suggests that the actual and perceived distributions of men and women into different occupational roles are associated with the traits thought to require success in such roles (Cejka & Eagly, 1999). Moreover, novel jobs depicted with male workers are rated as higher in affording some agentic goals (i.e., status and salary) and lower in affording some communal goals (i.e., spending time with family members) than the identical jobs depicted with female workers (Weisgram et al., 2010).

Given that stereotypes that pair men with math and science continue, despite some changes toward greater egalitarianism, it is critical to examine the effects of these beliefs. First, we examine how awareness of stereotypes can influence an individual's own performance on STEM-related tasks. Second, we examine how others' stereotypic beliefs impede women's STEM pursuits.

Effects of STEM stereotypes on own beliefs and performance. A pivotal implication of stereotypes about STEM is that they have been shown to influence individuals' performance on STEM-related tasks. Across a wide range of outcomes beyond the STEM domain, implicit stereotypes predict individuals' behaviors and performance (see Greenwald, Poehlman, Uhlmann, & Banaji, 2009, for a meta-analysis). Within the STEM domain, implicit beliefs associating men with mathematics were related to negative attitudes toward the field among women (Nosek, Banaji, & Greenwald, 2002). In addition, implicit stereotypes about science mediated the relationship between gender and intentions to participate in science activities, including choosing science as a major (Lane, Goh, & Driver-Linn, 2012).

Because of robust gender-STEM stereotypes, women in STEM are particularly likely to experience social identity threat, or the feeling that one's identity is devalued in a particular context (C. M. Steele, Spencer, & Aronson, 2002). For example, in engineering, interacting with a sexist man triggers identity threat in women and causes women to underperform on math but not verbal tests (Logel et al., 2009). In a naturalistic study of the workplace conversations of STEM faculty (Holleran, Whitehead, Schmader, & Mehl, 2011), the more that female faculty discussed research with male colleagues, the more disengaged the women were from their jobs. Furthermore, when women engaged in research conversations with a male colleague, they were rated as less competent than men engaged in research conversations with another man. No gender differences in perceived competence emerged during research conversations with female colleagues or during social conversations with male or female colleagues. This pattern suggests that women were experiencing social identity threat when speaking to men about research. Such research conversations are important for establishing collaboration, and thus, social identity threat in the workplace and the resulting drop in perceived competence may result in less collaboration and communal activities in the workplace for women in STEM.

The numeric underrepresentation of women in STEM itself triggers social identity threat, which decreases women's sense of belonging in the STEM fields and decreases interest in participating in a future STEM activity (Murphy, Steele,

& Gross, 2007). The effect of identity threat on belonging further suggests that when women experience identity threat in STEM, it affects their ability to pursue communal goals such as working with others. Furthermore, sense of belonging fosters interest and motivation in STEM (Good, Rattan, & Dweck, 2012; Walton & Cohen, 2007; Walton, Cohen, Cwir, & Spencer, 2012).

A particular form of social identity threat is stereotype threat: Here, an individual displays decreased performance in a domain in which he or she is faced with the possibility of confirming a negative self-relevant stereotype (Schmader, Johns, & Forbes, 2008; C. M. Steele & Aronson, 1995). More specifically, women who are highly identified with math demonstrate decreased performance on a math test when their gender is made salient (Spencer, Steele, & Quinn, 1999). Stereotype threat also affects interest and motivation in the stereotyped domain. When stereotype threat was induced by having women watch commercials that displayed women in stereotypical ways, they were less likely to express interest in STEM and more likely to express interest in humanities than women who watched commercials that displayed women in counterstereotypical ways (Davies, Spencer, Quinn, & Gerhardstein, 2002). Stereotype threat effects have been shown to influence not only performance in a domain, but processes by which people learn (Rydell, Shiffrin, Boucher, Loo, & Rydell, 2010). By definition, those who are most vulnerable to stereotype threat are those who are highly identified with the threatened domain. Thus, the women who are most affected by gender stereotypes about math are the very women who value math the most. Stereotype threat thus poses particular hazards for women who have persisted through the pipeline to high levels of STEM.

One implication of the communal goal congruity perspective is that enhancing communal goal opportunities in STEM might buffer against these negative effects of stereotypes. Believing that STEM practitioners value and fulfill communal goals in their work can enhance feelings that one's communal goals are valued in that setting, and thus increase a sense of belonging. Through a wide range of experimental and naturalistic evidence, belonging in particular settings and broader fields has been shown to strongly predict motivation and interest (Walton et al., 2012; Walton & Cohen, 2007). Belongingness might be especially important for communally oriented individuals, who are most likely to value connection to others.

Effects of STEM stereotypes on others' behavior toward girls and women. The strong gender stereotypes about math and science also lead others to treat women and girls in STEM differently than they treat boys and men. Parental stereotypes about girls' mathematic abilities predict girls' attitudes toward math (Gunderson, Ramirez, Levine, & Beilock, 2012), as well as their self-efficacy and interest (Bleeker & Jacobs, 2004). Indeed, mothers' rejection of stereotypes can buffer against the detrimental effects of stereotype threat (Tomasetto, Alparone,

& Cadinu, 2011). In addition, teachers' own anxiety related to math contributed to girls' gender stereotypes about math and in turn to their end-of-year math performance (Beilock, Gunderson, Ramirez, & Levine, 2010). Gender discrimination at the highest levels of math and science is also evident. For example, the landmark study of gender inequality at the Massachusetts Institute of Technology (MIT, 1999) found that female faculty in the School of Science were paid less, promoted less often, and given fewer resources than their male counterparts (see also Ginther, 2003).

Although some researchers argue that prejudice is not a likely explanation for current gender gaps in STEM pursuits (e.g., Ceci et al., 2009), recent experimental studies illustrate the continued presence of gender discrimination. In one study (Moss-Racusin, Dovidio, Brescoll, Graham, & Handelsman, 2012), biology, chemistry, and physics professors evaluated the application materials of a candidate for a lab manager position; all materials were identical, except that some scientists read materials from a candidate with a male name and others read materials from a candidate with a female name. Female candidates were less likely to be hired as a lab manager, perceived as less competent, offered a lower starting salary, and offered less career mentoring opportunities. In another study (Knobloch-Westerwick, Glynn, & Huge, 2013), scholars rated abstracts submitted for a conference that were associated with either a male name or a female name. Abstracts associated with a female name, relative to those with a male name, were rated as lower in quality and less interesting for possible collaboration, especially for female-related scientific topics. Bias against women in math has been shown to be rooted in implicit stereotypes (Reuben, Sapienza, & Zingales, 2014). In this demonstration, men were more likely to be hired for a mathematical task than women, and evaluators failed to account for men's tendency to overestimate their future mathematical performance, relative to women. Both of these biases were related to implicit stereotypes. The combination of these discrimination experiences over a career can have consequences for women's success in the field, as illustrated by the demonstration of the cumulative impact of even small differences in treatment of men versus women (Agars, 2004). Interestingly, knowing about gender discrimination that has occurred historically and is still present does not appear to decrease young women's interest in STEM but rather can motivate them to pursue STEM fields (Weisgram & Bigler, 2007).

Policy Implications of a Communal Goal Congruity Perspective

Developmental Challenges and Opportunities

The goal congruity perspective can provide new leverage to recruit and retain talented women in STEM. We consider policy implications at different points of cognitive and social development, given that the "leaky pipeline" for women in STEM presents challenges from childhood through adulthood. As we review evidence regarding intervention, it should be noted that much of the communal goal congruity experimental or intervention evidence to date focuses on short-term increases in interest in STEM careers. Harackiewicz and Hulleman (2010) differentiate between this *situational interest*, or interest evoked in a particular context, and *individual interest*, or long-term or chronic interest. Although situational interest may fluctuate more than individual interest, Harackiewicz and Hulleman review evidence suggesting that even situational interest can predict future choices and career paths. Even the short-term elevation of interest can have long-term consequences, especially if heightened interest results in recursive processes, such as a change in the way the self is viewed or enhanced likelihood of seeking out new opportunities (Yeager & Walton, 2011). For example, Stake and Mares (2005) found that science enrichment activities for academically talented students only revealed the benefits of the program once students had returned to their own schools, months later—an effect they termed the "splashdown effect." Interviews with students revealed that they attributed important changes to the program, including increased confidence in science and willingness to engage in new opportunities related to science. Policy can thus instigate short-term changes that can provide a way to open the door to longstanding individual change.

The developmental periods of childhood and early adolescence are crucial in promoting interest in science and mathematics. We highlight two particular ways here. First, childhood and early adolescence are key points to initiate interest in science and mathematics (Alexander et al., 2012; Frenzel, Goetz, Pekrun, & Watt, 2010). Early experiences can engage students not only in developing the necessary competencies, but in introducing them into inquiry-based mindsets where curiosity and discovery are essential. Second, childhood and early adolescence are critical times for the formation and maintenance of stereotypes about who enacts science and mathematics, and what is involved in science and mathematics (Andre et al., 1999; Frenzel et al., 2010). Interventions at this point can thus play roles not only in *changing* cultural stereotypes about STEM, but in *forming* more gender-equal beliefs in the first place.

As individuals move into late adolescence and early adulthood, other considerations about career paths become relevant. Certainly, interest in the work itself continues to be extremely important. In addition, however, concerns about the feasibility of career paths become more prominent. Students consider whether a particular career path would serve to fulfill their important goals, including family and lifestyle choices (Weisgram et al., 2010). The emerging adulthood years thus include a blend of *actual* experience in roles (college courses, first jobs) as well as *anticipated* experience in roles (e.g., ability of lab scientists to pursue communal goals; ability of engineers to have fulfilling family lives). Stereotypes about STEM careers and practitioners can thus be distinctly important at this point, as individuals form, change, and maintain their goals and beliefs about how to meet those goals.

As adults initiate careers, the actual experience of pursuing and fulfilling, or failing to fulfill, valued goals is primary. Although stereotypic expectations may play less of a role alongside actual experience, they do not become unimportant. Instead, perceptions and construals of roles continue to be important as filters for experience. Moreover, any decision about whether to stay or leave an occupational role is made with a comparison to a different role, and these comparisons must in part be based on expectations about the future, rather than lived experience in that role. Experience and expectations about fulfilling communal goals are thus likely to be important throughout the career trajectory.

What Is STEM? Inclusion of People-Oriented Activities and Purposes

The most basic implication of the communal goal perspective is that perceiving STEM roles as affording opportunities to work with and help others elicits greater positivity, especially among communally oriented individuals (Diekman et al., 2011). At different points in the career trajectory, then, a simple step may be for STEM professionals and educators to emphasize the ways in which their fields involve working with or helping others. We expect that emphasis on these communal goal pursuits will be notably effective in enhancing the subjective task value accorded to STEM pursuits. When it is clear how the activity involves others and benefits others, then enjoyment, importance, and utility of the task will be increased. Such subjective task value has repeatedly been shown to enhance interest in and persistence in achievement-related tasks (Chow et al., 2012; Hulleman, Durik, Schweigert, & Harackiewicz, 2008).

An important but difficult question is whether STEM activities and fields actually do afford these communal opportunities to work with others or help others. Our research shows clear perceptions that STEM careers are considered less likely than other fields to involve communal pursuits (e.g., Diekman et al., 2010), but the accuracy of these perceptions has not been determined. As with any generalization, even a relatively accurate estimate of the group average may be quite inaccurate when applied to a particular situation. Although understanding the extent to which STEM fields on average actually afford communal goals is an important task requiring systematic study, what is clear now is that many STEM fields or local contexts *can* and *do* afford opportunities to work with or help others. Disciplines such as engineering or chemistry regularly rely on design teams or laboratory groups, and the end goal of much research is to provide benefits to society. However, these more distal outcomes may be dismissed as "applied" research, and often the end results of basic research are not covered in introductory science or mathematics classes (e.g., Seymour & Hewitt, 2000). Emphasizing these communal outcomes and activities might thus be a feasible way to increase engagement and persistence in STEM for a broader range of people.

Engaging with science and mathematics: curricular and co-curricular opportunities. Outreach to girls throughout the primary and secondary school years can take the form of emphasizing the communal aspects of STEM work. For example, high school science and mathematics experiences that involve group projects, mentoring, and volunteering are associated with beliefs that STEM occupations are more likely to afford communal goals. Indeed, these communal experiences in science and math were associated with greater positivity toward STEM pursuits, independent of quantity of science/mathematics experience (Steinberg & Diekman, in review). These experiences can be incorporated into shorter, standalone intervention programs or can be incorporated throughout the curriculum. For example, many one day intervention programs are conducted across the country to bring girls together with the aim of increasing interest in STEM (e.g., Weisgram & Bigler, 2006a, 2007). These programs often include presentations by female scientists and a hands-on component where girls engage with science materials and concepts. These programs could specifically emphasize the need for teamwork and collaboration in working with the materials and completing the project. Within science curricula, teachers could emphasize the collaborative nature of lab research, collaborate with scientists or university STEM students to serve as mentors, or use their science skills to solve an applied problem in their community where students can see an immediate impact. Curricular, co-curricular, and extracurricular efforts that incorporate communal pursuits along with the topic of study are likely to be especially effective.

Existing evidence suggests that highlighting the communal aspects of STEM careers is a promising route for effective intervention. For example, middle school girls who engaged in engineering activities that emphasized integration of communal goals showed increases in enrollment in subsequent activities, as well as increased post-program perceptions of engineers as involved with communal goals (Colvin, Lyden, & León de la Barra, 2013). In addition, female high school students who viewed a video showing engineers working to improve water quality showed increased beliefs that engineering was communal, and in turn increased their positivity toward engaging in engineering projects in the future (Steinberg & Diekman, in review). Interventions that emphasize collaboration among participants or between participants and mentors have positively influenced girls' interest in STEM careers (Paris, Yambor, & Packard, 1998; Tyler-Wood, Ellison, Lim, & Periathiruvadi, 2012).

A promising avenue to integrate communal activities and purposes with the curriculum is to adopt service-learning frameworks. By integrating a service component in which students are able to help the community through applying what they are learning in their courses, students directly experience some of the ways in which STEM can be used to benefit others. For example, a middle-school science program included an after-school service component where students learned about environmental impact on their city, tested for pollution in the air and water, and developed an environmental awareness campaign and newsletter for their community; such an intervention can also have a positive effect on the community (e.g., Hammrich, 1998). Service learning courses may be especially effective at altering the perceived communal goal affordances of the STEM fields. In some of our research (Belanger, Diekman, & Steinberg, in review), we have found that engineering courses described as including a service learning component are expected to fulfill more communal goals than traditional engineering courses. The more people expect the service learning engineering course to fulfill communal goals, the more interested they are in taking the course. Courses described as service learning also have other benefits. Students anticipate a higher sense of belonging in the service learning course and expect the service learning course to better prepare them for future courses in engineering than the traditional course. Importantly, however, service learning courses are not expected to be any easier than traditional courses. Emphasizing communal goals does not appear to "dumb down" STEM instruction but instead enriches it.

In addition, communally oriented undergraduate and graduate students in STEM might particularly benefit from programs that encourage forming relationships with peers and mentors. These groups can help to fulfill the communal needs of these individuals, even as they also serve academic needs of providing coursework help and major or professional advising. For example, Cantor (1994) found that academic study groups can serve different needs for different people; for communally oriented individuals, such groups might offer a valuable opportunity to work closely with others.

Career persistence. As noted above, men with STEM degrees are more likely to work in a STEM occupation than women with STEM degrees (Beede et al., 2011). Women with STEM degrees tend to cluster disproportionately in health care or education, which are both fields that are broadly perceived as consistent with communal goal pursuits. What then might those in STEM careers do to increase the clarity and prominence of their communal aspects? One answer comes from a large body of work demonstrating the benefits of prosocial job features. Grant (2007, 2012) posits that the *relational architecture* of jobs is central to worker engagement, satisfaction, and performance. Across a wide range of evidence, Grant and colleagues show that closer contact with beneficiaries of help fosters various positive outcomes. For instance, phone bank callers soliciting scholarship donations who had a 5-minute meeting with a scholarship recipient showed increased task persistence and job performance over a month, compared to control groups who received a letter from the beneficiary or had no contact (Grant et al., 2007). Given that STEM fields are perceived as lacking in benefitting others, the gains from direct contact with beneficiaries are likely to be even larger than in non-STEM fields; for example, mentoring or volunteer activities can allow STEM workers to see direct benefits of their efforts, which may be crucial given that basic research or long-term projects might not yield benefits for extended periods of time.

Advancement in STEM. One of the key questions in understanding gender gaps in leadership generally is whether the skills and activities of women are valued as much as those of men in a leadership context (Eagly & Karau, 2002; Heilman, 1983). From the goal congruity perspective, the potential devaluation of communal activities in particular deserves attention. As we have detailed, one route to greater engagement and persistence in STEM careers is to include activities that afford opportunities to work with or help others. However, a pivotal question, especially with regard to the advancement of women to STEM leadership, is whether these communal activities are regarded as integral to the work of STEM, or instead are seen as distractions from "real" work. For example, a communally oriented scientist might find great value in volunteering in the community; explaining science to a broad audience might fulfill the communal goals of directly interacting with others or serve as a reminder of the broad community of knowledge or altruistic outcomes of basic research. However, this same activity might plausibly be regarded as extra work that takes time and energy away from laboratory work, data analysis, or scientific writing. From a policy perspective, one step would be for department chairs or managers to identify what activities might fulfill communal goals while at the same time provide value for the individual's professional development as well as for the organizational unit. Within an academic context, for example, a wide range of research, teaching, or service duties might provide fulfillment of communal goals while contributing to departmental and university functioning.

In recommending that STEM organizations develop programs that recognize communal goal pursuits as important to persistence in STEM, we also encourage such organizations to be aware of the subtle and overt devaluing of communal activities. Leadership in STEM organizations thus should be proactive in clarifying the value accorded to these activities.

Who Is in STEM? Highlighting Communally Oriented Role Models

Another cue to the goals afforded by STEM work comes from observations of *who* does such work. Many programs have female scientists speak about their careers (e.g., Weisgram & Bigler, 2006a), serve as mentors to girls and women (Holmes, Redmond, Thomas, & High, 2012), and lead girls in hands-on activities (Tyler-Wood et al., 2012). The presence of female role models can be important for STEM interests of girls and women, particularly in helping female students identify with STEM domains (Stout, Dasgupta, Hunsinger, & McManus, 2011), or reduce stereotype threat (Marx & Roman, 2002). Seeing numerous female scientists can also create a new social norm that girls and women use to judge whether a particular occupational role is possible and desirable for them, and such role models are generally important in shaping career interests. In their study of college major decisions, Seymour and Hewitt (2000) found that female STEM students were especially likely to mention personal connections or relationships with professors and teaching assistants as important in sustaining their confidence and interest.

To the extent that role models convey information about communal aspects, they can play an important role in eliciting interest. In a study by Weisgram and Bigler (2006a), female scientists were asked to talk about their careers and to include information in their presentation about how their career helps people. Girls who internalized the message by increasing their belief in the altruistic value of science from pretest to posttest also increased in their interest in science. Likewise, interventions including role models might be adapted from the experimental procedures of Diekman et al. (2011) Experiment 3, in which the collaborative activities of a scientist yielded positivity toward pursuing a career in science. Asking scientists to discuss the communal aspects of their day could serve to increase girls' and women's interest in STEM by increasing the congruity between the goals afforded by the job as conveyed by the scientists and the goals endorsed by the girls themselves.

Role models in STEM can also communicate about their pursuit of communal goals outside of the STEM professional role. Role models who provide an example of pursuing both professional goals and family goals can thus show that communal goal fulfillment in family roles can co-occur with STEM pursuits. Certainly, the extent to which communal goals can be successfully fulfilled depends in large part on the organizational structures and resources in place to support these goals (e.g., flexible work policies; high-quality child care).

Communal affordances in STEM can also be indirectly cued by features of the role model, even in the absence of direct communication by the role model. For example, Clark and Diekman (in review) found that female scientists were not more likely than male scientists to cue communal goal affordances in their work; however, female scientists who were prototypic of their gender were successful in cueing communal goals. Thus, receiving information that a woman in STEM is typical of her gender can lead communally oriented people to see that STEM can afford communal goals. An important implication of this research is that male STEM educators too can signal communal goal affordances, to the extent that they communicate that their work involves working with or helping others. We thus recommend that both male and female STEM educators consider highlighting the communal aspects of their own activities and those of the broader field;

such information about communal goal pursuits might be extremely valuable in capturing and retaining the interest of communally oriented students.

The focus on communal goal affordances brought by this theoretical framework might help to resolve some inconsistences in previous research, where presenting female STEM practitioners has shown mixed results in increasing girls' and women's STEM attitudes. For example, Hazari, Sonnert, Sadler, and Shanahan (2010) found that inclusion of female scientist guest speakers or discussion of research by female scientists did not predict the development of physics identity among high school girls. In addition, some experimental research that has varied the sex of the role model finds similar effects for male and female STEM practitioners (Cheryan, Siy, Vichayapai, Drury, & Kim, 2011; Clark and Diekman, in review). A key factor in producing these mixed results may be that role model sex provides at best an ambiguous cue as to whether the work involves communal goal opportunities. That is, information that a STEM practitioner's occupation involves working with or helping others might be more useful in elevating interest than mere knowledge of his or her sex.

This implication—that male as well as female STEM workers can communicate effectively about communal goal affordances—is important because solely relying on female STEM role models may be somewhat limited in terms of widespread effectiveness in elevating interest in STEM. A practical challenge is that because women are a minority in STEM professions, there are fewer women available to serve in these modeling roles. Moreover, the scarcity of women in STEM leads to difficulty in changing broad stereotypes. When individuals encounter counterstereotypic exemplars, the basic level stereotype remains intact and a new subordinate stereotype is formed including, and therefore isolating, the counterstereotypic exemplars (Hewstone, Macrae, Griffiths, Milne, & Brown, 1994). Thus, because women in STEM are relatively rare, female STEM practitioners may be subtyped as a distinct category, leaving the original stereotypes of scientists and of women intact. As a consequence, even the presence of female STEM workers may not lead girls to identify with the role models (Betz & Sekaquaptewa, 2012; Buck, Clark, Leslie-Pelecky, Lu, & Cerda-Lizarraga, 2008). Consistent with this subtyping explanation are the findings that directly providing information about a female scientist's female-prototypicality led to greater effectiveness of the role model in cueing communal goal affordances and increasing positivity toward science (Clark and Diekman, in review).

An additional moderator of what role models are most appropriate at the right time is the student's developmental phase. In particular, the presence of same-sex role models in STEM might be distinctly important for girls. Research indicates that children are more likely to imitate same-sex models than other-sex models (Grace, David, & Ryan, 2008) and that male and female role models provide information to children about appropriate behaviors for each gender (Bussey & Bandura, 1999). As students mature, they may become more concerned with other aspects communicated by the role model, such as what the work itself involves, whether the role model encounters discrimination, or whether the role model can have a family life.

However, it is likely that at any age, felt similarity to the role model is likely to be critically important. A primary challenge to relying on female scientists as the primary intervention strategy that girls may not identify with counterstereotypical role models, including female scientists within the intervention program (Bigler & Weisgram, 2005). To the extent that scientists can communicate similarity, they are more likely to be effective. In fact, girls rate female scientists who are similar to themselves as more helpful at teaching about STEM than scientists that are dissimilar (C. S. Brown, Weisgram, & Bigler, 2003). Models who girls feel are similar have also more effectively increased STEM interest than models who girls feel are dissimilar (Bigler & Weisgram, 2005). One suggestion for intervention programs is to employ female scientists who are diverse across a number of different characteristics to increase the likelihood that each of the participants would identify with one of the models. Integrating a diverse range of role models will take advantage of the different aspects of role models that have been shown to be important in different theoretical traditions (Clark, Diekman, & Belanger, in preparation).

Looking Forward: Challenges and Conclusions

Based on the evidence reviewed here, highlighting the ways in which STEM fields include communal goal pursuits provides a unique and promising route to increasing participation in these fields, particularly among girls and women. However, we certainly do not want to give the impression that achieving communal goal congruity throughout organizations will be an easy change. To provide substantial and lasting changes in the recruitment and retention of women, the emphasis on communal pursuits cannot merely take the form of advertising; STEM departments and organizations cannot simply claim to be communally focused and expect to retain communally oriented individuals. Instead, STEM organizational units must offer and reward communal pursuits. Otherwise, individuals may choose to enter STEM pathways on the basis of recruitment techniques, but soon realize that their goals are not valued, and thus opt for other pathways. To achieve this valuing of communal activities throughout the STEM pipeline, it is important for organizational units to reward communal activities so that there will be people who are willing to engage in such actions such as serve as role models and enact programs such as service-learning courses, which likely are regarded as "extra" work currently. However, recursive processes may play an important role in lasting change: As more women (and communally oriented men) enter STEM, more individuals should be motivated to engage in these actions and positively regard them in others.

Although we have argued throughout this review that STEM fields can and do offer opportunities for communal goal fulfillment, there is also reason to suspect that there may be strong opposition to increasing or highlighting these opportunities. The individuals who have succeeded in STEM fields have navigated the challenges of those fields by a particular set of standards, and thus they might be invested in the current standards and expectations. For example, Murphy, Steele, and Garcia (in review) found that the increasing representation of women in STEM led to greater social identity threat among men—a group typically thought to be invulnerable to such identity threats.

Finally, it should be noted that the burden of providing opportunities for communal goal pursuits should not be borne solely by the individual, but instead should be borne by the organization. Certainly, some individual-level strategies to increase communal goal fulfillment might be enacted to provide greater engagement in and enjoyment of one's work. However, policy decisions can also help to create social structures that afford communal goal pursuits and reward such pursuits. Activities such as mentoring or volunteering are often viewed as separate from or even detracting from the "real work" of STEM, but these types of activities may be crucial for creating and maintaining long-term engagement in one's work.

Given the importance of increasing the quality and quantity of the STEM workforce, effective interventions to recruit and retain highly qualified women are imperative. The goal congruity model points to new directions for effective interventions. In short, providing girls and women with additional training or skill building may not be sufficient to increase their decisions to enter and stay in a STEM career. However, clarifying the ways in which STEM fields include working with and helping others may help to open the doors of these fields to more people.

References

Abele, A. E., & Bruckmüller, S. (2011). The bigger one of the "Big Two"? Preferential processing of communal information. *Journal of Experimental Social Psychology*, *47*(5), 935–948. doi:10.1016/j.jesp.2011.03.028

Abele, A. E., & Wojciszke, B. (2007). Agency and communion from the perspective of self versus others. *Journal of Personality and Social Psychology*, *93*, 751–763. doi:10.1037/0022-3514.93.5.751

Agars, M. D. (2004). Reconsidering the impact of gender stereotypes on the advancement of women in organizations. *Psychology of Women Quarterly*, *28*, 103–111.

Alexander, J. M., Johnson, K. E., & Kelley, K. (2012). Longitudinal analysis of the relations between opportunities to learn about science and the development of interests related to science. *Science Education*, *96*(5), 763–786. doi:10.1002/sce.21018

Andre, T., Whigham, M., Hendrickson, A., & Chambers, S. (1999). Competency beliefs, positive affect, and gender stereotypes of elementary students and their parents about science versus other school subjects. *Journal of Research in Science Teaching*, *36*(6), 719–747. doi:10.1002/(SICI)1098-2736(199908)36:6<719::AID-TEA8>3.0.CO;2-R

Bailyn, L. (2003). Academic careers and gender equity: Lessons learned from MIT. *Gender, Work & Organization*, *10*, 137–153.

Bakan, D. (1966). *The duality of human existence: An essay on psychology and religion*. Chicago, IL: Rand McNally.

Baumeister, R. F., & Leary, M. R. (1995). The need to belong: Desire for interpersonal attachments as a fundamental human motivation. *Psychological Bulletin*, *117*, 497–529.

Beede, D., Julian, T., Langdon, D., McKittrick, G., Khan, B., & Doms, M. (2011). *Women in STEM: A gender gap to innovation* (ESA Issue Brief No. #04–11). U.S. Department of Commerce, Economics and Statistics Administration. (Downloaded from http://www.esa.doc.gov/sites/default/files/reports/documents/womeninstemagaptoinnovation8311.pdf, accessed February 21, 2012)

Beilock, S. L., Gunderson, E. A., Ramirez, G., & Levine, S. C. (2010). Female teachers' math anxiety affects girls' math achievement. *Proceedings of the National Academy of Sciences*, *107*(5), 1860–1863. doi:10.1073/pnas.0910967107

Belanger, A., Diekman, A. B., & Steinberg, M. (in review). Leveraging communal experiences in the curriculum: Increasing positivity toward engineering by changing stereotypic expectations.

Benbow, C. P. (2012). Identifying and nurturing future innovators in science, technology, engineering, and mathematics: A review of findings from the study of mathematically precocious youth. *Peabody Journal of Education*, *87*(1), 16–25. doi:10.1080/0161956X.2012.642236

Benbow, C. P., Lubinski, D., Shea, D. L., & Eftekhari-Sanjani, H. (2000). Sex differences in mathematical reasoning ability at age 13: Their status 20 years later. *Psychological Science*, *11*, 474–480.

Betz, D. E., & Sekaquaptewa, D. (2012). My fair physicist? Feminine math and science role models demotivate young girls. *Social Psychological and Personality Science*, *3*. doi:10.1177/1948550612440735.

Bigler, R. S. (1999). Psychological interventions designed to counter sexism in children: Empirical limitations and theoretical foundations. In W. B. Swann Jr., J. H. Langlois, & L. A. Gilbert (Eds.), *Sexism and stereotypes in modern society: The gender science of Janet Taylor Spence* (pp. 129–151). Washington, DC: American Psychological Association.

Bigler, R. S., & Weisgram, E. S. (2005). Striking similarity: Model femininity and girls' interest in scientific fields. *Presented at the 113th Annual Convention of the American Psychological Association*, Washington, DC.

Bleeker, M. M., & Jacobs, J. E. (2004). Achievement in math and science: Do mothers' beliefs matter 12 years later? *Journal of Educational Psychology*, *96*(1), 97–109.

Brown, C. S., Weisgram, E. S., & Bigler, R. S. (2003). How counterstereotypic models impact girls' interest in math and science. Presented at the 111th annual convention of the American Psychological Association, Toronto, Ontario.

Brown, E. R., Thoman, D. B., Smith, J. L., & Diekman, A. B. (in review). *Closing the communal goal gap: The Importance of Communal Affordances in Science Career Motivation*.

Buck, G. A., Clark, V. L. P., Leslie-Pelecky, D., Lu, Y., & Cerda-Lizarraga, P. (2008). Examining the cognitive processes used by adolescent girls and women scientists in identifying science role models: A feminist approach. *Science Education*, *92*, 688–707. doi:10.1002/sce.20257

Business Europe. (2011). *Plugging the skills gap—The clock is ticking*. Brussels, Belgium: Business Europe (Downloaded from http://www.businesseurope.eu/Content/Default.asp?pageid=568&docid=28659, accessed June 24, 2013).

Bussey, K., & Bandura, A. (1999). Social cognitive theory of gender development and differentiation. *Psychological Review*, *106*, 676–713. doi:10.1037/0033-295X.106.4.676

Cantor, N. (1994). Life task problem solving: Situational affordances and personal needs. *Personality and Social Psychology Bulletin*, *20*, 235–243.

Ceci, S. J., Williams, W. M., & Barnett, S. M. (2009). Women's underrepresentation in science: Sociocultural and biological considerations. *Psychological Bulletin*, *135*, 218–261.

Cejka, M. A., & Eagly, A. H. (1999). Gender-stereotypic images of occupations correspond to the sex segregation of employment. *Personality and Social Psychology Bulletin*, *25*, 413–423.

Chambers, D. W. (1983). Stereotypic images of the scientist: The draw-a-scientist test. *Science Education*, *67*(2), 255–265. doi:10.1002/sce.3730670213

Chen, X., & Weko, T. (2009). *Students who study science, technology, engineering, and mathematics (STEM) in postsecondary education*. U.S. Department of Education, National Center for Education Statistics.

Cheryan, S. (2011). Understanding the paradox in math-related fields: Why do some gender gaps remain while others do not? *Sex Roles*, *66*. doi:10.1007/s11199-011-0060-z.

Cheryan, S., Siy, J. O., Vichayapai, M., Drury, B. J., & Kim, S. (2011). Do female and male role models who embody STEM stereotypes hinder women's anticipated success in STEM? *Social Psychological and Personality Science*, *2*(6), 656–664. doi:10.1177/1948550611405218

Chow, A., Eccles, J. S., & Salmela-Aro, K. (2012). Task value profiles across subjects and aspirations to physical and IT-related sciences in the United States and Finland. *Developmental Psychology*, *48*(6), 1612–1628. doi:10.1037/a0030194

Clark, E. K., & Diekman, A. B. (in review). Signaling communal goals: Female-prototypic role models elicit positivity toward science.

Clark, E. K., Diekman, A. B., & Belanger, A. L. (in preparation). Social-psychological interventions to cultivate women's STEM interest.

Colvin, W., Lyden, S., & León de la Barra, B. (2013). Attracting girls to civil engineering through hands-on activities that reveal the communal goals and values of the profession. *Leadership and Management in Engineering*, *13*(1), 35–41. doi:10.1061/(ASCE)LM.1943-5630.0000208

Costa, P. T., Terracciano, A., & McCrae, R. R. (2001). Gender differences in personality traits across cultures: Robust and surprising findings. *Journal of Personality and Social Psychology*, *81*, 322–331.

Crowley, K., Callanan, M. A., Tenenbaum, H. R., & Allen, E. (2001). Parents explain more often to boys than to girls during shared scientific thinking. *Psychological Science*, *12*, 258–261.

Cvencek, D., Meltzoff, A. N., & Greenwald, A. G. (2011). Math–gender stereotypes in elementary school children. *Child Development*, *82*(3), 766–779. doi:10.1111/j.1467-8624.2010.01529.x

Cvencek, D., Meltzoff, A. N., & Kapur, M. (2014). Cognitive consistency and math–gender stereotypes in Singaporean children. *Journal of Experimental Child Psychology*, *117*, 73–91. doi:10.1016/j.jecp.2013.07.018

Davies, P. G., Spencer, S. J., Quinn, D. M., & Gerhardstein, R. (2002). Consuming images: How television commercials that elicit stereotype threat can restrain women academically and professionally. *Personality and Social Psychology Bulletin*, *28*, 1615–1628.

Diekman, A. B. (2007). Negotiating the double bind: Interpersonal and instrumental evaluations of dominance. *Sex Roles*, *22*, 551–561. doi:10.1007/s11199-007-9198-0

Diekman, A. B., Brown, E. R., Johnston, A. M., & Clark, E. K. (2010). Seeking congruity between goals and roles: A new look at why women opt out of science, technology, engineering, and mathematics careers. *Psychological Science*, *21*, 1051–1057.

Diekman, A. B., Clark, E. K., Johnston, A. M., Brown, E. R., & Steinberg, M. (2011). Malleability in communal goals and beliefs influences attraction to STEM careers. *Journal of Personality and Social Psychology*, *101*, 902–918.

Diekman, A. B., & Eagly, A. H. (2008). Of men, women, and motivation: A role congruity account. In J. Y. Shah & W. L. Gardner (Eds.), *Handbook of motivation science* (pp. 434–447). New York: Guilford.

Diekman, A. B., & Goodfriend, W. (2006). Rolling with the changes: A role congruity perspective on gender norms. *Psychology of Women Quarterly*, *30*, 369–383. doi:10.1111/j.1471-6402.2006.00312.x

Diekman, A. B., & Steinberg, M. (2013). Navigating social roles in pursuit of important goals: A communal goal congruity account of STEM pursuits. *Social and Personality Psychology Compass*, *7*, 487–501. doi:10.1111/spc3.12042

Eagly, A. H. (1987). *Sex differences in social behavior: A social-role interpretation*. Hillsdale, NJ: Erlbaum.

Eagly, A. H., & Carli, L. L. (2007). *Through the Labyrinth: The truth about how women become leaders*. Boston, MA: Harvard Business Press.

Eagly, A. H., & Diekman, A. B. (2003). The malleability of sex differences in response to changing social roles. In L. G. Aspinwall & U. M. Staudinger (Eds.), *A psychology of human strengths* (pp. 103–115). Washington, DC: American Psychological Association.

Eagly, A. H., & Karau, S. J. (2002). Role congruity theory of prejudice toward female leaders. *Psychological Review*, *109*, 573–598. doi:10.1037/0033-295X.109.3.573

Eagly, A. H., & Wood, W. (2011). Social role theory. In P. A. M. Van Lange, A. W. Kruglanski, & E. T. Higgins (Eds.), *Handbook of theories in social psychology* (Vol. *2*, pp. 458–476). London: Sage.

Eagly, A. H., Wood, W., & Diekman, A. B. (2000). Social role theory of sex differences and similarities: A current appraisal. In T. Eckes & H. M. Trautner (Eds.), *The developmental social psychology of gender* (pp. 123–174). Mahwah, NJ: Erlbaum.

Eccles, J. S. (1994). Understanding women's educational and occupational choices: Applying the Eccles et al. model of achievement-related choices. *Psychology of Women Quarterly*, *18*, 585–609. doi:10.1111/j.1471-6402.1994.tb01049.x

Eccles, J. S. (2009). Who am I and what am I going to do with my life? Personal and collective identities as motivators of action. *Educational Psychologist*, *44*(2), 78–89. doi:10.1080/00461520902832368

Ecklund, E. H., & Lincoln, A. E. (2011). Scientists want more children. *PLoS ONE*, *6*(8), e22590. doi:10.1371/journal.pone.0022590

Evans, C. D., & Diekman, A. B. (2009). On motivated role selection: Gender beliefs, distant goals, and career preferences. *Psychology of Women Quarterly*, *33*, 235–249.

Feingold, A. (1994). Gender differences in personality: A meta-analysis. *Psychological Bulletin*, *116*, 429–456.

Ferriman, K., Lubinski, D., & Benbow, C. P. (2009). Work preferences, life values, and personal views of top math/science graduate students and the profoundly gifted: Developmental changes and gender differences during emerging adulthood and parenthood. *Journal of Personality and Social Psychology*, *97*(3), 517–532. doi:10.1037/a0016030

Finson, K. D. (2002). Drawing a scientist: What we do and do not know after fifty years of drawings. *School Science and Mathematics*, *102*(7), 335–345. doi:10.1111/j.1949-8594.2002.tb18217.x

Fiske, S. T. (2004). *Social beings: A core motives approach to social psychology*. Hoboken, NJ: Wiley.

Fiske, S. T., Cuddy, A. J. C., & Glick, P. (2007). Universal dimensions of social cognition: Warmth and competence. *Trends in Cognitive Sciences*, *11*(2), 77–83. doi:10.1016/j.tics.2006.11.005

Frenzel, A. C., Goetz, T., Pekrun, R., & Watt, H. M. G. (2010). Development of mathematics interest in adolescence: Influences of gender, family, and school context. *Journal of Research on Adolescence*, *20*(2), 507–537. doi:10.1111/j.1532-7795.2010.00645.x

Frome, P. M., Alfeld, C. J., Eccles, J. S., & Barber, B. L. (2008). Is the desire for a family-flexible job keeping young women out of male-dominated occupations? In *Gender and occupational outcomes: Longitudinal assessments of individual, social, and cultural influences* (pp. 195–214). Washington, DC: American Psychological Association.

Ginther, D. K. (2003). Is MIT an exception? Gender pay differences in academic science. *Bulletin of Science, Technology & Society*, *23*(1), 21–26. doi:10.1177/0270467602239767

Good, C., Rattan, A., & Dweck, C. S. (2012). Why do women opt out? Sense of belonging and women's representation in mathematics. *Journal of Personality and Social Psychology*, *102*, 700–717. doi:10.1037/a0026659

Grace, D. M., David, B. J., & Ryan, M. K. (2008). Investigating preschoolers' categorical thinking about gender through imitation, attention, and the use of self-categories. *Child Development*, *79*(6), 1928–1941. doi:10.1111/j.1467-8624.2008.01234.x

Grant, A. M. (2007). Relational job design and the motivation to make a prosocial difference. *The Academy of Management Review ARCHIVE*, *32*, 393–417.

Grant, A. M. (2012). Leading with meaning: Beneficiary contact, prosocial impact, and the performance effects of transformational leadership. *Academy of Management Journal*, *55*(2), 458–476. doi:10.5465/amj.2010.0588

Grant, A. M., Campbell, E. M., Chen, G., Cottone, K., Lapedis, D., & Lee, K. (2007). Impact and the art of motivation maintenance: The effects of contact with beneficiaries on persistence behavior. *Organizational Behavior and Human Decision Processes*, *103*(1), 53–67. doi:10.1016/j.obhdp.2006.05.004

Greenhaus, J. H., & Powell, G. N. (2006). When work and family are allies: A theory of work-family enrichment. *The Academy of Management Review Archive*, *31*(1), 72–92.

Greenwald, A. G., Poehlman, T. A., Uhlmann, E. L., & Banaji, M. R. (2009). Understanding and using the Implicit Association Test. III. Meta-analysis of predictive validity. *Journal of Personality and Social Psychology*, *97*, 17–41.

Gunderson, E. A., Ramirez, G., Levine, S. C., & Beilock, S. L. (2012). The role of parents and teachers in the development of gender-related math attitudes. *Sex Roles*, *66*(3–4), 153–166. doi:10.1007/s11199-011-9996-2

Halpern, D. F., Benbow, C. P., Geary, D. C., Gur, R. C., Hyde, J. S., & Gernsbache, M. A. (2007). The science of sex differences in science and mathematics. *Psychological Science in the Public Interest*, *8*, 1–51.

Hammrich, P. L. (1998). Sisters in science: An intergenerational science program for elementary school girls. *School Community Journal*, *8*(2), 21–35.

Harackiewicz, J. M., & Hulleman, C. S. (2010). The importance of interest: The role of achievement goals and task values in promoting the development of interest. *Social and Personality Psychology Compass*, *4*(1), 42–52. doi:10.1111/j.1751-9004.2009.00207.x

Haussler, P., & Hoffmann, L. (2002). An intervention study to enhance girls' interest, self-concept, and achievement in physics classes. *Journal of Research in Science Teaching*, *39*, 870–888.

Hazari, Z., Sonnert, G., Sadler, P. M., & Shanahan, M.-C. (2010). Connecting high school physics experiences, outcome expectations, physics identity, and physics career choice: A gender study. *Journal of Research in Science Teaching*, *47*(8), 978–1003. doi:10.1002/tea.20363

Heilman, M. E. (1983). Sex bias in work settings: The lack of fit model. *Research in Organizational Behavior*, *5*, 269–298.

Hewstone, M., Macrae, C. N., Griffiths, R., Milne, A. B., & Brown, R. (1994). Cognitive models of stereotype change. (5) Measurement, development, and consequences of subtyping. *Journal of Experimental Social Psychology*, *30*(6), 505–526. doi:10.1006/jesp.1994.1024

Holleran, S. E., Whitehead, J., Schmader, T., & Mehl, M. R. (2011). Talking shop and shooting the breeze: A study of workplace conversation and job disengagement among STEM faculty. *Social Psychological and Personality Science*, *2*(1), 65–71. doi:10.1177/1948550610379921

Holmes, S., Redmond, A., Thomas, J., & High, K. (2012). Girls helping girls: Assessing the influence of college student mentors in an afterschool engineering program. *Mentoring & Tutoring: Partnership in Learning*, *20*(1), 137–150. doi:10.1080/13611267.2012.645604

Hulleman, C. S., Durik, A. M., Schweigert, S. B., & Harackiewicz, J. M. (2008). Task values, achievement goals, and interest: An integrative analysis. *Journal of Educational Psychology*, *100*(2), 398–416. doi:10.1037/0022-0663.100.2.398

Hulleman, C. S., & Harackiewicz, J. M. (2009). Promoting interest and performance in high school science classes. *Science*, *326*(5958), 1410–1412. doi:10.1126/science.1177067

Hyde, J. S., Fennema, E., & Lamon, S. J. (1990). Gender differences in mathematics performance: A meta-analysis. *Psychological Bulletin*, *107*, 139–155.

Jarvis, T., & Pell, A. (2004). Primary teachers' changing attitudes and cognition during a two-year science in-service programme and their effect on pupils. *International Journal of Science Education*, *26*(14), 1787–1811. doi:10.1080/0950069042000243763

Jayaratne, T. E., Thomas, N. G., & Trautmann, M. (2003). Intervention program to keep girls in the science pipeline: Outcome differences by ethnic status. *Journal of Research in Science Teaching*, *40*(4), 393–414. doi:10.1002/tea.10082

Jolliff, L., Leadley, J., Coakley, E., & Sloane, R. A. (2012). *Women in U.S. academic medicine and science: Statistics and benchmarking report*. Washington, DC: Association of American Medical Colleges.

Jones, G. (1991). Gender differences in science competitions. *Science Education*, *75*(2), 159–167. doi:10.1002/sce.3730750202

Jones, M. G., Howe, A., & Rua, M. J. (2000). Gender differences in students' experiences, interests, and attitudes toward science and scientists. *Science Education*, *84*(2), 180–192. doi:10.1002/(SICI)1098-237X(200003)84:2<180::AID-SCE3>3.0.CO;2-X

Judd, C. M., James-Hawkins, L., Yzerbyt, V., & Kashima, Y. (2005). Fundamental dimensions of social judgment: Understanding the relations between judgments of competence and warmth. *Journal of Personality and Social Psychology*, *89*, 899–913.

Kaminski, D., & Geisler, C. (2012). Survival analysis of faculty retention in science and engineering by gender. *Science*, *335*(6070), 864–866. doi:10.1126/science.1214844

Kenrick, D. T., Griskevicius, V., Neuberg, S. L., & Schaller, M. (2010). Renovating the pyramid of needs: Contemporary extensions built upon ancient foundations. *Perspectives on Psychological Science*, *5*(3), 292–314. doi:10.1177/1745691610369469

Knobloch-Westerwick, S., Glynn, C. J., & Huge, M. (2013). The matilda effect in science communication: An experiment on gender bias in publication quality perceptions and collaboration interest. *Science Communication*, *35*. doi:10.1177/1075547012472684

Konrad, A. M., Ritchie, J. E. J., Lieb, P., & Corrigall, E. (2000). Sex differences and similarities in job attribute preferences: A meta-analysis. *Psychological Bulletin*, *126*, 593–641.

Kopesky, J. W., Veach, P. M., Lian, F., & LeRoy, B. S. (2011). Where are the males? Gender differences in undergraduates' interest in and perceptions of the genetic counseling profession. *Journal of Genetic Counseling*, *20*, 341–354.

Lane, K., Goh, J., & Driver-Linn, E. (2012). Implicit science stereotypes mediate the relationship between gender and academic participation. *Sex Roles*, *66*(3–4), 220–234.

Langdon, D., McKittrick, G., Khan, B., & Doms, M. (2011). *STEM: Good jobs now and for the future*. U.S. Department of Commerce, Economics and Statistics Administration (Downloaded from http://www.esa.doc.gov/sites/default/files/reports/documents/stemfinalyjuly14_1.pdf, accessed May 28, 2013).

Liben, L. S., & Bigler, R. S. (2002). The developmental course of gender differentiation: Conceptualizing, measuring, and evaluating constructs and pathways. *Monographs of the Society for Research in Child Development*, *67*, i–viii, 1–147. doi:10.1111/1540-5834.t01-1-00187

Lindberg, S. M., Hyde, J. S., Petersen, J. L., & Linn, M. C. (2010). New trends in gender and mathematics performance: A meta-analysis. *Psychological Bulletin*, *136*(6), 1123–1135. doi:10.1037/a0021276

Logel, C., Walton, G. M., Spencer, S. J., Iserman, E. C., von Hippel, W., & Bell, A. E. (2009). Interacting with sexist men triggers social identity threat among female engineers. *Journal of Personality and Social Psychology*, *96*(6), 1089–1103. doi:10.1037/a0015703

Martin, C. L., & Ruble, D. (2004). Children's search for gender cues cognitive perspectives on gender development. *Current Directions in Psychological Science*, *13*(2), 67–70. doi:10.1111/j.0963-7214.2004.00276.x

Marx, D. M., & Roman, J. S. (2002). Female Role Models: Protecting Women's Math Test Performance. *Personality and Social Psychology Bulletin*, *28*(9), 1183–1193. doi:10.1177/01461672022812004

Maslow, A. H. (1943). A theory of human motivation. *Psychological Review*, *50*(4), 370–396. doi:10.1037/h0054346

Mason, M. A. (2012, February 13). The next step for female scientists. *The Chronicle of Higher Education* (Downloaded from http://chronicle.com/article/The-Next-Step-for-Female/130717/, accessed June 24, 2013).

Mason, M. A. (2014, March 3). How to level the playing field for women in science. *The Chronicle of Higher Education* (Downloaded from http://chronicle.com/article/How-to-Level-the-Playing-Field/145037/?cid=at&utm_source=at&utm_medium=en, accessed April 8, 2014).

McNeil, L., & Sher, M. (1999). The dual-career-couple problem. *Physics Today*, *52*(7), 32–37. doi:10.1063/1.882719

MIT. (1999). *A study on the status of women faculty in science at MIT*. Cambridge, MA: Massachusetts Institute of Technology (Downloaded from http://web.mit.edu/fnl/women/women.html, accessed June 24, 2013).

Morgan, C., Isaac, J. D., & Sansone, C. (2001). The role of interest in understanding the career choices of female and male college students. *Sex Roles*, *44*, 295–320.

Moss-Racusin, C. A., Dovidio, J. F., Brescoll, V. L., Graham, M. J., & Handelsman, J. (2012). Science faculty's subtle gender biases favor male students. *Proceedings of the National Academy of Sciences*, *109*. doi:10.1073/pnas.1211286109

Murphy, M. C., Steele, C. M., & Garcia, J. A. (in review). *The Fragility of Fit: Cues Affect the Concerns, Belonging, and Performance of Women and Men in STEM Settings*.

Murphy, M. C., Steele, C. M., & Gross, J. J. (2007). Signaling threat: How situational cues affect women in math, science, and engineering settings. *Psychological Science*, *18*(10), 879–885. doi:10.1111/j.1467-9280.2007.01995.x

National Research Council. (2010). *Gender differences at critical transitions in the careers of science, engineering, and mathematics faculty*. Washington, DC: The National Academies Press.

National Science Board. (2012). *Science and engineering indicators 2012*. Arlington, VA: National Science Foundation (NSB 12-01).

Newcombe, N. S., Ambady, N., Eccles, J. S., Gomez, D., Linn, M., Miller, K., & Mix, K. (2009). Psychology's role in mathematics and science education. *American Psychologist*, *64*, 538–550.

Niemeier, D. A., & González, C. (2004). Breaking into the guildmasters' club: What we know about women science and engineering department chairs at AAU universities. *NWSA Journal*, *16*(1), 157–171.

Nosek, B. A., Banaji, M. R., & Greenwald, A. G. (2002). Math = male, me = female, therefore math not = me. *Journal of Personality and Social Psychology*, *83*, 44–59.

Paris, S. G., Yambor, K. M., & Packard, B. W.-L. (1998). Hands-on biology: A museum-school-university partnership for enhancing students' interest and learning in science. *The Elementary School Journal*, *98*(3), 267–288. doi:10.2307/1002260

Pohlmann, K. (2001). Agency- and communion-orientation in life goals: Impacts on goal pursuit strategies and psychological well-being. In P. Schmuck & K. M. Sheldon (Eds.), *Life goals and well-being: Towards a positive psychology of human striving* (pp. 68–84). Seattle, WA: Hogrefe and Huber.

Prentice, D. A., & Carranza, E. (2002). What women should be, shouldn't be, are allowed to be, and don't have to be: The contents of prescriptive gender stereotypes. *Psychology of Women Quarterly*, *26*, 269–281.

Reid, P. T., & Roberts, S. K. (2006). Gaining options: A mathematics program for potentially talented at-risk adolescent girls. *Merrill-Palmer Quarterly*, *52*(2), 288–304. doi:10.1353/mpq.2006.0019

Reuben, E., Sapienza, P., & Zingales, L. (2014). How stereotypes impair women's careers in science. *Proceedings of the National Academy of Sciences*, *111*(12), 4403–4408. doi:10.1073/pnas.1314788111

Riegle-Crumb, C., King, B., Grodsky, E., & Muller, C. (2012). The more things change, the more they stay the same? Prior achievement fails to explain gender inequality in entry into stem college majors over time. *American Educational Research Journal*, *49*(6), 1048–1073. doi:10.3102/0002831211435229

Riegle-Crumb, C., Moore, C., & Ramos-Wada, A. (2011). Who wants to have a career in science or math? Exploring adolescents' future aspirations by gender and race/ethnicity. *Science Education*, *95*(3), 458–476. doi:10.1002/sce.20431

Robertson, K. F., Smeets, S., Lubinski, D., & Benbow, C. P. (2010). Beyond the threshold hypothesis even among the gifted and top math/science graduate students, cognitive abilities, vocational interests, and lifestyle preferences matter for career choice, performance, and persistence. *Current Directions in Psychological Science*, *19*(6), 346–351. doi:10.1177/0963721410391442

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist*, *55*, 68–78.

Rydell, R. J., Shiffrin, R. M., Boucher, K. L., Loo, K. V., & Rydell, M. T. (2010). Stereotype threat prevents perceptual learning. *Proceedings of the National Academy of Sciences*, *107*(32), 14042–14047. doi:10.1073/pnas.1002815107

Sadler, P. M., Sonnert, G., Hazari, Z., & Tai, R. (2012). Stability and volatility of STEM career interest in high school: A gender study. *Science Education*, *96*(3), 411–427. doi:10.1002/sce.21007

Sansone, C., & Harackiewicz, J. M. (2000). *Intrinsic and extrinsic motivation: The search for optimal motivation and performance*. San Diego, CA: Academic Press.

Schmader, T., Johns, M., & Forbes, C. (2008). An integrated process model of stereotype threat effects on performance. *Psychological Review*, *115*(2), 336–356. doi:10.1037/0033-295X.115.2.336

Seymour, E., & Hewitt, N. M. (2000). *Talking about leaving: Why undergraduates leave the sciences*. Boulder, CO: Westview Press.

Sharp, L., Carey, N., Frechtling, J. A., Burgdorf, K., & Westat Inc. (1994). *Short-term impact study of the National Science Foundation's Young Scholars Program*. Washington, DC: National

Science Foundation, Directorate for Education and Human Resources (Downloaded from http://nsf.gov/pubs/1996/nsf9551/nsf9551.pdf, accessed June 17, 2013).

Signorella, M. L., Bigler, R. S., & Liben, L. S. (1993). Developmental differences in children's gender schemata about others: A meta-analytic review. *Developmental Review*, *13*(2), 147–183. doi:10.1006/drev.1993.1007

Spelke, E. S. (2005). Sex differences in intrinsic aptitude for mathematics and science? A critical review. *American Psychologist*, *60*, 950–958.

Spencer, S. J., Steele, C. M., & Quinn, D. M. (1999). Stereotype threat and women's math performance. *Journal of Experimental Social Psychology*, *35*(1), 4–28. doi:10.1006/jesp.1998.1373

Stake, J. E., & Mares, K. R. (2001). Science enrichment programs for gifted high school girls and boys: Predictors of program impact on science confidence and motivation*. *Journal of Research in Science Teaching*, *38*(10), 1065–1088. doi:10.1002/tea.10001

Stake, J. E., & Mares, K. R. (2005). Evaluating the impact of science-enrichment programs on adolescents' science motivation and confidence: The splashdown effect. *Journal of Research in Science Teaching*, *42*(4), 359–375. doi:10.1002/tea.20052

Steele, C. M., & Aronson, J. (1995). Stereotype threat and the intellectual test performance of African Americans. *Journal of Personality and Social Psychology*, *69*(5), 797–811. doi:10.1037/0022-3514.69.5.797

Steele, C. M., Spencer, S. J., & Aronson, J. (2002). Contending with group image: The psychology of stereotype and social identity threat. *Advances in Experimental Social Psychology*, *34*, 379–440.

Steele, J. (2003). Children's gender stereotypes about Math: The role of stereotype stratification. *Journal of Applied Social Psychology*, *33*(12), 2587–2606. doi:10.1111/j.1559-1816.2003.tb02782.x

Steinberg, M., & Diekman, A. B. (in review). Working together to increase STEM interest: Communal experience predicts STEM positivity.

Steinberg, M., & Diekman, A. B. (2013). *Increasing interest in STEM among high school students: A test of the goal congruity model. Poster presented at the annual meeting of the Society for Personality and Social Psychology*, New Orleans, LA.

Stout, J. G., Dasgupta, N., Hunsinger, M., & McManus, M. A. (2011). STEMing the tide: Using in-group experts to inoculate women's self-concept in science, technology, engineering, and mathematics (STEM). *Journal of Personality and Social Psychology*, *100*(2), 255–270. doi:10.1037/a0021385

ten Brummelhuis, L. L., & Bakker, A. B. (2012). A resource perspective on the work–home interface: The work-home resources model. *American Psychologist*, *67*. doi:10.1037/a0027974

Thomas, M. D., Henley, T. B., & Snell, C. M. (2006). The draw a scientist test: A different population and a somewhat different story. *College Student Journal*, *40*(1), 140–148.

Tomasetto, C., Alparone, F. R., & Cadinu, M. (2011). Girls' math performance under stereotype threat: The moderating role of mothers' gender stereotypes. *Developmental Psychology*, *47*(4), 943–949.

Twenge, J. M. (1997). Changes in masculine and feminine traits over time: A meta-analysis. *Sex Roles*, *36*, 305–325.

Tyler-Wood, T., Ellison, A., Lim, O., & Periathiruvadi, S. (2012). Bringing up girls in science (BUGS): The effectiveness of an afterschool environmental science program for increasing female students' interest in science careers. *Journal of Science*, *21*, 46–55.

U.S. Congress Joint Economic Committee. (2012). *STEM education: Preparing for the jobs of the future*. Washington, DC.

U.S. Department of Labor. (2013). *Labor force statistics from the current population survey. Bureau of Labor Statistics database (Table 11)* (Downloaded from http://www.bls.gov/cps/cpsaat11.pdf, accessed June 25, 2013).

Walton, G. M., & Cohen, G. L. (2007). A question of belonging: Race, social fit, and achievement. *Journal of Personality and Social Psychology*, *92*(1), 82–96. doi:10.1037/0022-3514.92.1.82

Walton, G. M., Cohen, G. L., Cwir, D., & Spencer, S. J. (2012). Mere belonging: The power of social connections. *Journal of Personality and Social Psychology*, *102*(3), 513–532. doi:10.1037/a0025731

Wang, M.-T., Eccles, J. S., & Kenny, S. (2013). Not lack of ability but more choice individual and gender differences in choice of careers in science, technology, engineering, and mathematics. *Psychological Science*, *24*(5), 770–775. doi:10.1177/0956797612458937

Watt, H. M. G., Shapka, J. D., Morris, Z. A., Durik, A. M., Keating, D. P., & Eccles, J. S. (2012). Gendered motivational processes affecting high school mathematics participation, educational aspirations, and career plans: A comparison of samples from Australia, Canada, and the United States. *Developmental Psychology*, *48*(6), 1594–1611. doi:10.1037/a0027838

Weisgram, E. S., & Bigler, R. S. (2006a). Girls and science careers: The role of altruistic values and attitudes about scientific tasks. *Journal of Applied Developmental Psychology*, *27*, 326–348.

Weisgram, E. S., & Bigler, R. S. (2006b). The role of attitudes and intervention in high school girls' interest in computer science. *Journal of Women and Minorities in Science and Engineering*, *12*, 325–336. doi:10.1615/JWomenMinorScienEng.v12.i4.40

Weisgram, E. S., & Bigler, R. S. (2007). Effects of learning about gender discrimination on adolescent girls' attitudes toward and interest in science. *Psychology of Women Quarterly*, *31*(3), 262–269. doi:10.1111/j.1471-6402.2007.00369.x

Weisgram, E. S., Bigler, R. S., & Liben, L. S. (2010). Gender, values, and occupational interests among children, adolescents, and adults. *Child Development*, *81*, 778–796.

Weisgram, E. S., & Diekman, A. B. (in preparation). Believing that science helps people predict positivity toward science careers from middle school through college.

Wigfield, A., Eccles, J. S., Yoon, K. S., Harold, R. D., Arbreton, A. J. A., Freedman-Doan, C., & Blumenfeld, P. C. (1997). Change in children's competence beliefs and subjective task values across the elementary school years: A 3-year study. *Journal of Educational Psychology*, *89*(3), 451–69.

Williams, W. M., & Ceci, S. J. (2012). When scientists choose motherhood. *American Scientist*, *100*, 138–145.

Witt, M. G., & Wood, W. (2010). Self-regulation of gendered behavior in everyday life. *Sex Roles*, *62*, 635–646. doi:10.1007/s11199-010-9761-y

Wood, W., & Eagly, A. H. (2012). Chapter two – biosocial construction of sex differences and similarities in behavior. In J. M. Olson, & M. P. Zanna (Ed.), *Advances in experimental social psychology* (Vol. *46*, pp. 55–123). New York: Academic Press (Downloaded from http://www.sciencedirect.com/science/article/pii/B9780123942814000027, accessed November 21, 2014).

Wood, W., Niels, P., Hebl, M. R., & Rothgerber, H. (1997). Conformity to sex-typed norms, affect, and the self-concept. *Journal of Personality and Social Psychology*, *73*, 523–535. doi:10.1037/0022-3514.73.3.523

Xie, Y., & Shauman, K. A. (2005). *Women in science: Career processes and outcomes*. Cambridge, MA: Harvard University Press.

Yeager, D. S., & Walton, G. M. (2011). Social-psychological interventions in education: They're not magic. *Review of Educational Research*, *81*(2), 267–301. doi:10.3102/0034654311405999

Ziegler, A., & Stoeger, H. (2004). Evaluation of an attributional retraining (modeling technique) to reduce gender differences in chemistry instruction1. *High Ability Studies*, *15*(1), 63–83. doi:10.1080/1359813042000225348

AMANDA B. DIEKMAN is Professor of Psychology and a Faculty Affiliate in Women's, Gender, & Sexuality Studies at Miami University. She received her Ph.D. in social psychology from Northwestern University. Her research examines the implications of communal goal processes for STEM engagement, as well as change and stability in gender roles.

ERICA S. WEISGRAM is an Associate Professor of Developmental Psychology at University of Wisconsin-Stevens Point. She received her Ph.D. in Developmental Psychology from University of Texas at Austin in 2006. Her research focuses

on gender roles in children's development, gender stereotyping, and girls and women's interest in STEM fields.

AIMEE L. BELANGER is a doctoral student at Miami University. She received her Master's degree in Social Psychology from Miami University. Her research focuses on the social and motivational factors that impact interest in the STEM fields.