Seeking congruity between goals and roles:

A new look at why women opt out of STEM careers

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Abstract

Although women have nearly attained equality with men in several formerly male-dominated fields, they remain underrepresented in science, technology, engineering, and mathematics (STEM). We argue that one important factor is that STEM careers are perceived as less likely than other careers to fulfill communal goals. Such perceptions might disproportionately affect women's decisions, because women especially endorse communal goals. As predicted, STEM careers, relative to other careers, were perceived to impede communal goals. Moreover, communal goal endorsement negatively predicted interest in STEM careers, even when controlling for past experience and self-efficacy in science and math. Understanding how communal goals influence interest in STEM fields thus provides a new perspective on the question of women's representation in STEM.

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Women remain a minority in science, technology, engineering, and mathematics (STEM), both in the U.S. (Snyder, Dillow, & Hoffman, 2009) and internationally (National Science Board, 2002). Women's absence from STEM is particularly puzzling given their large increases in other fields, such as medicine or law. We present a new perspective on this question by proposing that careers are thought to afford certain goals, and that individuals' own goals intersect with these perceived affordances to produce interest in some careers and disinterest in others. In particular, we hypothesize that people perceive STEM as incompatible with *communion*, or an orientation to care about others (Bakan, 1966). Because women especially endorse communal goals, they may be more likely than men to opt out of STEM in favor of careers that seem to afford communion.

Several critical factors contribute to women's underrepresentation in STEM, including gender differences in self-efficacy, differential encouragement for science/math, and cultural stereotypes (e.g., see Ceci & Williams, 2007; Halpern et al., 2007; Spelke, 2005, for reviews). However, examination of career trends over time reveals that the nearly exclusive focus on agentic explanations, such as competence or achievement, is incomplete (see Table 1). Women have increased their presence at the highest levels of a range of fields, but their gains in male-stereotypic/nonSTEM fields overshadow those in STEM fields (Snyder et al., 2009). For example, women earn about 20-30% of the highest degrees in STEM, whereas they approach equality with men in nonSTEM fields such as medicine (which requires a scientifically-demanding background) and in business and law (which were at one time extremely male-dominated). These trends suggest that to explain women's STEM absence, research must focus on what differentiates STEM from other careers. We hypothesize that a critical but relatively unexplored difference may be that other careers are perceived as fulfilling communal goals, such as working with or helping others. In contrast, STEM may elicit thoughts of the "lone scientist" or technology and

machinery. This "communion gap" may particularly influence women's STEM decisions, because women particularly endorse communal goals.

A Role Congruity Perspective

We posit that social roles are critical to understanding STEM pursuits. First, broader gender roles influence the goals that individuals endorse (Diekman & Eagly, 2008). In terms of traditional gender roles, men's occupancy of leadership or breadwinner roles is associated with a focus on agency, or self-orientation, whereas women's occupancy of caretaking roles is associated with communion, or other-orientation (Eagly, Wood, & Diekman, 2000). In recent decades, women have increasingly adopted agentic attributes as they enter male-stereotypic roles (e.g., Twenge, 2001). Moreover, consistent with their continued presence in female-stereotypic roles, women have maintained high levels of communion: Meta-analyses find that women more than men report tender-mindedness and warmth (Costa, Terracciano, & McCrae, 2001) and benevolent and universalist values (Schwartz & Rubel, 2005).

A second role congruity principle is that specific social roles form an opportunity structure that individuals navigate as they pursue their goals (Diekman & Eagly, 2008). Individuals select specific roles, such as occupational or family roles, that fulfill important goals. For example, meta-analyzed job attribute preferences show that the largest sex differences are women's greater preference for helping others (d=-.35) and working with people (d=-.36)(Konrad, Ritchie, Lieb, & Corrigall, 2000). Women and more feminine individuals favor working with people over things, and this preference predicts differing vocational interests (Lippa, 1998). Women's greater valuing of people- or society-oriented occupations predicts their preference for health-related careers, even controlling for expectations of success in science (Eccles, 2007). Likewise, girls who perceive science as consistent with altruism tend to show interest in scientific careers (Weisgram & Bigler, 2006).

Applying the role congruity logic, we argue that careers vary in the goals they are thought to afford. We propose that women's communal goal orientation intersects with beliefs that STEM careers

do not involve helping or working with others, with the result that even scientifically-talented women frequently choose other careers – careers that they believe will allow them to fulfill their communal goals.

Overview

This research adopts a different perspective to explain women's avoidance of STEM: Previous efforts have generally focused on how to align women and girls more closely with men and boys, primarily by increasing their self-efficacy or experience in math and science. Yet, a critical piece of the puzzle is that STEM careers may be perceived as incompatible with communion. If women value communal goals, they may avoid STEM. We thus examined (1) whether communal goal affordances are perceived to differ between STEM and other careers, and (2) whether given consensual beliefs about affordances, communal goal endorsement inhibits STEM interest.

Method

Participants

Participants were 333 introductory psychology students (193 women) who participated for partial course credit, and 27 paid participants (14 women) from STEM classes. The majority (86.94%) were of European American descent. The median age was 19 years, ranging from 18 to 43.

Measures

As part of a larger study, participants completed randomly-ordered measures of goal endorsement, career interest, and self-efficacy. Participants then provided goal affordance ratings and information about math/science experience.

Career Items

Our goal was to determine predictors of differential interest in STEM, male-stereotypic/nonSTEM, and female-stereotypic careers. To create scales reflecting these different stereotypicality categories, we used archival and primary data. We generated a pool of careers that

were likely to be attractive to college participants and that were at least 65% male or female (U.S. Department of Labor, 2009). STEM careers were identified from the male-dominated group following accepted definitions of STEM as natural/physical sciences, technology, engineering, and mathematics (e.g., Chen & Weko, 2009). Table 2 presents these "core" careers.

Second, we factor-analyzed participants' estimates of gender representation in these careers to ensure the stereotypicality of these groupings. The estimated percentages of women in the careers were submitted to a factor analysis (promax rotation). The scree plot revealed a three-factor solution, reflecting the a priori groups: STEM careers constituted the first factor, female-stereotypic the second, and male-stereotypic/nonSTEM the third. As shown in Table 2, each item loaded at least .30 on its respective factor. Additionally, two coders blind to hypotheses categorized careers with good interrater reliability (κ=.77).

Perceived goal affordances. For each of the core careers, participants rated how much the career fulfills *agentic goals* ("power, achievement, and seeking new experiences or excitement") and *communal goals* ("intimacy, affiliation, and altruism"; definitions from Pohlmann, 2001). Ratings were completed on 7-point scales, from *not at all* to *extremely.* The agentic goal affordance scale averaged ratings within each career type (α_{STEM}=.79; α_{MST}= .72; α_{FST}= .76), as did the communal goal affordance scale (α_{STEM}=.80; α_{MST}=.53; α_{FST}=.78).

Career interest. Because career interest was our critical dependent measure, participants rated their interest in the core careers plus additional careers (selected from archival data as described above). Interest ratings were made on 7-point scales from *not at all* to *extremely*.

To construct interest scales using this broader pool of items, a career was added if its interest rating correlated highly with interest in one of the three career types, based on the interest averaged over the core careers (see note to Table 2). The resulting scales showed high internal consistency (α_{STEM}=.92; α_{MST}=.84; α_{FST}=.80).[1]

Goal Endorsement

Participants rated goals according to "how important each of the following kinds of goals is to you personally." Indices of *agentic* and *communal goal endorsements* were created by averaging within each scale (see Table 3).

Self-Efficacy and Experience

Measures of self-efficacy included the scientific, mechanical, and computational subscales of the Kuder Task Self-Efficacy Scale, αs>.83 (Lucas, Wanberg, & Zytowski, 1997), as well as estimated grades in STEM classes (α=.86). These scales were standardized and averaged to produce a single self-efficacy index (α=.86). Participants also reported their number of past or current math/science courses, which were summed for total enrollment.

Results

We first examined whether STEM careers were perceived as uniquely inhibiting communal goals, relative to agentic goals or other careers. Second, based upon these disparate perceptions, we examined whether communal goal endorsement was differentially related to interest in STEM vs. other careers. Third, we tested whether endorsement of communal goals mediated sex differences in STEM interest.

STEM Careers Believed to Impede Communal Goals

Data were analyzed in a 2(goal) × 3(career type) × 2(participant sex) analysis of variance (ANOVA), with participant sex as a between-subjects factor. Main and lower-order effects are omitted for brevity; effect sizes for critical interactions are in the generalized eta squared statistic (Bakeman, 2005).

The hypothesized Goal × Career Type interaction, $F(2, 716)=730.69$, $p<.0001$, $\eta^2_G=.31$, is depicted in Figure 1. For communal goals, the simple effect of career type, $F(2, 716)=741.55$, $p<.0001$, $\eta^2_G=.53$, reflected perceptions that STEM careers afford communion significantly less than male-stereotypic

careers, which in turn afford communion less than female-stereotypic careers, all *p*s<.0001. For agentic goals, the simple effect of career type, $F(2, 716)=142.58$, $p<.0001$, $\eta^2_G=.14$, reflected perceptions that female-stereotypic careers afforded agency less than STEM careers, which were in turn afforded agency less than male-stereotypic careers, all *p*s<.0001.

To examine the comparison between STEM and male-stereotypic/nonSTEM careers specifically, we conducted a 2(goal) × 2(career type: STEM or male-stereotypic) × 2(sex) ANOVA with sex as a between-subjects factor. As reflected in the Goal × Career Type interaction, $F(1, 358)=131.77$, $p<.0001$, $\eta^2_G=.04$, male-stereotypic and STEM careers differed more on communal goals, $F(1, 358)=351.70$, $p<.0001$, $\eta^2_G=.25$, than agentic goals, $F(1, 358)=31.84$, $p<.0001$, $\eta^2_G=.02$. The bigger difference between male-stereotypic and STEM careers is *communion*, rather than agency.

Communal Goal Endorsement Negatively Predicts STEM Interest

Given these robust differences in perceived goal affordances, we examined whether communal goal endorsement differentially predicted interest in careers. Communal goal endorsement was expected to negatively predict interest in STEM careers (which are thought to impede communal goal pursuit) but to positively predict interest in female-stereotypic careers (which are thought to afford communal goal pursuit). For agentic goals, we expected a different pattern, but one consistent with the role congruity logic. Here, we expected agentic goal endorsement to positively predict interest in male-dominated careers (STEM and nonSTEM) but to negatively predict interest in female-stereotypic careers.

To explore these hypotheses, we regressed career interest on participant sex, communal and agentic goal endorsements, and all interactions, as shown in Table 4. As predicted, for STEM careers, communal goal endorsement significantly inhibited interest and agentic goal endorsement facilitated interest. For male-stereotypic careers, agentic goal endorsement facilitated interest but communal goal

endorsement showed no relationship. For female-stereotypic careers, communal goals facilitated interest and agentic goals inhibited interest.[2]

Consistent with our primary hypothesis, communal endorsement differentially predicted interest across the three career types (see Figure 2). We statistically compared these slopes by regressing discrepancies between interest in STEM and other careers on sex, goals, and all interactions. Communal goal endorsement predicted the discrepancy between STEM and female-stereotypic careers, B=.85, p<.0001, β=.43, as well as the discrepancy between STEM and male-stereotypic careers, B=.34, p<.001, β=.23.

Self-efficacy and experience. Finally, we tested whether communal goal endorsement inhibited STEM interest even when controlling for math/science experience and self-efficacy. These analyses regressed STEM interest on sex, goal endorsements, and new variables reflecting past/current enrollment in STEM courses and STEM self-efficacy. Self-efficacy significantly predicted interest, B=.83, p<.0001, β=.56; course enrollment did not, B=.00, p=.57, β=.02.

Especially important is that communal goal endorsement remained significant even when controlling for self-efficacy or experience: Communal goal endorsement negatively predicted STEM interest, B=-.19, p=.001, β=-.13. In contrast, agentic goal endorsement was reduced to nonsignificance, p=.16. Even though self-efficacy is a robust predictor, communal goals predict STEM interest above and beyond self-efficacy.

Communal Goals Mediate Sex Differences in STEM Interest

To investigate whether communal goals underlie sex differences in STEM interest, we conducted a series of path analyses (Kenny, Kashy, & Bolger, 1998). As shown in Figure 3, women more than men endorsed communal goals, communal goals predicted STEM interest , and the relationship between sex and STEM interest diminished when controlling for communal goal endorsement, Sobel Z=2.08, p=.04.

Moreover, testing alternative models suggested that communal goal endorsement uniquely underlies STEM interests. One alternative tested whether agentic goals mediate the sex difference in STEM interest; this mediation failed because sex did not predict agentic goals, p=.34. Another model tested whether communal goals mediate the sex difference in interest in male-stereotypic/nonSTEM careers; this model failed because communal goals did not predict interest in male-stereotypic careers, p=.24. The success of the communal goals/STEM model, compared to these alternatives, suggests that communal goal endorsement might uniquely explain women's disinterest in STEM.

General Discussion

Understanding communal motivations can provide unique information about why women opt out of STEM career paths. STEM careers are perceived as inhibiting communal goals; when individuals endorse communal goals, they are less interested in STEM. If women perceive STEM as antithetical to highly valued goals, then it is no surprise that even talented women might choose alternative career paths. Certainly, traditionally-studied predictors of STEM interest, such as agentic motivations or self-efficacy, continue to be critical factors, as illustrated in our data. Our argument is not that the study of communal motivations should replace agentic motivations or self-efficacy, but that the traditional approach overlooks critically important information. Indeed, studying communal motives alongside these other variables is most promising, because the current data illustrate that communal motives provide distinct explanation of STEM interest. Given the importance of increasing participation in STEM, a range of tools should address the challenge. Even small effects of communal motivations might lead to women opting out of STEM, especially if such small effects cumulate over time (e.g., Martell, Lane, & Emrich, 1996).

A great irony is that STEM fields hold the key to helping many people but are commonly regarded as antithetical (or at best, irrelevant) to such communal goals. However, the first step toward change is knowledge about this belief and its consequences. Interventions could not only provide

opportunities for girls and young women to succeed in math/science but also demonstrate how STEM fields involve helping and collaborating with others. For example, our current research investigates how portraying science or engineering careers as more other-oriented fosters positivity. Indeed, those science-related fields with the greatest influx of women are those that more obviously involve helping people, such as biomedical or psychological science (Snyder et al., 2009).

Psychological science can play a desperately needed role in understanding why STEM paths are chosen, or, more often, not chosen (Newcombe et al., 2009). If one barrier to women's participation is a perceived misalignment between STEM and communal goals, psychological science can help understand how to begin to change this perception.

Footnotes

[1]Analyses of interest in the core careers showed similar patterns. Male-stereotypic/nonSTEM interest moderately correlated with STEM interest, $r(359)=.43$, and female-stereotypic interest, $r(359)=.33$. STEM interest did not correlate with female-stereotypic interest, $r(359)=-.06$.

[2]Tentative evidence emerged for sex-differentiated goal-interest relationships. For STEM, the marginal Communal Goals × Sex interaction, $p=.10$, reflected a stronger inhibitory effect of communal goal endorsement on STEM interest for women than men. For male-stereotypic careers, the Agentic Goals × Sex interaction, $p=.05$, reflected a stronger effect of agentic goals for men than women; the Agentic Goals × Communal Goals × Sex interaction, $p=.08$, reflected a stronger interaction between goals for men than women.

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Table 1

Temporal Trends in Women's Representation in STEM and NonSTEM Fields

Field	1959-60	2006-07
nonSTEM/male-stereotypic		
Dentistry	0.80%	44.56%
Medicine	5.50%	49.22%
Law	2.49%	47.62%
Business	1.48%	41.45%
STEM		
Engineering	0.38%	20.94%
Math/statistics	5.94%	29.76%
Physical sciences and science technologies	3.37%	31.55%
Computer science and information technologies	2.34%[1]	20.56%

Note. Values reflect the percentage of total degree holders who are women in the designated years. Data are for the terminal degrees in each field (e.g., for business, engineering, math/statistics, and physical sciences, percentages given are for doctoral degrees). Data were compiled from the National Center for Education Statistics, *Digest of Education Statistics, 2008*.

[1] For computer science, the earlier time period is 1970-71, which is the first year degree data are available for this field.

Table 2

STEM, Male-Stereotypic/nonSTEM, and Female-Stereotypic Careers

	Factor		
	STEM	Male-stereotypic/ nonSTEM	Female-stereotypic
STEM			
mechanical engineer	**.73**	-.02	-.05
computer scientist	**.73**	-.01	-.09
aerospace engineer	**.77**	.09	-.05
environmental scientist	**.63**	-.08	.24
Male-stereotypic/nonSTEM			
lawyer	.22	**.58**	.06
architect	.36	**.44**	-.01
dentist	.26	**.49**	-.04
physician	-.37	**.79**	-.01
Female-stereotypic			
preschool or kindergarten teacher	-.18	-.06	**.73**
human resources manager	.09	.28	**.31**
social worker	.05	.14	**.68**
education administrator	.14	.31	**.47**
registered nurse	-.00	-.16	**.68**

Note. Factor loadings were obtained from a factor analysis (promax rotation) of gender representation estimates for the core careers. In the rare cases of double loadings, the higher loading matched the a priori grouping based on archival data (i.e., *architect* as male-stereotypic, *human resources manager* as female-stereotypic, *physician* as STEM). The interest scales were expanded to include careers that correlated with the core career scales (STEM: *industrial engineer, chemical engineer, electrical engineer, network & computer systems administrator*; male-stereotypic/nonSTEM: *chief executive, surgeon, chiropractor, pediatrician;* female-stereotypic: *elementary school teacher, administrative assistant, therapist, health services advocate*).

Table 3

Goal Endorsement Items

	Agentic goals	Communal goals
	Power	Helping others
	Recognition	Serving humanity
	Achievement	Serving community
	Mastery	Working with people
	Self-promotion	Connection with others
	Independence	Attending to others
	Individualism	Caring for others
	Status	Intimacy
	Focus on the self	Spiritual rewards
	Success	
	Financial rewards	
	Self-direction	
	Demonstrating skill or competence	
	Competition	
alpha	.87	.84

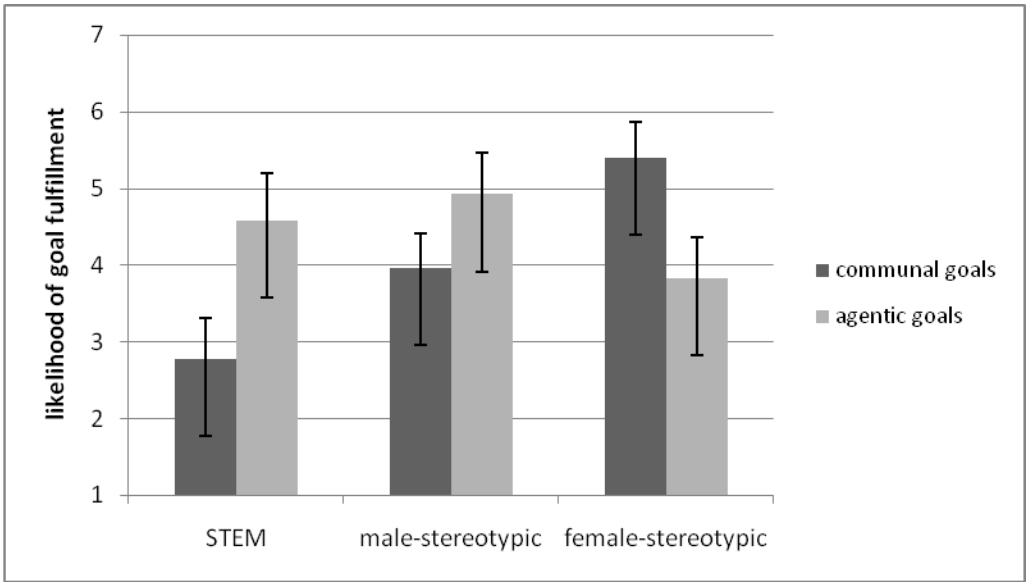
Note. Items were submitted to a factor analysis (promax rotation). Based on examination of the scree plot, we chose a two-factor solution, with agentic goals loading on the first factor and communal goals on the second factor. All retained items loaded at least .30 on their respective factors (resulting in the dropping of one item, *other-oriented*). Agentic and communal goals were not significantly correlated across the sample, $r(359)=.08$, $p=.15$. Within women, no relationship appeared, $r(206)=.04$, $p=.60$, and within men, the relationship approached conventional levels of significance, $r(152)=.14$, $p = .08$.

Table 4
Predicting Career Interest from Goal Endorsement

	STEM careers			Male-stereotypic careers			Female-stereotypic careers		
	R^2	*B*	β	R^2	*B*	β	R^2	*B*	β
	.17***			.10***			.21***		
Sex		.80***	.32		.23†	.10		-.51***	-.21
Communal goals		-.35***	-.25		-.01	-.01		.50***	.37
Agentic goals		.18†	.12		.25*	.17		-.30**	-.22
Communal Goals × Sex		.24†	.11		.13	.06		-.06	-.03
Agentic Goals × Sex		-.01	-.00		.31*	.14		.15	.07
Communal × Agentic Goals		-.05	-.03		-.08	-.06		.13	.09
Sex × Communal × Agentic		-.02	-.01		.28†	.14		-.18	-.09

*** p < .001, ** p < .01, *p < .05, † p <.10

Figure 1
Perceived Goal Affordances by Career



Note. Error bars reflect standard deviations.

Figure 2
Communal Goal Endorsement Predicts Career Interest

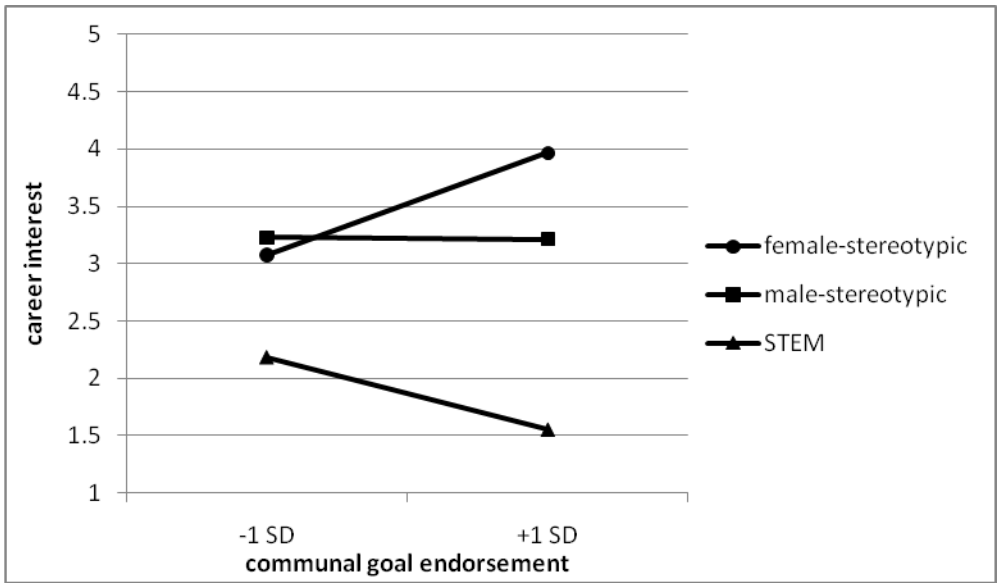
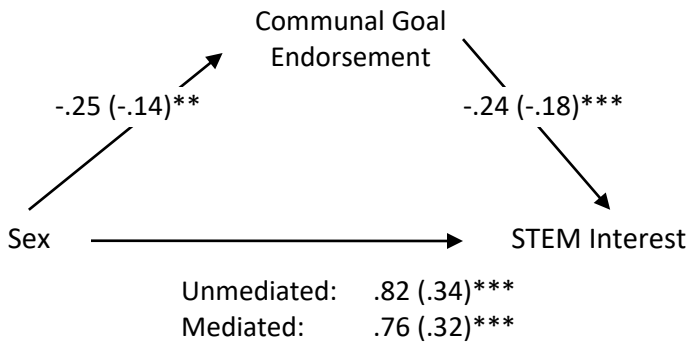


Figure 3
Communal Goal Endorsement Mediates Sex Differences in STEM Interest



*** p < .001, ** p < .01, *p < .05

Note. Participant sex was dummy-coded as 1=men, 0=women. Standardized regression coefficients are given in parentheses.