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To Grab and to Hold: Cultivating Communal Goals to Overcome Cultural and Structural Barriers in First-Generation College Students' Science Interest

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Homogeneity within science limits creativity and discovery, and can feed into a perpetuating cycle of underrepresentation. From enhancing social justice to alleviating health and economic disadvantages, broadening participation in science is imperative. We focus here on first-generation students (FGS) and identify factors which grab and hold science interest among this underrepresented group. Might the culture and norms within science unintentionally limit FGS' participation? We argue that 2 distinct aspects of communal goals contribute to FGS' underrepresentation at different stages of the STEM pipeline: cultural perceptions of science as uncommunal (little emphasis on prosocial behavior and collaboration) and the uncommunal structure of STEM graduate education and training. Across 2 studies we investigated factors that catch (Study 1) and hold (Study 2) FGS' science interest. In Study 1, we find only when FGS believe that working in science will allow them to fulfill prosocial communal purpose goals are they more intrinsically interested in science. Yet, later in the pipeline science education devalues prosocial communal goals creating a structural mobility barrier among FGS. Study 2 found that FGS generally want to stay close to home instead of relocating to pursue a graduate education. For FGS (vs. continuing-generation students), higher prosocial communal goal orientation significantly predicted lower residential mobility. We discuss implications for interventions to counteract the uncommunal science education and training culture to help improve access to FGS and other similarly situated underrepresented populations.

Keywords: communal goals, first-generation students, intrinsic motivation, residential mobility

We need more scientists: The U.S. government reports that available science jobs will outnumber qualified applicants by 1 million in 2018 (President's Council of Advisors on Science and Technology, 2012). Will these career opportunities be perceived as equally attractive to students from diverse backgrounds? Recruiting students from diverse and underrepresented

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backgrounds into science may help fill this critical job void and advance innovation within scientific research. A diverse workforce will not only help improve organizational performance (i.e., generating creative solutions; Mannix & Neale, 2005) but will allow for upward changes in social class and more secure and attractive job opportunities, alleviating health and economic disadvantages (Phelan, Link, & Tehranifar, 2010).

The current research focuses on first-generation students (FGS) and factors which grab and hold their interest in science compared to continuing-generation students (CGS). FGS are defined as having neither parent earning a 4-year college degree, whereas CGS are defined as having at least one parent who has earned a 4-year college degree. FGS represent only 15.9% of incoming college freshmen (Saenz, Hurtado, Barrera, Wolf, & Yeung, 2007). One possible explanation for lower rates of college participation might be a cultural capital deficit (i.e., parents lacking higher education experience, less social/financial support for college transition; Bourdieu, 1986). FGS, compared with CGS, are typically underprepared for the challenges and expectations of undergraduate and graduate education (Gardner & Holley, 2011). Thus, it is not surprising that undergraduate FGS are less likely to select science majors compared with CGS (College Board, 2013) and less likely to attain a M.A. or Ph.D. within 10 years (across fields) than CGS (Engle & Tinto, 2008). Taken together, if there is a shortage of FGS interested in science fields and even fewer of those FGS completing graduate school, this points to an underrepresentation of FGS among qualified applicants in science careers.[1]

Is there something about the reputation of science that, however unintentionally, limits FGS' participation? We focus on two unique barriers which have likely resulted in FGS being excluded from science, technology, engineering, and math (STEM) opportunities. First, we focus on cultural barriers including the reputation of science as being uncommunal (not allowing for working with and helping others). Second, we focus on structural barriers that require mobility for STEM success. Obtaining a graduate education, taking a prestigious postdoctoral fellowship, and finally landing a lucrative STEM career typically require a willingness and ability to relocate. Thus, we suggest that the uncommunal culture of science and its assumption that scientists-in-training are willing and able to relocate may hinder FGS' advancement in science careers precisely because these expectations are inconsistent with communal goals of FGS.

First-Generation Students, Communal Goals, and Academic Pursuits

Two fundamental and highly valued dimensions guiding motivation are communion (other-focused goals which benefit the collective) and agency (self-focused goals which benefit the individual; Bakan, 1966). Because STEM fields are not associated with communion, there is incongruity between the personal valuation of communion and motivation to pursue STEM (Diekman, Clark, Johnston, Brown, & Steinberg, 2011). Goal Congruity Theory posits this goal incongruity may deter people who highly endorse communion from considering a STEM career (Diekman & Steinberg, 2013; Diekman, Weisgram, & Belanger, 2015). Research on Goal Congruity Theory has primarily focused on gender (e.g., Diekman, Brown, Johnston, & Clark, 2010) as women are more likely than men to highly endorse communion (Diekman et al., 2010, 2011), but recent research has demonstrated the importance of communal goal processes for underrepresented minority groups (Native Americans, Latinos) in STEM who also tend to highly endorse communion (Smith, Cech, Metz, Huntoon, & Moyer, 2014; Thoman, Brown, Mason, Harmsen, & Smith, 2015). We extend goal congruity predictions by examining predictors of STEM career interest for FGS, who value more other-oriented and less self-oriented motives for attending college, than CGS (Stephens, Fryberg, Markus, Johnson, & Covarrubias, 2012).

Further, we suggest that distinct aspects of communal goals matter for students' choices to pursue STEM and matter at different points in students' educational/career development trajectories. Motivational scholars (Hidi & Harackiewicz, 2000; Mitchell, 1993) have suggested that the development of interest occurs at

[1] Many national agencies do not currently track data on FGS across the STEM pipeline. We speculate that this will change in the next decade as empirical research on FGS becomes more fully integrated in the STEM literature.

two interacting stages: first "catching" (triggering situational interest) and then "holding" (maintaining that interest over time). In a novel application of Goal Congruity Theory to FGS, we predict that FGS who perceive science as supporting communal purpose goals (e.g., perceptions that science gives back to the community and/or involves collaboration) are especially likely to have science *catch* their interest. However, extending Goal Congruity Theory, we expect that students with higher communal goal orientation (e.g., personal endorsement of communal goals) are especially likely to choose to stay close to home in their educational and career pursuits. Thus, FGS considering graduate or medical school may be less likely to *hold* their science interest when faced with residential mobility challenges.

A Culture of Science That Does Not Highly Value Communal Goals

Importantly, some types of communion may be more important than others for predicting science interests of FGS or underrepresented minority students (Harackiewicz, Canning, Tibbetts, Prinisky, & Hyde, in press; Thoman et al., 2015). When considering the different elements of communion it is possible to disaggregate the construct into specific purpose goals[2]: prosocial (i.e., perceptions that science helps others and gives back to community) and collaboration (i.e., perceptions that science involves working with others; Diekman & Steinberg, 2013; Pöhlmann, 2001). Although both are important predictors of students' science interest (Diekman et al., 2011; Brown, Smith, Thoman, Allen, & Muragishi, 2015), most research on communal purpose goals has conflated prosocial and collaborative components. Science careers (e.g., computer science) are believed to provide fewer opportunities to fulfill prosocial and collaborative purpose goals than stereotypically masculine (e.g., law) or feminine careers (e.g., elementary education; Diekman et al., 2010). Additionally, scientists are stereotyped as lacking interpersonal skills; thus, science careers may further be seen as unlikely to fulfill collaborative communal purpose goals (Cheryan, Plaut, Handron, & Hudson, 2013). One novel contribution of our work is disentangling whether science interest among undergraduate FGS is more strongly influenced by the extent to which they perceive science careers as being able to fulfill prosocial and/or collaborative communal purpose goals compared with CGS.

Structure of Science Denies Communal Goal Fulfillment

The structure of careers in STEM typically assumes the ability and willingness to move away from one's home in pursuit of advanced career opportunities, a characteristic referred to as residential mobility (Oishi, Lun, & Sherman, 2007). Residential mobility has been assessed retrospectively (i.e., number of childhood moves affecting adult outcomes), experimentally (i.e., stable vs. unstable groups), and within communities (i.e., proportion of new vs. long-term residents in a location; Oishi, 2010; Oishi & Talhelm, 2012). Residential mobility is associated with emphasizing the personal self (i.e., self-oriented goals) and minimizing the collective self (i.e., group-based membership and associated duties; Oishi, 2010). We extend the existing work on residential mobility by assessing it prospectively by asking whether and why individuals desire to move and connecting it to moving *specifically* in pursuit of science education and training.

We argue that residential mobility conflicts with the goals of staying close to one's family and community, which might be particularly problematic for FGS. Nearly 27% of FGS selected their undergraduate institution (in part) because of its close proximity to home, whereas only 17% of CGS reported the same (Saenz et al., 2007). Staying close to home allows students to help others and give back, not just broadly, but to their family members and immediate communities (Smith et al., 2014). Thus, we predict that FGS may be less willing and able to balance long-distance moves expected by science, and instead desire—or have a family obligation—to be involved in family and community life at home.

In academic career pursuits, for example, Ph.D. and M.D. candidates almost always embark on multiple moves (i.e., undergraduate and graduate institutions, postdoctoral position, res-

[2] Our broad use of the term "purpose goals" maps onto recent educational literature which delineates the "purpose for learning" (Yeager et al., 2014, p. 560), although this construct overlaps theoretically with goal affordances.

idency, visiting and/or tenure-track faculty position) creating personal, social, and financial burdens to maximize their career success. Indeed, many leading medical and graduate schools in science are clustered in the Northeastern U.S. (Cover, Jones, & Watson, 2011), requiring a substantial move and cultural shift for individuals living in other areas.[3] Thus, options for top medical research programs are more limited in the Western and Midwestern regions of the U.S., requiring prospective biomedical researchers to look outside their home regions for advanced training. The problem of mobility for advanced training is not just a problem for those pursuing academic research careers. Rather, opportunities for advancement to the highest levels of STEM work (in public and private sectors) require an advanced degree. Thus, if a recent graduate is unwilling or unable to travel for advanced training, he or she may be limited to lower-level STEM positions with fewer opportunities for advancement than a highly mobile peer. We argue that this barrier is distinct from other professional fields, such as business, where MBA candidates often continue working full-time in the same community where they have established personal and professional ties (Yeaple, 2012) or law where top graduate programs are more accessible in all regions of the country (U.S. News, 2015). Students beginning to develop career interests in science (i.e., when interest is caught) are unlikely to think about the structural mobility of science training and education. This is likely to matter most for holding students' interest, as they start to make decisions about how (and where) to pursue an science career.

Financial Resources as an Alternative Explanation

Although it is often assumed that all FGS come from a low-income background, empirical data suggest some (but not complete overlap) with socioeconomic status (SES); approximately half (46%) of FGS in Stephens et al. (2012) were from low-income backgrounds (< $60,000) and almost two thirds (59%) of FGS received federal Pell grants (Stephens, Hamedani, & Destin, 2014). Could financial resources for education explain the difference in *catching* and *holding* FGS' science interest? For instance, a working class undergraduate student needing to contribute financially to their families or pay for their education may be unable to volunteer in a research laboratory because they hold a part-time job (Ward, Siegel, & Davenport, 2012). Additionally, in the graduate school application process, limited financial resources resulting from high undergraduate debt might restrict the number of schools a student is able to visit or apply (Gardner & Holley, 2011). Indeed, lower (vs. higher) SES individuals hold more other-oriented values (Kraus & Stephens, 2012), which emphasize connections with close others and communal goal pursuit. Disentangling these explanations is critical as it suggests different routes to increasing the presence of FGS in STEM fields: either through providing increased financial resources or transforming the culture/structure of science to become more accommodating to meet the needs of those who hold communal goals. Thus, a secondary goal of our research is to try and separate the influence of SES and FGS status on science motivation and persistence.

Overview and Hypotheses

Across two studies, we investigate whether science research is less culturally supportive for FGS (vs. CGS), both in the reasons why students should conduct science research (purpose goals) and the structure of how students are trained for science research (mobility). Study 1 assessed whether perceiving science as not fulfilling communal purpose goals serves as a cultural barrier to FGS' science motivation. We hypothesized that FGS would report less interest in science when science was perceived as lower (vs. higher) in communal purpose goals and we disaggregated communal purpose into prosocial and collaborative components. Further, because science interest is often perceived as being driven by agentic goals (Diekman et al., 2010), we tested whether communal purpose goals would predict science interest for FGS (but not CGS) above and beyond more

[3] Consider that the distance to a Top 10 medical research program (U.S. News, 2015) is 412 miles from our data collection site in Long Beach, CA and 676 miles from our second data collection site in Bozeman, MT. In contrast, within a 400 mile range between Boston, MA and Baltimore, MD there are four top 10 medical research universities (U.S. News, 2015).

self-oriented goals (cf. Thoman et al., 2015). Study 2 extended this work by investigating a communal-related structural barrier to FGS' science access. We assessed whether science education creates a structural mobility barrier for FGS considering biomedical research programs. We hypothesized that higher communal goal orientation would be negatively associated with residential mobility for FGS, but not CGS. Further, in both studies we controlled for SES and ethnicity to disentangle the role of financial resources and racial/ethnic background from first-generation status, as a large proportion of FGS are from racial/ethnic minority groups (38.2% Hispanic/Latino, 22.6% African American, 16.8% Native American; Saenz et al., 2007). The broader aim of this research is to make empirically informed programming recommendations tailored for changing the uncommunal culture and structure of science that will foster diversity within science.

Study 1

The purpose of Study 1 was to examine the relationships among communal purpose goals (i.e., perceptions that science benefits others and/or involves collaboration) and science interest for undergraduate students. Consistent with Yeager et al. (2014) and Thoman et al. (2015), we included agentic purpose goals (i.e., perceptions that science allows for power and achievement) for comparison to establish that the pathway to FGS' increased motivation is uniquely through one or more types of communal purpose goals.

Method

Undergraduate students at a minority-serving institution were invited to participate in a larger online study on math and science experiences.[4] The sample included 211 undergraduate students (91 FGS; 52% women; median age = 20 years), with the majority self-identifying as ethnic minorities (49% Hispanic/Latino, 6% Multiracial, 4% Pacific Islander, 2% African American). The sample showed similar gender representation between FGS (46% women) and CGS (57% women); however, there was variation in ethnic representation between FGS (87% URM) and CGS (43% URM). Students were diverse in academic standing: 15% freshmen, 30% sophomores, 25% juniors, and 30% seniors. Students received a $10 gift card for participation.

Students' purpose goals were measured using a modified version of the Work Values Scale (Johnson, 2002). Prosocial communal purpose goals were assessed with three items (e.g., "I expect that a career in science will allow me to do work that gives me an opportunity to be directly helpful to others"; $\alpha = .86$). Collaborative communal purpose goals were assessed with three items (e.g., "I expect that a career in science permits contact with a lot of people"; $\alpha = .79$). Agentic purpose goals were measured using six items (e.g., "I expect that a career in science will allow me to do work that is interesting to do"; $\alpha = .84$). Students' science interest was measured using 11 items (e.g., "I enjoy coming to my science class"; $\alpha = .90$; Linnenbrink-Garcia et al., 2010). All items were rated on 1 to 7 scales and averaged, with higher numbers indicating greater purpose goals or interest, respectively. Consistent with previous literature (Saenz et al., 2007; Stephens et al., 2012, 2014), SES and ethnicity were assessed. Participants self-identified as being below the poverty line, working class, middle class, upper-middle class, or upper class. SES was coded (0 = working class or below, 1 = middle class or above). Ethnicity was coded based on underrepresented minority (URM) status in science (0 = non-URM; 1 = URM).

Results and Discussion

We tested whether FGS status moderated the relationship between science purpose goals (communal and agentic) and science interest. To examine whether one or both types of communal purpose goals increased science interest among FGS, we examined prosocial and collaborative purpose goals in the same model. Because the sample was cross-sectional, with students represented widely across undergraduate academic levels, we statistically controlled for academic credits earned to account for variabil-

[4] Exclusion criteria across both studies included incomplete data for FGS or self-identification as Asian-American. Participants self-identifying as Asian-American were excluded from analyses because of their unique non-underrepresented yet non-majority status in science (Garrison, 2013).

ity in students' normative changes in career values and interests during college (e.g., Low, Yoon, Roberts, & Rounds, 2005).

Science interest was regressed on a model including academic credits earned (mean centered; $M = 70.94$, $SD = 41.38$), SES, ethnicity, prosocial communal purpose goals (mean centered; $M = 5.82$, $SD = 1.04$), collaborative communal purpose goals (mean centered; $M = 5.48$, $SD = 1.16$), agentic purpose goals (mean centered; $M = 5.95$, $SD = 0.84$), FGS (0 = CGS, 1 = FGS), and all higher order interactions involving FGS and goals. Overall, the model significantly predicted science interest, $F(18, 176) = 3.26$, $p < .001$, $R^2 = .25$. Consistent with hypotheses, the FGS × Prosocial communal interaction emerged, $t(176) = 2.99$, $p = .003$ (see Table 1). Prosocial communal purpose goals predicted greater science interest for FGS ($\beta = 0.76$, $t = 3.58$, $p < .001$) but not CGS ($\beta = 0.000$, $t = 0.003$, $p = .99$), even after accounting for SES and ethnicity.[5] The FGS × Collaborative communal interaction was not significant, $t(176) = -1.52$, $p = .13$. Secondary analyses showed that neither the FGS × Agentic nor any higher order interactions involving agentic purpose goals were significant, *p*s > .05 (see Table 1). These results point to one specific barrier to catching FGS' science interest: lower prosocial communal purpose (but not collaborative communal purpose or agentic purpose) goals.

Study 1 provided initial evidence that FGS expressed greater science interest when science was perceived as being able to fulfill a *prosocial* communal purpose. Furthermore, FGS status specifically, rather than SES or ethnicity, was driving the effects on science interest. Further, results suggests that for FGS the prosocial aspect of communal goals matters more than the collaborative (or interpersonal) aspect of communal goals.

Study 2

The purpose of Study 2 was to examine how the noncommunal structure of science education and training creates a barrier to FGS' science access. Given that Study 1 demonstrated that agentic and collaborative purpose goals do not play a unique role in FGS' science interest (vs. CGS), Study 2 focused on the predictive utility of a prosocial communal goal orientation. In Study 2, we examined prosocial communal goal orientation as a predictor of residential mobility among highly identified FGS and CGS research assistants (RAs).

Method

Undergraduate RAs at several Mountain West and West Coast universities were invited to participate in a larger study. The sample included 77 undergraduate biomedical RAs (25 FGS; 61% women, median age = 21 years) who completed surveys at Times 1 through 3. Most of the sample identified as White (72%), with Hispanic/Latino (17%), American Indian (5%), African American (3%), and Pacific Islander (3%) also represented. The sample showed variation in gender and ethnic representation between FGS (72% women, 76% URM) and CGS (56% women; 12% URM). The majority of the participants identified as upperclassmen (65%).

Undergraduate RAs were recruited through faculty mentors and participated in a survey assessing undergraduate research experiences midway through the semester they were nominated. On enrollment, participants provided a description of the laboratory research they were involved in and FGS status ($N = 77$, 25 FGS). After three semesters working in the lab, participants were contacted to participate in an online follow-up survey. At this point, participants reported their prosocial communal goal orientation ($N = 52$, 18 FGS). Reduced sample size was a result of inability to contact participants by email, wavering interest in the project, and incomplete survey responses. Finally, participants were contacted at the end of the next semester to participate in another follow-up survey to report residential mobility ($N = 77$, 25 FGS). Participants received a $35 gift card for each survey completed.

Participants' goal orientation was assessed using a modified Life Goal Assessment Questionnaire (Diekman et al., 2010; Pöhlmann, 2001). Prosocial communal goal orientation was assessed with 5 items (e.g., serving the community, helping others, $\alpha = .86$). Residential mobility was assessed with three items (e.g., "How much do your postcollege plans (for a job

[5] The pattern of results was unchanged when controlling for gender.

Table 1
Predictors of Science Interest for FGS and CGS (Study 1)

Predictors	*b*	*SE*	β	*t*
Constant	60.38	2.84		21.26***
Academic credits	.006	.02	.02	.35
Ethnicity	−.27	1.83	−.01	−.15
SES	.24	2.12	.01	.11
FGS (0 = CGS, 1 = FGS)	−2.91	2.33	−.13	−1.25
Agentic	1.43	.39	.61	3.67***
Prosocial	.001	.50	.000	.003
Collaborative	−.25	.47	−.08	−.52
Prosocial × Agentic	−.18	.12	−.33	−1.47
Collaboration × Agentic	.13	.12	.22	1.09
Prosocial × Collaborative	−.14	.13	−.16	−1.08
FGS × Agentic	−.49	.55	−.14	−.90
FGS × Prosocial	2.68	.90	.46	2.99**
FGS × Collaborative	−1.20	.79	−.24	−1.52
Prosocial × Collaborative × Agentic	−.03	.03	−.40	−1.26
FGS × Prosocial × Agentic	−.27	.22	−.39	−1.24
FGS × Collaborative × Agentic	.25	.20	.33	1.21
FGS × Prosocial × Collaborative	.18	.18	.16	1.00
FGS × Prosocial × Collaborative × Agentic	−.001	.03	−.01	−.03

Note. Ethnicity (0 = non-URM, 1 = URM); SES (0 = below poverty line or working class, 1 = middle class or above). Agentic = agentic purpose goal; Prosocial = prosocial communal purpose goal; Collaborative = collaborative communal purpose goal.
** $p < .01$. *** $p < .001$.

or graduate school) depend on how close you would live to your family, and how important is it for you to live near your family after graduation?"; modified from Carroll, Shepperd, & Arkin, 2009; α = .88). As in Study 1, SES and ethnicity were measured as control variables. To assess SES, participants self-identified as coming from working class, middle class, or upper class family backgrounds. Responses were coded into 0 = working class, 1 = middle or upper class. Ethnicity was coded based on URM status in science (0 = non-URM, 1 = URM).

Results and Discussion

We examined whether FGS and CGS differed in residential mobility using an Analysis of Covariance (ANCOVA), controlling for SES and ethnicity. Indeed, FGS (M = 2.76, SE = .46) reported less residential mobility compared to CGS (M = 4.18, SE = .29) following graduation, $F(1, 72) = 5.57$, $p = .02$, $\eta_p^2 = .07$. Next, residential mobility was regressed on a model including prosocial communal goal orientation (mean centered; M = 5.90, SD = 1.01), FGS status (0 = CGS, 1 = FGS), SES, ethnicity, and the FGS × Prosocial communal goal interaction. The overall model was significant, $F(5, 46) = 2.60$, $p = .038$, $R^2 = .22$. As hypothesized, the FGS × Prosocial communal goal interaction emerged on residential mobility, $t(46) = -2.02$, $p = .049$ (see Table 2). Among FGS, as students endorsed higher prosocial communal goal orientation, they showed less residential mobility, β = −0.76, $t = -2.19$, $p = .03$, even after accounting for

Table 2
Predictors of Residential Mobility for FGS and CGS (Study 2)

Predictors	*b*	*SE*	β	*t*
Constant	3.21	.62		5.15***
Ethnicity	.89	.70	.22	1.28
SES	1.20	.63	.27	1.90
FGS (0 = CGS, 1 = FGS)	−1.10	.66	−.29	−1.66
Prosocial communal goal orientation	−.01	.27	−.004	−.03
FGS × Prosocial	−1.38	.68	−.32	−2.02*

Note. Ethnicity (0 = non-URM, 1 = URM); SES (0 = working class, 1 = middle or upper class).
* $p < .05$. *** $p < .001$.

SES and ethnicity.[6] In contrast, CGS' prosocial communal goal orientation was unrelated to residential mobility, $\beta = -0.004$, $t = -0.03$, $p = .98$. Our data show that prosocial communal goal orientation differentiated mobility patterns for FGS and CGS. Taken together, FGS' prosocial communal goal orientation negatively predicted residential mobility. Lower residential mobility represents a structural barrier limiting educational and career options for FGS (but not CGS) when major relocation from one's family is involved to pursue advanced science training. As in Study 1, SES or ethnicity did not explain the mobility patterns among FGS.

General Discussion

First-generation students remain an overlooked social group to contribute innovative ideas to science and address the national priority of training future scientists. Our findings illustrate how two issues related to science motivation at different stages of the science pipeline (catching undergraduate science interest and pursuing graduate education) both create barriers for FGS' science access because they fail to support the communal orientations of FGS. This work extends existing literature on communal goals and Goal Congruity Theory (Diekman et al., 2010). First, we extended the consideration of purpose goals for science to FGS, which represents an expansion to the scope of Goal Congruity Theory, which has primarily examined gender differences in STEM pursuits (Diekman et al., 2010, 2011). Second, whereas Goal Congruity Theory has emphasized the distinction between communal and agentic goals, our work demonstrates that distinctions among types of communal goals are important (cf. Brown, Thoman, Smith, & Diekman, 2015). Only prosocial purpose goals, but not collaborative purpose goals, accounted for science interest differences between FGS and CGS. Third, we have identified a boundary condition in understanding the impact of communal goals on academic and career motivation. Much of the advanced education and training in STEM requires residential mobility to participate in these opportunities. For many FGS, however, and especially those in the Western and Midwestern U.S. regions, this educational structure becomes a barrier in pursuit of advanced training because it conflicts with staying close to family. Even if this barrier does not prevent these students from entering STEM careers, graduates who choose STEM jobs after a bachelor's degree may find limited opportunities for advancement in their careers compared to those who choose to pursue advanced degrees and training that often require residential mobility.

Communal Culture of Science Grabs Interest

Adding to a growing body of literature focused on FGS' academic motivation (e.g., Harackiewicz et al., 2014; Stephens et al., 2012, 2014), our findings suggest that one route to *catching* FGS' science interest is through enhancing the perception that science fulfills prosocial communal purpose goals. Consistent with an emerging line of psychological interventions focused on academic outcomes (e.g., Brown, Smith, et al., 2015; Harackiewicz et al., 2014; Yeager et al., 2014), we suggest that more explicit connections to prosocial communal utility value in science made by science educators, workforce training programs, research mentors, science practitioners, and career counselors should help enhance students' perception that science fulfills prosocial communal purpose goals. Strategically designed writing exercises can be easily incorporated into science classes, for example, and these have been effective at helping students make such connections (Brown, Smith, et al., 2015; Harackiewicz et al., in press). Science educators and workforce training programs could also incorporate more community-based learning opportunities (e.g., volunteering at local hospitals and field trips to companies/organizations that use science to help the community) into science curriculum. Furthermore, research mentors and science practitioners could intervene by more explicitly communicating the prosocial communal purpose of their work through research publications and public outreach (i.e., news interviews). Career counselors could intervene by enlisting the support of community members to set up opportunities for students to shadow science practitioners who use science in ways which better the community.

[6] The pattern of results was unchanged when controlling for gender.

Communal Structure of Science Holds Interest

A novel contribution of our work is suggesting that FGS experience a structural mobility barrier in *holding* their science interest. We suggest that distance learning opportunities, corporate partnerships, and telecommuting offer promising routes to hold FGS' science interest by removing the residential mobility barrier. When regional programs emphasize the importance of training in and giving back to their communities, programs begin to facilitate the process of changing the structure of science education and training (Hays, 2001). Providing access for all students to obtain graduate training close to home has the potential to increase accessibility to academic science careers (for a model, see Regional Medicine–Public Health Educational Center Initiative of the Association of American Medical Colleges[7]), while simultaneously providing the communal structure that benefits FGS students. Furthermore, given the wide variety of educational and career pursuits available to students after their undergraduate education—we also offer programming recommendations to employers. Corporations valuing the analytic and technological skills acquired by STEM students can become corporate partners with regional colleges and universities to recruit FGS for industry-related internship programs and/or entry-level jobs. Furthermore, partner corporations could offer more telecommuting opportunities in STEM-related jobs for FGS students. These types of opportunities would allow FGS to remain in the same community postgraduation and/or move to nearby cities which are accessible to FGS' families and personal support networks.

Future Research Directions

Most existing work on FGS and achievement focuses on early stages of the college career (Harackiewicz et al., 2014; Saenz et al., 2007; Stephens et al., 2014), but integrating support for communal goals into both the culture and structure of science education and training is important to recruiting and retaining diversity in STEM. Beyond testing our extensions of Goal Congruity Theory, as noted above, future work should explore the intersection of FGS with other identities (cf. Harackiewicz et al., in press). Furthermore, testing for differences between FGS of traditional/nontraditional age will be important in future work, as nontraditional aged FGS may have even more roots in their communities including home ownership and spousal careers.

Finally, we argue that other underrepresented groups in science valuing communal goals (e.g., women, Native American, Latino populations; Smith et al., 2014) may encounter similar barriers. For example, when describing a science task more independently (vs. collaboratively), women were less positive toward science (Diekman et al., 2011). Yet when describing biomedical research as not allowing for either helping others or collaborating with others, both men and women expressed less motivation to pursue science (Brown, Smith, et al., 2015). Our findings suggest that for members of groups that value giving back to and helping their community (i.e., FGS, Native American), interventions focusing on the prosocial as opposed to collaborative aspect of communion might be particularly effective. Future research is needed to better understand why this occurs, although promising directions may incorporate identity centrality and bringing a sense of honor to one's family and community. Indeed, as the cultural and structural barriers limiting science access are transformed, all underrepresented groups in STEM will likely benefit as will the field of science itself.

Conclusion

There is a synergistic opportunity for educators and researchers to combine forces to diversify and increase the scientific workforce by focusing on FGS' experiences. We argue it is important for stakeholders to facilitate student motivation and persistence by addressing cultural or structural issues with science itself, not by changing the students or simply offering financial incentives. Indeed, science has a responsibility for its graduate programs, research experiences, and academic and nonacademic careers to be unbiased and inclusive, thus enhancing its appeal to prospective students with diverse backgrounds.

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[7] For more information, see https://www.aamc.org/initiatives/diversity/portfolios/cdc/aamcbased/rmphec/.

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