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Putting Belonging in Context: Communal Affordances Signal Belonging in STEM

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Abstract

A sense of belonging in a particular context is cued not only by the people in the role but by the affordances of the role—that is, the opportunities for goal pursuit. We investigate this role-based belonging in four studies documenting that the perceived affordances of social roles inform sense of belonging and convey known benefits of belonging. Perceiving more communal opportunities in naturalistic science, technology, engineering, and mathematic (STEM) settings was associated with heightened belonging in those roles (Studies 1–2). Experimentally manipulating collaborative activities in a science lab increased anticipated belonging in the lab and fostered interest, particularly among women (Study 3). Finally, mentally simulating communal affordances in a role promoted recovery from belonging threat: Considering communal opportunities in STEM facilitated recovery of STEM-specific belonging after recalling exclusion in STEM (Study 4). Investigations of role-based belonging offer the potential for both theoretical and practical advances.

Keywords

belonging; motivation; communion; goal congruity; STEM

As individuals engage with roles—whether starting a new job, entering a new friendship network, or declaring a new major—they ask whether they belong in that specific role: Do I fit here? *Belonging* is a “general inference, drawn from cues, events, experiences, and relationships, about the quality of fit or potential fit between oneself and a setting” (Walton & Brady, 2017, p. 272). Although *who* is present in a role is an important cue to belonging, other cues matter as well: *What* is being done, *how* it is being done, and *why* it is being

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Supplemental Material

Supplemental material is available online with this article.

done. Thus, role activities can cue whether an individual belongs or not. We contend that the study of *role-based* belonging—a sense of fit to a particular social role—can expand knowledge about cues to belonging and about the nature of belonging itself.

Existing research has focused on only part of the construct of belonging. Namely, most work focuses solely on social cues, or how the people in a setting transmit messages that an individual is valued or devalued by other people in that setting. This interpersonal belonging, or a sense of connection to other people (e.g., Baumeister & Leary, 1995), is essential to understand because humans are fundamentally social creatures. However, the predominant focus on interpersonal belonging ignores other cues. Various features of the setting can signal belonging (such as physical surroundings; Cheryan et al., 2009; Murphy et al., 2007). We approach the study of belonging from a social structural perspective that examines individual behavior as emerging from and contributing to the broader environment. In this view, an individual's cognitions and attitudes are derived from their position in the social structure, whether that is defined as social roles (Eagly & Wood, 2011), status (Ridgeway & Bourg, 2004), or other features of culture (Markus & Kitayama, 2010).

This research investigates belonging as stemming from perceived alignment with social roles, and as contributing to selection and experience in social roles. For example, when a student feels that she can fulfill important values in science, technology, engineering, and mathematic (STEM) contexts, she is more likely to view STEM favorably and engage further in STEM. From a social structural perspective, aspects of the social role—indeed, the nature of the role activities themselves—can signal belonging. We focus on whether perceived *affordances*, or opportunities to fulfill valued goals within a role, inform sense of belonging. The affordances of particular interest here are opportunities to fulfill communal goals, such as altruism or collaboration. These perceived opportunities uniquely predict interest in STEM fields, relative to other careers (Diekman et al., 2017). Perceiving chances to fulfill communal goals opens up pathways to STEM that are attractive to a broader range of people. In STEM fields, belonging predicts positive academic and social outcomes (Good et al., 2012; Walton et al., 2015). Yet, to date, research has not investigated whether STEM belonging is signaled by the perceived nature of STEM work itself—specifically, whether STEM fields are perceived to afford communal goals.

Figure 1 presents the conceptual model of the psychological processes investigated in this research. The sequence begins with experience with a particular social role; that role then signals whether communal goals will be met in that role or not (i.e., affordances). When individuals perceive roles to provide opportunities to meet communal goals such as working with or helping others, they feel a greater sense of belonging in those roles. Greater belonging in STEM is then hypothesized to foster positive role outcomes, including interest in deepening role engagement or mitigating belonging threat. Simply put, substantial evidence documents that the communal affordances of roles can enhance role interest, and that belonging fosters positive outcomes. However, no evidence to date links communal affordances to belonging, or investigates whether role-based belonging cues might uniquely benefit role outcomes.

Existing Evidence: From Role to Affordance to Outcome

Individuals navigate networks of different social roles, which form opportunity structures to fulfill valued goals (Diekman & Eagly, 2008). Individuals approach roles seen as fulfilling important motives, and they avoid roles seen as thwarting important motives. In the model above, roles (a) communicate affordances (b), which influence engagement with the role (d).

In both perception and reality, social roles offer different affordances to fulfill goals: Some social roles offer opportunity to realize achievement or financial motivation, some social roles offer opportunity to connect to or help others, and some social roles offer both (Diekman et al., 2017). Situational affordances vary based on external realities as well as internal mental representation; a "match" between a want state and an expectation that the want will be filled motivates action (Kruglanski et al., 2014).

Opportunities to fulfill two fundamental dimensions of human motivation particularly influence social role decisions: *Communal* goals primarily focus on others (e.g., collaboration, altruism), whereas *agentic* goals primarily serve the self (e.g., success, power; Judd et al., 2005). Communal and agentic goals can be pursued simultaneously and can be mutually beneficial, and roles that offer both may be particularly valued. An obstacle for STEM recruitment is that STEM fields are commonly perceived—by those in and outside of the fields—as less likely than other occupations to fulfill communal goals (but equally likely to fill agentic goals; Diekman et al., 2010, 2011).

When a particular setting misaligns with motivation (in perception or reality), the result is dissatisfaction with the role. Students express less interest or engagement in STEM careers when they believe STEM careers do not afford communal goals (Brown et al., 2015; Jackson et al., 2016). Furthermore, experimentally framing STEM as fulfilling communal goals increases positivity toward that role, demonstrating that communal goal affordances causally influence STEM career interest (Belanger et al., 2017; Brown et al., 2015). Yet, the psychological processes through which communal affordances result in enhanced interest have not been documented.

Novel Questions Emerging From Role-Based Belonging

The expansion of the literature on belonging to encompass role-based belonging, or a sense of fit derived from attributes of social roles, can advance research and theory on belongingness. A sense of fit, or lack of fit, can be signaled from the content, nature, and purpose of role activities. Explicating these role-based belonging cues and processes can provide valuable insight, as we elaborate here.

Specifying a Mechanism Underlying Goal Congruity: Do Communal Affordances Cue Belonging in STEM?

We propose belonging as a mechanism through which communal affordances enhance STEM interest. In other words, individuals who occupy roles that fulfill their goals tend to feel fit, and in turn are more interested in persisting in those roles. We make these predictions for two reasons. First, collaborative roles might provide direct opportunities to

interact and connect with others. Second, even in the absence of direct interaction, prosocial purpose might signal that one fits in that role because it aligns with one's own values.

Although the prediction that perceiving communal goal opportunities will enhance belonging in STEM is straightforward, to date research has not examined whether perceived affordances of a role signal belonging (i.e., the b→c link in Figure 1). Some research provides suggestive but not direct evidence: Among a small sample of Native American students, valuing communal work goals predicted more uncertainty about belonging on campus 20 weeks later (Smith et al., 2014). However, this study did not measure whether the academic setting was perceived as lacking in communal opportunity, whether belonging decreased in STEM specifically, or whether other factors contributed. The current research is thus the first systematic investigation of the relationships among roles, perceived communal affordances, and sense of belonging in STEM.

Does Role-Based Belonging Provide Inclusion Benefits?

If communal STEM roles signal belonging to STEM, then these roles should confer known benefits of inclusion. We investigate whether role-based belonging buffers against the deleterious effects of exclusion experiences. Social exclusion results in the immediate decrease of belonging that recovers with time (Williams, 2007, 2009). Repeated exclusion can lead to detachment and feelings of alienation (Williams, 2009), resulting in withdrawal and avoidance (Ren et al., 2016; Smart Richman & Leary, 2009).

Understanding strategies to promote recovery from exclusion is of paramount importance. Features of both the individual and the exclusion event matter (Wesselmann et al., 2015). For example, individuals who pray, self-affirm, or distract recover more quickly from exclusion (Hales et al., 2016), and ostracism events attributed to a temporary rather than a permanent group membership promote recovery (Wirth & Williams, 2009). A social structural perspective suggests a third set of factors in the potential social roles that an individual might occupy: Roles that offer potential for inclusion should promote recovery from exclusion. Direct inclusion experiences mitigate negative effects of exclusion (Tang & Richardson, 2013), and anticipated inclusion derived from a social role may similarly promote recovery. Yet, this structural aspect has not been investigated. Mentally simulating roles that afford communal goals may serve as an inclusion proxy, even if they are not yet experienced. Understanding role-based belonging thus can provide new insight into processes of social exclusion and inclusion, as well as further understanding of how to prevent long-term disengagement from STEM.

Gender Differences and Similarities

The impact of communal affordances on belonging in STEM may be especially strong among women. In many STEM contexts, women experience greater belonging uncertainty than men due to their lower numerical representation (Murphy et al., 2007), as well as cultural stereotypes that associate men and masculinity with science and math (Nosek et al., 2002). Both men and women value communal goals, but women on average report greater communal goal endorsement (Diekman et al., 2011; Pohlmann, 2001). Perceiving STEM as affording communal goals can particularly foster interest among women (Diekman et al.,

2011; Steinberg & Diekman, 2018). Thus, communal affordances may signal belonging more strongly to women than men.

Yet, there is also good reason to hypothesize gender similarities in responses to communal opportunities. Similar responses are plausible because communal goals are highly valued by both men and women; the gender difference is moderate in size and reflects substantial overlap in the distributions of men and women. Highlighting communal opportunities increases the availability of goals in a setting, which can attract both men and women. In this case, the signal of communal affordances can foster belonging for both men and women. Consistent with the gender similarities hypothesis (Hyde, 2005), we expect communal affordances to signal belonging for both men and women in many contexts. In particular, settings that elicit strong communal needs similarly influence men's and women's interest in STEM (Diekman et al., 2011, Experiment 2). In the current studies, we test for gender moderation in all initial analyses. As noted above, plausible reasons exist to expect either gender similarly (i.e., no gender moderation) or gender difference (i.e., stronger effects for women). Due to these competing hypotheses, we made no firm a priori prediction.

Overview

The current research investigates whether communal affordances of a role signal a sense of belonging, and how belonging influences role outcomes (see Figure 2 for a visual representation). We focus on two key questions:

1. Do role-based communal affordances within STEM cue anticipated belonging (Studies 1–3)?
2. Do role-based communal affordances protect against threats to belonging by enhancing recovery from exclusion (Study 4)?

To address these questions, we employ a multimethodological approach incorporating longitudinal, field, and experimental methods. Furthermore, we examined questions in a wide range of samples, including college students, middle school students, STEM majors, and individuals highly identified with math and science. Study 1 examined whether undergraduates in STEM courses who perceive more communal affordances in their majors report greater belonging and, in turn, whether this belonging benefits career attitudes a year later. Study 2 investigated the naturalistic relationships among communal affordances, belonging, and career interest at a day-long event where middle school girls learned about women in STEM. In Study 3, we experimentally tested the hypothesis that a communal STEM role will cue greater belonging in the role and interest in role entry.

Finally, we investigated whether STEM communal affordances promote recovery from threatened STEM belonging. In Study 4, we predicted that considering the communal aspects of a science career would promote recovery from STEM-based exclusion. We tested whether unique benefits derive from perceiving communal opportunities in a STEM role, compared with communal opportunities outside of STEM.

Study 1: Longitudinal Benefits of Perceiving Communal Affordances

College represents an important choice point where students can opt out of or into STEM pathways. Indeed, longitudinal data indicate that nearly half (47%) of incoming STEM majors did not receive a STEM degree 6 years later (Chen & Weko, 2009). We thus sought to understand whether STEM students' early-college beliefs about goal opportunities in STEM cue belonging and predict their later-college career attitudes.

Method

Participants.—A recruitment message via email to introductory STEM courses or via the introductory psychology participant pool asked STEM majors to participate in a longitudinal study. Participants were compensated with a US$10.00 gift card or partial course credit at Time 1 and a US$15.00 gift card at Time 2.

These analyses include 152 college students participating in both Time 1 and Time 2 (approximately 1 year apart; an additional 75 respondents participated in Time 1 but not Time 2; 33% attrition). Participants included 68 men and 84 women (M_{age} = 19.3, SD = 2.12). Sensitivity analyses[1] using G*Power (Faul et al., 2007, 2009) demonstrated that this sample size could detect small-to-medium single regression coefficients (f^2 = .05). The sample at Time 1 was 84.8% White, 2.0% Black or African American, 2.0% Hispanic/Latino, 5.3% Asian, 5.9% other, and 0.7% unreported. The sample at Time 2 was 86.0% White, 2.2% Black or African American, 1.5% Hispanic/Latino, and 4.4% Asian (the remainder selected "other" or did not respond).

Procedure.—After granting informed consent, participants completed a battery of measures. Those relevant to current hypotheses are reported; other measures and results are available from the authors. Measures were completed in the order listed below.

Major affordances (Time 1).—Participants rated how much courses in their major fulfilled communal goals to *serve the community, work with others*, and *help others* on scales from 1 (*not at all*) to 7 (*extremely*). Items were averaged (α = .74).

Belonging (Time 1).—Participants rated six statements regarding belonging in the role (i.e., *I feel like I belong in my major; I feel like I fit in with the people in my major; I am unsure whether I belong in my major* [reverse]; *I consider myself a member of my major; Among people in my major, I feel like an outsider* (reverse); *I feel included by people in my major*). Ratings were made on scales from 1 (*strongly disagree*) to 7 (*strongly agree*), and items were averaged (α = .86).

Future career attitudes (Time 2).—Participants rated two items reflecting positivity toward their future careers: *I will enjoy my future career* and *How sure are you that this will be your future career?* Ratings were made on scales ranging from 1 (*not at all*) to 7 (*extremely*); items were averaged, $r(139) = .59$, $p < .001$.

[1] Sensitivity analyses throughout this work determine the smallest effect size that analyses can detect given the study sample size, power = .80, α = .05, and two-tailed tests.

Results

Major affordances.—Students perceived moderate levels of communal affordances in their majors; men (M = 4.98, SD = 1.11) and women (M = 4.75, SD = 1.26) did not significantly differ, $t(150) = 1.18$, $p = .25$.

Do affordances predict belonging and career attitudes?.—We hypothesized that early-college perceptions of communal opportunities in the major would predict belonging in the major, and that this sense of belonging would predict later-college career attitudes. We investigated this indirect effect using Hayes's (2013) PROCESS macro model 4 with 10,000 bootstrap samples (Figure 3). Communal affordances at Time 1 predicted sense of belonging in the major at Time 1, which in turn predicted students' career positivity at Time 2, b = 0.07, SE = 0.04, 95% confidence interval (CI) = [0.001, 0.167]. All paths were simultaneously tested for moderation by gender in Hayes's PROCESS macro model 59 but none were significant.

Summary

STEM students who see their major as fulfilling goals to help or work with others perceive greater belonging in their majors. In turn, greater belonging predicts more positive attitudes toward one's career path 1 year later. The effect of perceiving communal opportunities in one's major signaling career positivity through major belonging occurred for both male and female undergraduates. In the next study, we take a step further back in the STEM pathway to examine beliefs about communal opportunities in STEM among middle school girls.

Study 2: Girls at Science Day

We investigated communal affordance-based belonging among middle school girls who attended a one-day science advocacy event highlighting female scientists. Middle school is a point of inflection: Girls' STEM interest decreases by high school (Sadler et al., 2012). Because this event was not designed to highlight communal aspects of science, it provided a naturalistic opportunity to observe relationships between perceived communal affordances and interest in STEM.

Method

Participants.—Participants were 136 seventh- to eighth-grade girls (M_{age} = 13.18) attending Women and Science Day. Of these, 26 participants only completed end-of-day measures and were omitted from analyses, including beginning-of-day measures. With the final sample size of 110, sensitivity analyses show sufficient power to detect small- to medium-sized regression coefficients in all analyses (f^2 = .07 for models with two and three predictors; Faul et al., 2007, 2009). The sample was 73% White, 2% Black or African American, 1% Hispanic/Latino, and 3% Asian (the remainder selected "other" or did not respond). Participants were recruited for the event from regional middle schools. Teachers attended the event but not individual sessions. Parents provided consent for girls to attend the event and complete the surveys.

Procedure.—Upon arrival, participants completed pretest questionnaires, including perceptions of and interest in science/math careers. They attended two keynote addresses and three breakout sessions covering a range of topics (e.g., *Introduction to Competitive Robotics, Save the Frogs! Amphibian Conservation*, and *Dawn of Astronomy*). Sessions were assigned on preferences collected prior to Women and Science Day; all analyses controlled for preexisting goal affordances to account for self-selection effects. As part of an end-of-day survey, participants reported perceptions of Women and Science Day and STEM careers.

Materials

Initial measures

STEM career goal affordances.: Participants rated agreement with statements describing science and math as communal or agentic from 1 (*strongly disagree*) to 5 (*strongly agree*). Statements were adapted from prior measures of occupational value affordances designed for children (Weisgram et al., 2010). Communal affordances ($\alpha = .66$) included the following: *I believe science contributes to the well-being of society; I believe that math and science helps people; Science is interesting, but it does not benefit society much* (reverse); *I believe scientists aid the needy through their work; Scientists are loners who do not work to help others* (reverse); *I believe a career in science would allow me to connect with others.* Agentic affordances ($\alpha = .65$)[2] included the following: *A career in science would allow me to be in a position of power; I believe that scientists make a lot of money; Scientists often get more recognition than people in other jobs; Scientists often compete with others as part of their job; I believe a career in science would allow me to be my own boss; I believe a career in science would allow me to master my skills.* Items were averaged within each scale. Perceptions of STEM careers as affording communal and agentic goals were moderately correlated, $r(109) = .49$.

STEM career interest.: Participants read brief descriptions of seven STEM careers (e.g., "Scientists are people who try to figure out how the many different things in our world and our universe work using science. How much do you want to be a scientist?" Full text is available in supplemental materials). Participants rated interest in each career as "not at all," "a little bit," "some," or "a lot" (coded 1–4). Ratings were averaged into an interest score ($\alpha = .69$).

End-of-day measures.: Measures of *STEM career goal affordances*, $\alpha_{communal} = .69$; $\alpha_{agentic} = .64$; $r(135) = .40$, and *career interest* ($\alpha = .71$) were identical to the initial survey.

Session goal affordances.: Participants evaluated each of the three breakout sessions they attended. Participants reported how much each presenter "works with other people, helps others, or serves the community" in her career (communal affordances) and how much the presenter "can be in a position of power or make important decisions" in her career (agentic affordances). For each session, participants provided ratings on scales ranging from 1 =

[2]The alphas for affordances are lower than typically found in prior research or in later studies, perhaps due to the age of the sample. We retained the use of the averaged measure to be able to compare across studies, but results should be interpreted with caution.

strongly disagree to 5 = *strongly agree.* Responses were averaged across the three sessions as a proxy for the overall sense of how the set of presenters focused on communal or agentic aspects of science.

Belonging in STEM careers.: Participants rated agreement with the statement that "After Women and Science Day, I think I would fit in if I were in a math or science career" (1 = *strongly disagree* to 5 = *strongly agree*).

Results

Like many other interventions (see Liben & Coyle, 2014, for a review), the day-long event did not increase interest in STEM careers from the initial measure to the end-of-day measure, $t(109) = -0.41$, $p = .682$, 95% CI = [−0.11, 0.07], $d = -0.07$. However, exposure to different combinations of breakout sessions allowed us to test whether variability in the perceived communal content of the sessions predicted end-of-day STEM career interest, and whether any benefit of communal focus accrued from increased belonging in STEM. Our main analyses thus focus on participant-level beliefs and attitudes; analyses examining session effects in terms of temporal position or topic are presented in supplemental materials.

Unique contributions of communal affordances.—We employed a series of ordinary least squares (OLS) regressions to understand how perceiving breakout sessions as focused on communal or agentic aspects related to end-of-day STEM career affordances. The perceived communal focus of the sessions predicted end-of-day communal STEM affordances, $b = 0.24$, $p < .001$, $\beta = .27$, 95% CI = [0.12, 0.36], controlling for initial communal affordances. Likewise, the perceived agentic focus of the sessions predicted end-of-day agentic affordances, $b = 0.25$, $p < .001$, $\beta = .29$, 95% CI = [0.12, 0.38], controlling for initial agentic affordances.

We then tested whether end-of-day communal and agentic STEM affordances predicted end-of-day belonging in STEM (controlling for initial communal and agentic affordances). End-of-day communal STEM affordances uniquely predicted belonging, $b = 0.59$, $p = .004$, $\beta = .36$, 95% CI = [0.19, 0.99]. No other predictors emerged as significant in either model. Although both agentic and communal affordances of STEM were extracted from the breakout sessions, only end-of-day communal affordances uniquely predicted belonging in STEM.

Session communal affordances cue belonging and interest.—We examined whether the communal sequence described above predicted interest in STEM careers (see Figure 4 for serial mediation model; Hayes's (2013) PROCESS model 6 with 10,000 bootstrapped samples). Analyses controlled for initial beliefs about STEM communal goal affordances. As predicted, perceived communal affordances of the sessions predicted greater end-of-day perceptions of STEM communal affordances; these perceptions predicted greater STEM belonging, which subsequently predicted greater STEM career interest: .03, 95% CI = [0.006, 0.080].

Summary

Middle school girls who perceived female scientists acting communally in their careers reported greater beliefs that STEM careers afford communal goals, and in turn greater feelings of belonging in math and science. Greater belonging then predicted greater interest in pursuing math and science careers. These benefits occurred above and beyond girls' initial perceptions that STEM fulfills communal goals.

The naturalistic variability in the perceived communal focus of the breakout sessions illustrates that these affordances *can* be highlighted and communicated (see also Weisgram & Bigler, 2006), even among scientists who were not explicitly instructed to convey the communal aspects of their careers. Although this naturalistic evidence is promising, key questions remain. In particular, although analyses controlled for preexisting perceptions, the claim that communal opportunities heightens belonging requires an experimental manipulation of communal opportunities in science.

Study 3: Experimental Manipulation of Research Role

Following from the naturalistic relationships documented in Studies 1 and 2, we employed an experimental method in Study 3. Here, we recruited a sample of STEM majors to investigate the causal effects of role-based communal affordances on belonging.

Method

Participants and procedure.—Participants were 216 undergraduate STEM majors (M_{age} = 25.38; 119 men, 97 women) recruited via MTurk. On TurkPrime (Litman et al., 2017), participants read that the study investigated "reading comprehension and beliefs about careers." Participants' self-reported identifications were 60% White, 10% African American, 16% Asian American, 8% Hispanic, and 3% multiracial (the remainder selected "Other" or did not respond). Participants represented a variety of STEM majors (most frequently biological sciences [26%], engineering [25%], computing [19%], and math [16%]). Additional respondents who reported a non-STEM major were excluded from analyses. Sensitivity analyses suggested adequate power to detect small to moderate effects in between-subjects analyses of variance (ANOVAs; f = .19), mixed model ANOVA (f = .18 for between-subjects, f = .09 for within-subjects, and f = .18 for within-between interactions), and regression analyses (f^2 = .04 for all models; Faul et al., 2007, 2009).

Participants read a description of a typical day in a chemical engineering lab (adapted from Diekman et al., 2011) and imagined what working as a research assistant (RA) in the lab would be like. Participants were randomly assigned to learn about one of the two labs led by a male scientist (Dr. Smith). Labs were identical except that the collaborative lab provided more opportunities for face-to-face connection and mentoring than the independent lab (see supplemental materials). For instance, the core task of seeking consultation about procedure occurs through contact in the collaborative condition (i.e., "He meets some of his graduate students and research assistants in the lab and consults with them about the procedures") but without contact in the independent condition (i.e., "He looks up relevant past research to consult about the procedures"). After reading the lab description, participants rated the

likelihood that the RA role would fulfill communal and agentic goals, their interest in the RA position, and their projections of belonging in the lab.

Measures.—All items were on scales from 1 (*not at all*) to 7 (*extremely*). Items were averaged to form scales.

Goal affordances.—Participants rated how much working as Dr. Smith's RA would fulfill four communal goals (*work with or collaborate with others; conduct or contribute to work that benefits others; form connections with others; increase affiliation with her field*; α = .87) and four agentic goals (*gain competence, develop new skills; gain a deeper understanding of science or research materials; gain success*; α = .86; Fuesting & Diekman, 2017). Communal and agentic affordances were positively correlated, $r(216) = .72$, $p < .001$.

Belonging.—Participants rated their projected belonging (α = .90) on three items: "Would you fit in the lab?" "Would you feel like you belong in the lab?" and "Would you feel accepted in the lab?"

Role interest.—Participants rated three items assessing their interest in the RA role: Their likelihood of applying for and accepting the RA role, as well as their interest in taking the role (α = .92).

Results

Goal affordances.—We submitted perceived affordances to a 2 (Lab: collaborative, independent) × 2 (Gender) × 2 (Affordance: communal, agentic; within) mixed ANOVA. The main effect of lab, $F(1, 212) = 15.44$, $p = .0001$, $\eta_p^2 = .07$, was qualified by the Lab × Affordance interaction, $F(1, 212) = 25.27$, $p < .0001$, $\eta_p^2 = .11$(see Figure 5). The collaborative lab role was expected to fulfill more communal goals than the independent lab role, $F(1, 212) = 28.33$, $p < .0001$, $d = 0.72$. No significant difference emerged for agentic affordances, $F(1, 212) = 3.50$, $p = .06$, $d = 0.22$.

Furthermore, the three-way Lab × Affordance × Gender interaction was significant, $F(1, 212) = 6.19$, $p = .03$, $\eta_p^2 = .03$(see Figure 6). For communal affordances, only the simple effect of lab type emerged, $F(1, 212) = 28.82$, $p < .0001$, $\eta_p^2 = .12$, $d = 0.72$ (other ps > .45), showing that the role manipulation produced similar perceptions of communal opportunities among women and men (see Figure 6A). For agentic affordances, the Lab × Gender interaction, $F(1, 212) = 6.48$, $p = .01$, $\eta_p^2 = .03$, reflected that women viewed the collaborative lab as affording more agentic goals than the independent lab, $t(95) = 2.91$, $p = .005$, $d = 0.59$, whereas men did not, $t(117) = 0.51$, $p = .61$, $d = 0.09$ (see Figure 6B). Overall, the collaborative lab role afforded communal goals for both women and men, as well as agentic goals for women.

Effects of lab type on belonging and interest.—We submitted belonging to a 2 (Lab) × 2 (Gender) ANOVA. The main effect of lab, $F(1, 212) = 5.71$, $p = .02$, $\eta_p^2 = .03$, $d = 0.31$, was qualified by a Lab × Gender interaction, $F(1, 212) = 4.17$, $p = .04$, $\eta_p^2 = .02$. As seen in

Figure 7, the collaborative lab cued greater belonging for women than did the independent lab, $t(95) = 2.85$, $p = .01$, $d = 0.58$, but this same effect did not emerge for men, $t(117) = 0.27$, $p = .79$, $d = 0.05$.

A parallel analysis examining interest in joining the lab yielded only the Lab × Gender interaction, $F(1, 212) = 4.05$, $p = .05$, $\eta_p^2 = .02$. The communal (vs. the independent) lab elevated interest for women, $t(95) = 2.25$, $p = .03$, $d = 0.46$, but not men, $t(117) = 0.45$, $p = .65$, $d = 0.08$ (see Figure 8).

Effects of Affordances on Belonging and Interest

We investigated indirect effects of lab type on interest for all participants through a serial mediation model in which collaborative lab type (0 = independent; 1 = collaborative) predicted increased communal affordances, which predicted belonging in the role and then interest in the role (see Figure 9). We submitted data to Hayes's (2013) PROCESS macro model 6 with 10,000 bootstrapped samples, $b = 0.43$, $SE = 0.10$, 95% CI = [0.26, 0.66].

We examined moderation of all pathways by participant gender in Hayes's (2013) PROCESS macro model 92 with 10,000 bootstrapped samples (see supplemental materials). In addition to moderating the direct path as reported in ANOVA results above, participant gender (effect coded: −1 = male, 1 = female) moderated the path from communal affordances to belonging, interaction $b = 0.17$, $SE = 0.06$, $p = .004$, $\beta = .16$ (all other interaction ps > .50). Lab communal affordances more strongly predicted belonging for women, $b = 0.80$, $SE = 0.08$, $p < .0001$, $\beta = .75$, than for men, $b = 0.50$, $SE = 0.08$, $p < .0001$, $\beta = .47$. However, indirect effects emerged for both women, $b = 0.58$, $SE = 0.18$, 95% CI = [0.28, 1.02], and men, $b = 0.29$, $SE = 0.11$, 95% CI = [0.13, 0.56]. An index of moderated mediation suggests the indirect effects for men and women did not significantly differ: $b = 0.29$, $SE = 0.21$, 95% CI = [−0.11, 0.72].

Summary

For STEM majors, a hypothetical lab experience with communal opportunities cued anticipated belonging and interest in joining the lab. This study provided a conceptual replication of the key relationships demonstrated in previous studies while using an experimental manipulation of communal context. For women in particular, who can experience belonging uncertainty in STEM domains (Good et al., 2012), communal science contexts signal belonging, and projected belonging predicted interest in entering the role. Effects were stronger for women, but path analyses for men also showed the predicted pattern. The effect of communal affordances signaling lab interest through belonging did not significantly differ for women and men. Thus, for a wide range of students, perceiving communal opportunities in STEM roles can initiate a positive sequence.

Study 4: Communal Science Can Promote Recovery From Exclusion

Given the evidence that communal affordances cue belonging in STEM, we investigated whether communal construals of STEM can provide other known benefits of belonging. In particular, Study 4 examined whether communal affordances can promote recovery from

exclusion, similar to reminders of social belonging (Derrick et al., 2009; Troisi & Gabriel, 2011).

The study of role-based belonging can advance the understanding of social exclusion, which has predominantly considered belonging as a general need that might be fulfilled in various ways (e.g., Williams, 2007, 2009). If the purpose is to restore belonging generally, then which activity replenishes belonging is not of consequence. However, if the purpose is to restore belonging with a particular role, then the activities that replenish belonging matter a great deal. If role-specific belonging is absent, individuals will gravitate toward other roles that do provide belonging. A parallel pattern emerges in reaffiliation behaviors after exclusion: Individuals do not approach exclusion perpetrators for reaffiliation but instead approach novel others (Maner et al., 2007). Similarly, roles that offer reaffirmation of goal opportunities should uniquely replenish role-specific belonging, whereas roles that do not offer that reaffirmation should not.

Understanding these patterns of recovery can contribute to knowledge about how individuals navigate their social role networks. In particular, when a student experiences exclusion within STEM, what is the most effective way to bolster STEM belonging? Those who are excluded within a STEM context likely search for reaffiliation opportunities (Bernstein et al., 2008; Claypool & Bernstein, 2014; Pickett et al., 2004). Whether belonging is recovered through a role within or outside STEM can change what kind of belonging is recovered: Cues to communal affordances outside of STEM might restore a general sense of belonging, but cues to communal affordances within STEM are more likely to restore STEM-specific belonging. We predicted that a communal STEM context would provide unique benefits to STEM-specific belonging relative to general belonging.

Because our key hypothesis tested the effects of remembering exclusion in STEM fields, this study only included individuals who were highly identified with math or science (otherwise, exclusion from this domain may not be psychologically meaningful).

Method

Participants.—The final sample consisted of 153 students recruited from MTurk (M_{age} = 23.78; 75 men, 73 women, four other or not reporting) who reported being highly identified with math and science (Spencer et al., 1999). Sensitivity analysis showed that analyses could detect small to moderate effects in mixed model ANOVAs (f = .29 for between-subjects, f = .15 for within-subjects, f = .10 for within-between interactions). The sample was 62.7% European American, 9.8% African American, 12.5% Asian American, 9.9% Hispanic American, and 3.3% other. An additional 22 respondents stopped participating during the study without completing dependent measures; another 19 respondents did not comply with the writing prompt instructions (i.e., 17 wrote about being affirmed in STEM or did not write; two did not follow role manipulation instructions).[3]

[3]Supplemental materials report a study identical in design that failed to randomly assign participants to condition. All results replicated in direction and in significance.

Procedure.—Participants first reported communal goal endorsement (Diekman et al., 2010); no moderation emerged and this factor was omitted from subsequent analyses. As shown in Figure 10, participants reported baseline levels of STEM and general belonging (Time 1-baseline). Next, participants wrote about a time they were excluded in STEM, and then reported their levels of STEM and general belonging (Time 2-immediate). Participants then wrote a first-person essay about a communal STEM career, a noncommunal STEM career, or a communal non-STEM activity, and reported their STEM belonging and general belonging (Time 3-delayed). Finally, participants reported demographics.

Exclusion and role manipulations

Exclusion.—Participants wrote about a time they felt excluded in a STEM class for 4 min (e.g., Bernstein et al., 2008). A pilot test with an independent sample ($N = 23$) tested whether this manipulation threatened belonging by comparing it with a control condition where participants wrote about what happened after they woke up the previous day. Students highly identified with math and science reported greater belonging threat after writing about a time they were excluded in STEM than the control, $p = .04$.

Role manipulation.—Participants then completed one of the three writing prompts that varied whether the focal activity included communal affordances and occurred in STEM. The *communal STEM* prompt was the condition of interest compared against two control conditions: *noncommunal STEM* and *communal non-STEM*. The *noncommunal STEM control* condition allowed us to test whether communal opportunities in STEM, relative to any engagement in STEM, promote recovery of STEM belonging. The second control condition, the *communal non-STEM control*, allowed us to test whether communal opportunities in STEM, relative to communal opportunities outside of STEM, promote recovery of STEM belonging. The three writing prompts were as follows:

Communal STEM Prompt

Imagine that you are a scientist who is part of a lab group that researches genetic mutations to help people who have heart disease. As part of your job, you work with others to conduct experiments, use a microscope, analyze data, mentor younger scientists, and share your findings with others.

Noncommunal STEM Control Prompt

Imagine you are a scientist who works alone to research genetic mutations to understand the causes of biological processes. As part of your job, you conduct experiments alone, use a microscope, analyze data, and share your findings with others.

Communal Non-STEM Control Prompt

Imagine you are part of the club, Volunteers United. As part of Volunteers United, you work with other members to help people in the community. As part of your role, you volunteer at a soup kitchen, mentor a child, and play games with people at a local nursing home.

Participants wrote for 4 min about what they would do in the role, how they would feel about the role, and whether they would like the role. An independent pilot sample perceived

the communal STEM role to afford more communal goals than the noncommunal STEM role, $p < .001$, $d = 0.74$, whereas no difference emerged for agentic goals, $p = .40$, $d = 0.26$. The writing tasks did not differ in perceived difficulty, $p = .75$, $d = 0.10$. In a separate sample (Study S1 in supplemental materials), both communal conditions were believed to fulfill communal goals more than the noncommunal control, $F(2, 198) = 22.83$, $p < .001$, $d = 0.68$, and both the communal STEM and noncommunal STEM prompts were perceived as more related to STEM than the non-STEM control, $F(2, 200) = 154.21$, $p < .001$, $d = 1.77$.

Measures.—Throughout, items were averaged within time point.

STEM belonging.—STEM belonging was measured using a subscale adapted from the basic needs fulfillment scale (Zadro et al., 2004). The prefix “in STEM” was added: “In STEM, I feel like I belong to a group,” “In STEM, I feel disconnected (reverse scored),” “In STEM, I feel rejected (reverse scored),” “In STEM, I feel like an outsider (reverse scored).” Items were rated on scales from 1 (*not at all true*) to 9 (*completely true*; $\alpha_{\text{time 1}} = .87$; $\alpha_{\text{time 2}} = .88$; $\alpha_{\text{time 3}} = .84$).

General belonging.—Immediately following the STEM belonging measure, participants reported their general belonging using the standard belongingness need fulfillment questionnaire (Zadro et al., 2004; $\alpha_{\text{time 1}} = .85$; $\alpha_{\text{time 2}} = .87$; $\alpha_{\text{time 3}} = .81$).

Mood.—To rule out mood as an alternative explanation, participants rated their mood at each time point. Participants responded to three items on nine-point scales anchored by *bad-good, sad-happy*, and *tense-relaxed*. Higher scores indicated more positive mood ($\alpha_{\text{time 1}} = .87$, $\alpha_{\text{time 2}} = .91$, $\alpha_{\text{time 3}} = .90$).

Results

Initial results tested for moderation by gender; no systematic effects emerged, and thus we omitted gender from the analyses reported here.

Exclusion manipulation check.—We first examined changes in belonging following the exclusion prompt in a 3 Role (communal STEM, communal non-STEM, or noncommunal STEM) × 2 Time (baseline, immediate) × 2 Belonging Type (STEM, general) mixed ANOVA with role as a between-subjects factor.[4] Belonging decreased after writing about exclusion (from baseline to immediately following exclusion), $F(1, 150) = 20.32$, $p < .001$, $\eta_p^2 = .12$, although significant effects obtained only for STEM belonging, as reflected in the Time × Belonging Type interaction, $F(1, 150) = 14.24$, $p < .001$, $\eta_p^2 = .09$(see Figure 11). STEM belonging decreased following the STEM exclusion writing, $F(1, 150) = 31.29$, $p < .001$, $\eta_p^2 = .17$, whereas general belonging did not, $F(1, 150) = 3.06$, $p = .08$, $\eta_p^2 = .02$.

Test of the hypothesis.—The key hypothesis posited that considering a communal STEM career would especially promote recovery of STEM belonging, relative to the two

[4]The role manipulation had not yet occurred at baseline and thus cannot have affected baseline belonging. However, we included this factor to rule out the failure of random assignment.

control conditions. Analyses thus compared STEM and general belonging immediately after exclusion and after the role manipulation.

We conducted a 3 Role (communal STEM, communal non-STEM, or noncommunal STEM) × 2 Time (immediate, delayed) × 2 Belonging Type (STEM, general) mixed ANOVA with role as a between-subjects factor. The Role × Time × Belonging Type interaction, $F(2, 149) = 6.80$, $p = .002$, $\eta_p^2 = .08$, subsumed the effect of time, $F(1, 149) = 34.68$, $p < .001$, $\eta_p^2 = .19$ (see Figures 12 for discrepancy scores and Figure 13 for raw scores). No other effects emerged. As predicted, the communal STEM career condition most effectively promoted recovery of STEM-specific belonging following a reminder of exclusion in STEM. To decompose the three-way interaction, we conducted Time × Belonging Type within-subjects ANOVAs within each role condition.

Communal STEM condition.—In the communal STEM condition, the Time × Belonging Type interaction, $F(1, 53) = 6.91$, $p = .01$, $\eta_p^2 = .12$, subsumed the effect of time, $F(1, 53) = 26.46$, $p < .001$, $\eta_p^2 = .34$. After writing about a communal STEM career, STEM belonging increased more, $F(1, 53) = 21.52$, $p < .001$, $\eta_p^2 = .30$, than general belonging, $F(1, 53) = 5.67$, $p = .02$, $\eta_p^2 = .10$. Considering a communal STEM career improved STEM belonging more than general belonging.

Noncommunal STEM control.—In the noncommunal STEM control condition, the lone effect was an increase in belonging over time, $F(1, 47) = 7.02$, $p = .01$, $\eta_p^2 = .14$. Belonging type did not moderate the effect of time, $F(1, 47) = 0.20$, $p = .65$, $\eta_p^2 = .004$, for the two-way interaction.

Communal non-STEM control.—In the communal non-STEM control condition, the Time × Belonging Type interaction, $F(1, 49) = 7.09$, $p = .01$, $\eta_p^2 = .13$, subsumed the effect of time, $F(1, 49) = 10.39$, $p = .002$, $\eta_p^2 = .18$. Here, general belonging increased more, $F(1, 48) = 12.92$, $p < .001$, $\eta_p^2 = .22$, than STEM belonging, $F(1, 49) = 4.49$, $p = .04$, $\eta_p^2 = .09$. After writing about a communal activity outside of STEM, general belonging increased more than STEM belonging.

As shown in Figures 12 and 13, the communal STEM career condition most effectively promoted recovery of STEM-specific belonging following a reminder of exclusion in STEM. Considering a communal science role increased STEM-specific belonging more than considering either a noncommunal science role or a communal but nonscience role.

Mood as an alternative explanation?—To assess mood as a possible explanation for the effects of role on STEM belonging, mood scores were submitted to a Role × Time mixed ANOVA. There was no main effect of role on mood, $F(2, 149) = 0.82$, $p = .44$, $\eta_p^2 = .01$. The main effect of time reflected that positive mood decreased from Time 1 to Time 2 and increased from Time 2 to Time 3: $F(2, 298) = 22.21$, $p < .001$, $\eta_p^2 = .13$. However, this effect

was not moderated by role, $F(4, 298) = 1.14$, $p = .34$, $\eta_p^2 = .01$, thus ruling out mood as accounting for effects on recovery of STEM-specific belonging.

Summary

Considering communal opportunities within a scientist role accorded unique benefits to STEM belonging. After recalling an exclusion experience in STEM, respondents who imagined enacting science in a communally oriented way experienced greater recovery of STEM belonging, relative to general belonging, than did respondents who imagined enacting science independently or engaging in communally oriented volunteer activities.

The control conditions provided two important comparisons. First, writing about communal science benefited STEM belonging more than writing about independent science, and this differential recovery suggests that the benefit of the communal STEM condition cannot solely be attributed to considering any STEM role or to spontaneous recovery over time. Second, writing about communal opportunities in volunteering benefited general belonging but not STEM belonging. Communal affordances that are STEM-specific uniquely promoted recovery of threatened STEM belonging. Future research should address the long-term sequelae of meeting communal goals outside of STEM: An unintended consequence of reinforcing belonging outside of STEM may be reducing capacity for STEM belonging.

General Discussion

These studies demonstrate a structural basis for belonging: When roles are perceived to afford valued goals, individuals anticipate that they will belong more in that role. Within STEM roles, seeing opportunities to fulfill communal goals signaled belonging. This heightened fit between the self and the setting then fostered interest in entering the role. Across a range of methods, perceived communal affordances in STEM predicted belonging and interest in STEM and promoted recovery of threatened STEM belonging.

Robust relationships between communal affordances and belonging emerged across varying samples, measures, and methods. Among college students in STEM, perceptions that their major provided opportunities to pursue communal goals predicted increased belonging in their major. Among middle school girls, girls who saw presenters at Women and Science Day as acting communally in their careers anticipated more belonging (and in turn expressed more interest in math and science careers). Similarly, STEM majors randomly assigned to consider a collaborative research assistant role believed the role would fulfill communal goals; this collaborative role cued belonging in the lab for female students. Finally, imagining a communally oriented science role protected against the negative effects of exclusion in STEM. In different settings, at different developmental stages, and with different STEM disciplines, anticipated belonging emerged as a robust mechanism underlying the motivational benefits of communal affordances for STEM interest.

Theoretical Implications

These findings suggest that a sense of belonging in a particular role (i.e., a major or field) can be usefully differentiated from a sense of belonging more generally. This distinction

provides clarity for research programs on belonging and exclusion. One priority is to demarcate different *cues* to belonging that go beyond demographic characteristics, and another is to delineate *types* of belonging—that is, what fit is being assessed? The study of belongingness often presumes but does not explicitly note social fit, and some fit assessments encompass both social and nonsocial elements—for example, Walton and Cohen's (2007) academic fit construct includes social and self-efficacy. Multiple forms of fit (goal fit, social fit, and self-concept fit) are integrated into the situated authenticity as fit to environment model (Schmader & Sedikides, 2017), and the current findings suggest that such different aspects of fit can inform each other. This work thus joins the call for additional research that elaborates both cues and types of belonging, and their relationships with each other.

This research adds another set of variables that can mitigate the negative effects of exclusion by demonstrating that anticipating social roles can serve as a proxy for inclusion. Future research should elaborate whether such role moderation is unique to communally focused social roles (which can involve direct social contact) or also occurs for other goal-congruent roles (which may or may not involve direct social contact). Examining how anticipated social roles can serve as simulated inclusion experiences offers a new direction to understand responses to exclusion. Exclusion reactions can include both prosocial and antisocial responses (see Smart Richman & Leary, 2009). Prosocial responses emerge when individuals think that the context affords affiliation, such as interactions with people other than the person who excluded them (Maner et al., 2007). A contribution of the current work is demonstrating that these potential affiliative contexts can be broader in nature. Here, participants were simply asked to mentally simulate being in a STEM role that involved working with and helping others (rather than to actually engage in such a role). Yet, highlighting such communal opportunities in STEM promoted recovery following exclusion. Even the act of mentally representing that role was sufficient to boost belonging in STEM.

These findings provide evidence of both gender similarity and difference in whether communal affordances in STEM cue belonging. In studies with stronger contextual signals, men and women perceived communal opportunities similarly and reacted similarly to their presence. For example, students reflecting on their own majors showed similar prediction of belonging from communal affordances. Likewise, male and female students remembering a threat to belonging (e.g., Study 4's exclusion manipulation) showed similar benefits of considering a communal STEM role. Yet, communal affordances might be a more powerful cue in roles with less contextual information—and particularly where women are underrepresented. Consistent with this idea, women who considered joining a hypothetical chemistry lab (Study 3) showed stronger effects of a collaborative lab structure on their goal affordances, belonging, and interest in joining the lab. Yet, even in this study, both men and women who perceived communal opportunities reported greater anticipated belonging. Highlighting communal affordances in science or engineering contexts can benefit not only women but also men (see Boucher et al., 2017, for discussion).

Practical Implications

These studies offer a new vantage point to consider why some interventions to increase interest in STEM fail: Only exposure that disrupts noncommunal stereotypes about STEM will change these perceptions about STEM. Simply increasing exposure to STEM may either have no effect, or could even cement preexisting noncommunal stereotypes due to expectancy confirmation processes. Integrating communal experiences in intervention efforts, such as including activities that highlight altruistic or collaborative practices (Colvin et al., 2013) or service learning (Brinkman & Diekman, 2016), can disrupt stereotypic expectancies and engage a broader swath of students in STEM.

Understanding the processes involved in role-based belonging broadens the definition of belonging and, in so doing, can broaden the range of belonging cues. Cues based on the nature of the work itself occupy a meaningful middle ground between identity-based cues (e.g., numerical representation; Murphy et al., 2007) and cues that have no relation to STEM work (e.g., shared birthday; Walton et al., 2012). Finding cues to belonging that can be enacted by majority group members is practically important to broadening participation in STEM: Relying solely on demographic similarity is an inherently inefficient strategy because most current STEM role occupants are *not* from underrepresented groups (by definition). Highlighting communal aspects of STEM to cue belonging—and doing so by men and in male-dominated fields—can cue belonging for women in STEM even when they are numerically underrepresented. Establishing that majority stakeholders can provide belongingness cues to underrepresented students through their inclusion of communally oriented content holds promise as an intervention strategy.

Limitations

These studies demonstrate that communal affordances can signal belonging to individuals from middle school through adulthood; future research should investigate moderation by such theoretically and practically relevant variables such as ethnicity. As noted earlier, Native American students in STEM more highly endorsed communal work goals than White students, and such endorsement of communal work goals predicted later belonging uncertainty (Smith et al., 2014). Cues to prosocial values within scientific lab groups more strongly predicts underrepresented minority students' interest in continuing in science, relative to majority students (Thoman et al., 2017). Documenting role-based belonging within majority populations, therefore, may be a conservative test of the hypothesis and deserves further exploration.

The knowledge that considering communal opportunities outside of STEM boosts general belonging, but not STEM-specific belonging, provides an answer to a key question from the goal congruity model: If communal goals are not met within STEM, is it possible to meet them outside of STEM, and if so, what are the consequences? Considering communal opportunities outside of STEM promoted recovery of general belonging, suggesting that people whose communal goals go unmet within their major or workplace can benefit from considering extra-role opportunities. However, this benefit comes at a cost: Although general belonging is elevated, STEM-specific belonging is not. Yet, the current research cannot yet

answer questions about the long-term consequences of restoring belonging outside of STEM for motivation and persistence within STEM.

Conclusion

The social structure serves as both antecedent and consequence of belonging. STEM roles perceived as affording communal goals predict heightened belonging, and that belonging predicts interest in engaging in the role, as well as mitigating negative effects of belonging threat. This theoretical and empirical advance can also yield direct practical advances by expanding the range of potential cues to belonging in STEM. When belonging is cued by the nature of the work itself, a tool for inclusion is in the hands of many more people.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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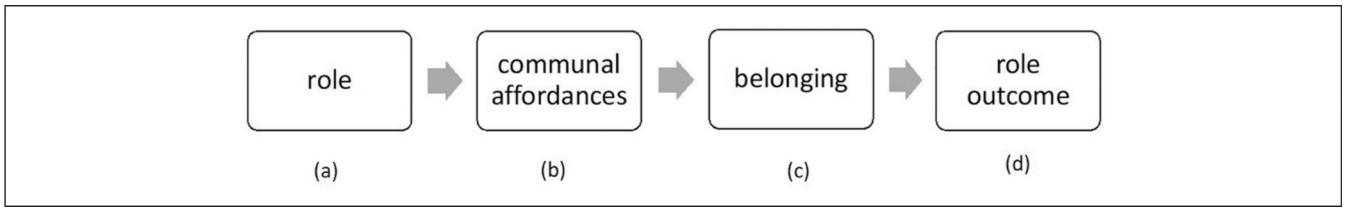

Figure 1.
A model of role-based belonging.

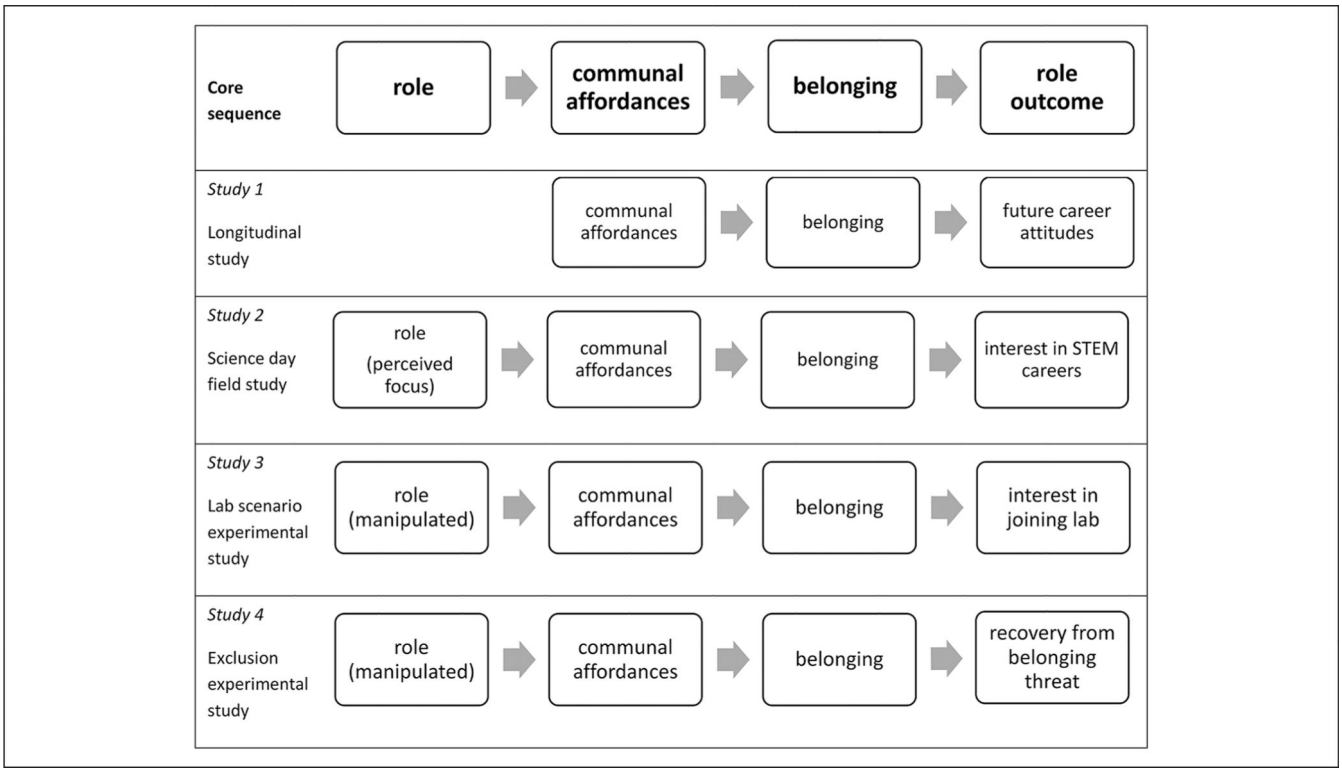

Figure 2.
Overview of role-based belonging processes (Studies 1–4).

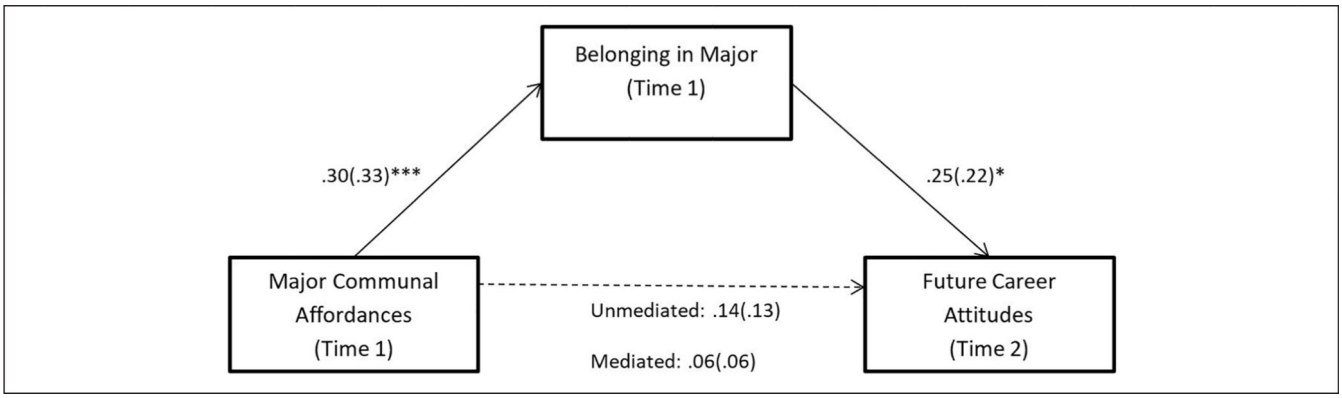

Figure 3.

Indirect effect of communal affordances on career attitudes through belonging—*b*(β).

**p* < .05. ****p* < .001.

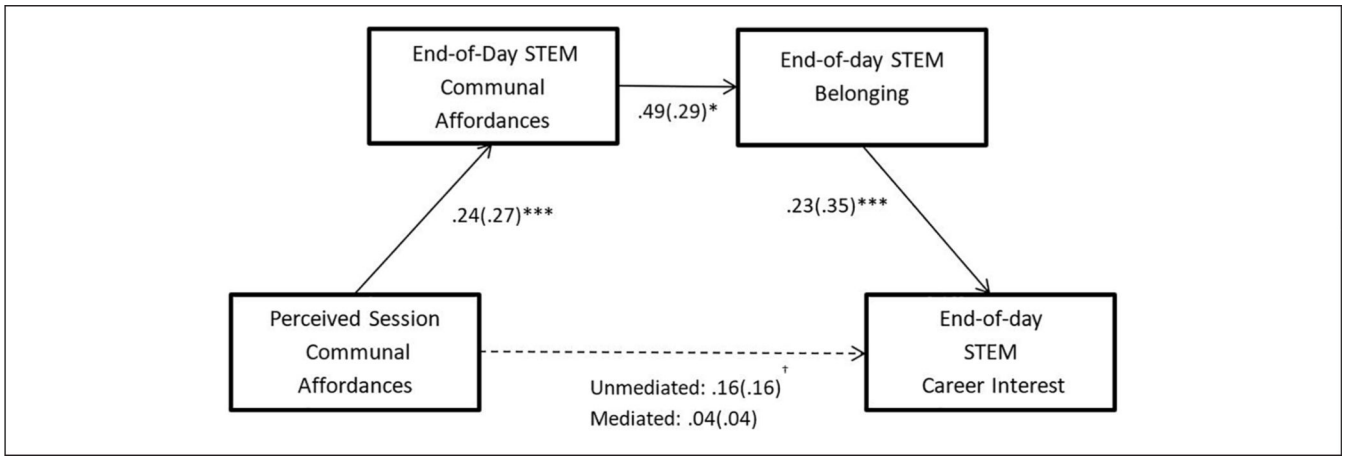

Figure 4.

Serial mediation (Study 2), controlling for initial STEM communal affordances—*b*(β).

Note. STEM = science, technology, engineering, and mathematics.

†$p = .08$. *$p < .05$. ***$p < .001$.

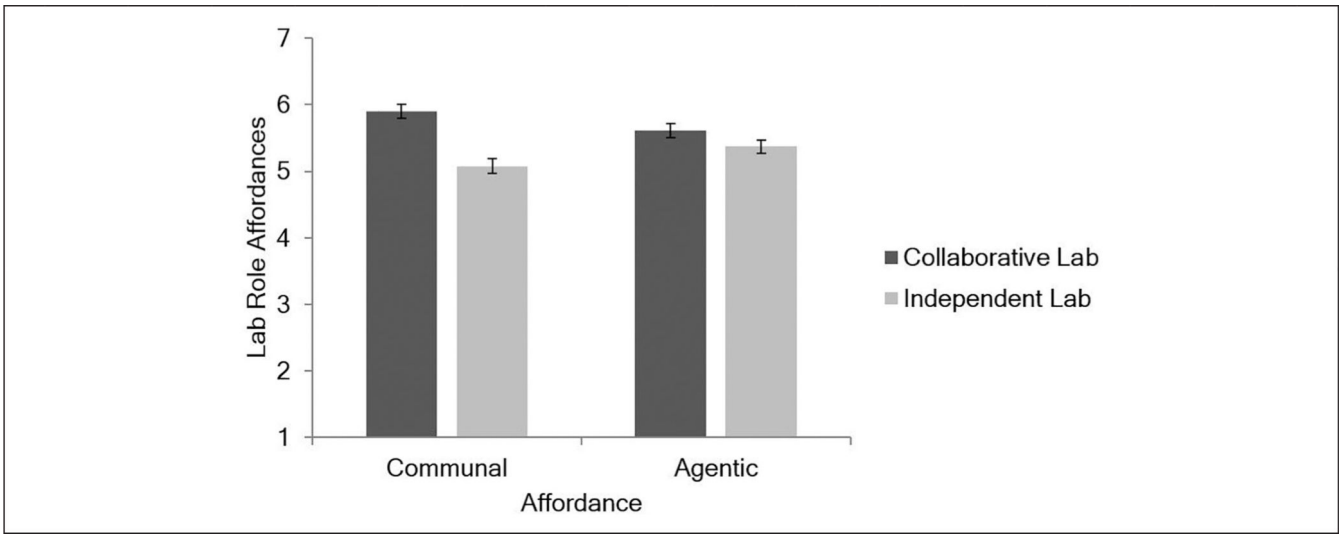

Figure 5.
Effects of lab type on goal affordances (Study 3).
Note. Error bars represent ±1 *SE*.

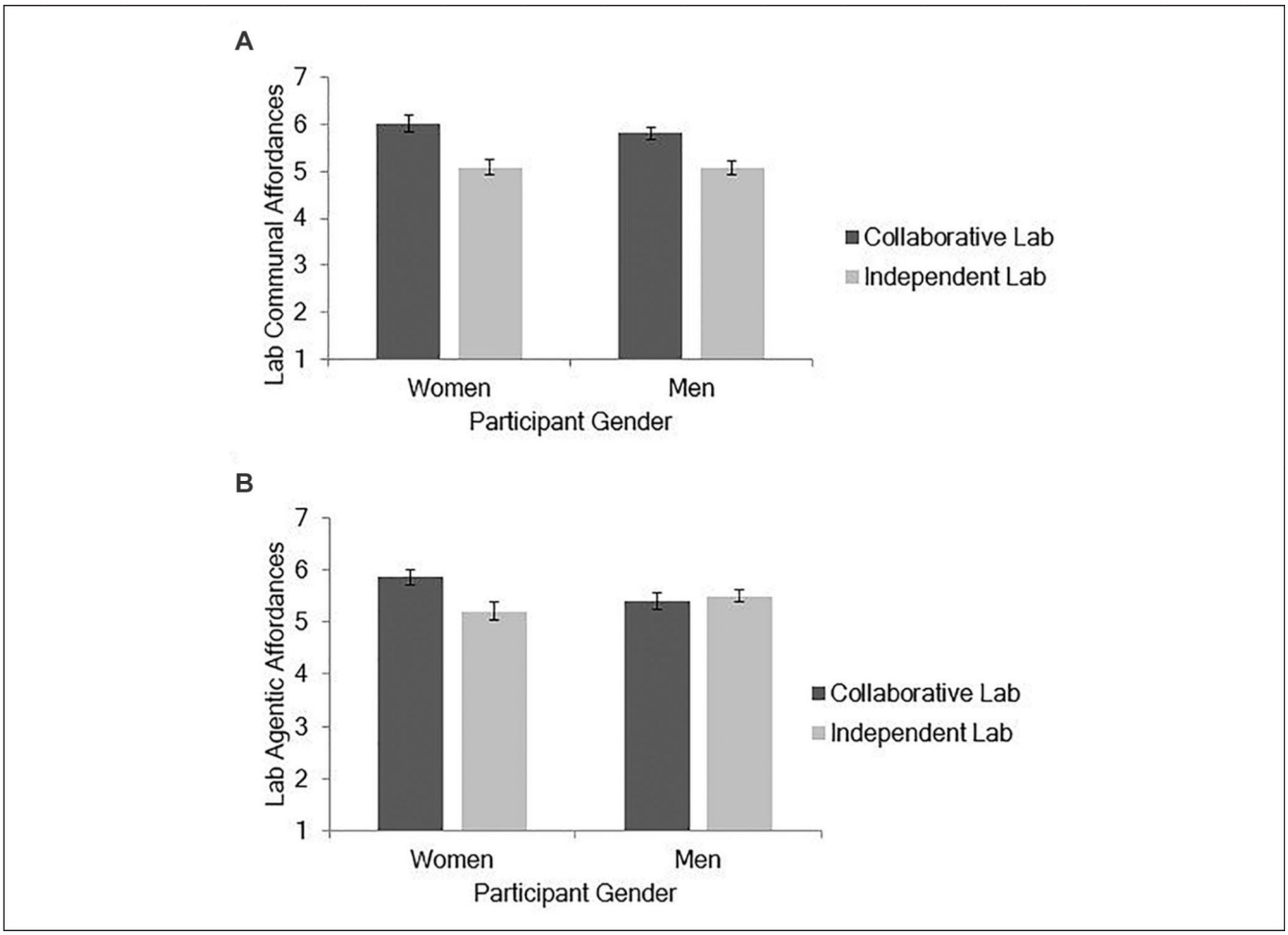

Figure 6.

The effects of lab type and gender on communal affordances (panel A) and agentic affordances (panel B; Study 3).

Note. Error bars represent ±1 *SE*.

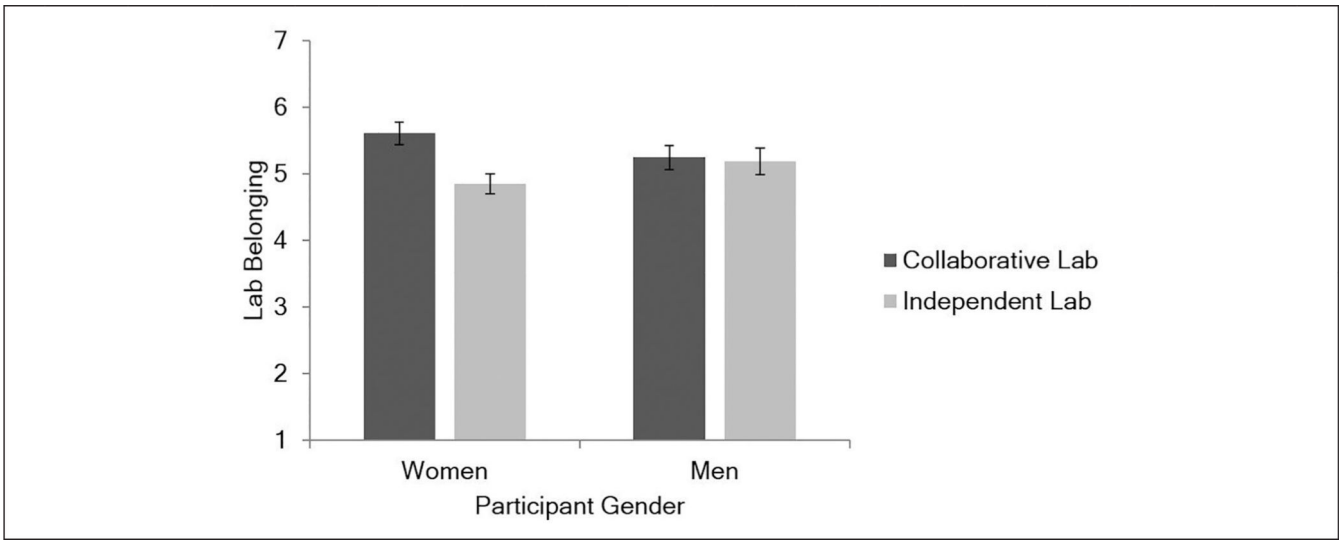

Figure 7.
Effects of lab type and gender on belonging (Study 3).
Note. Error bars represent ±1 *SE*.

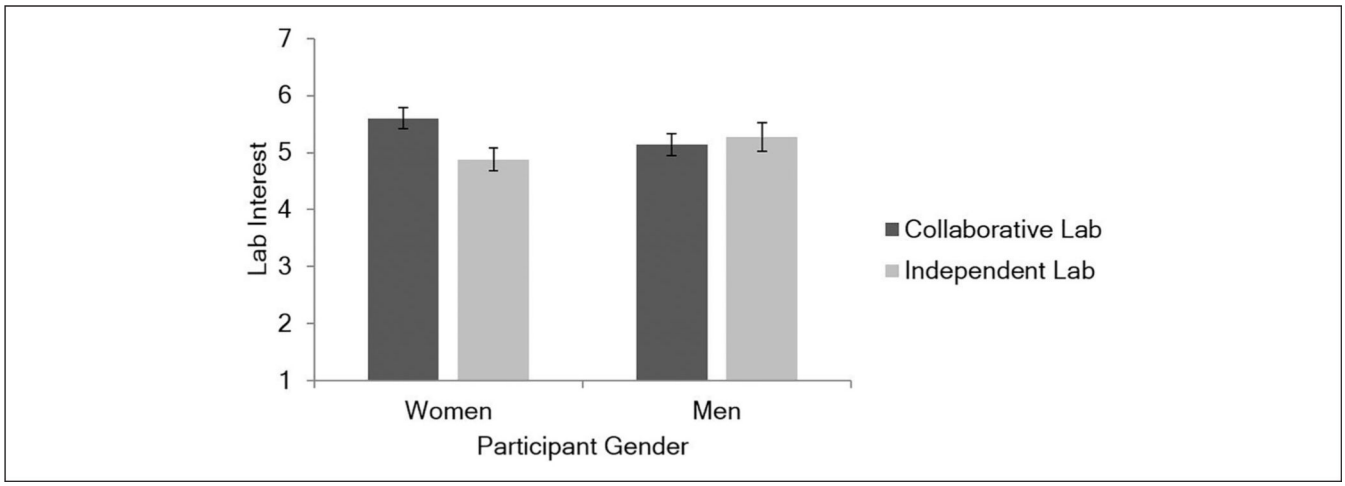

Figure 8.
Effects of lab type and gender on interest in joining the lab (Study 3).

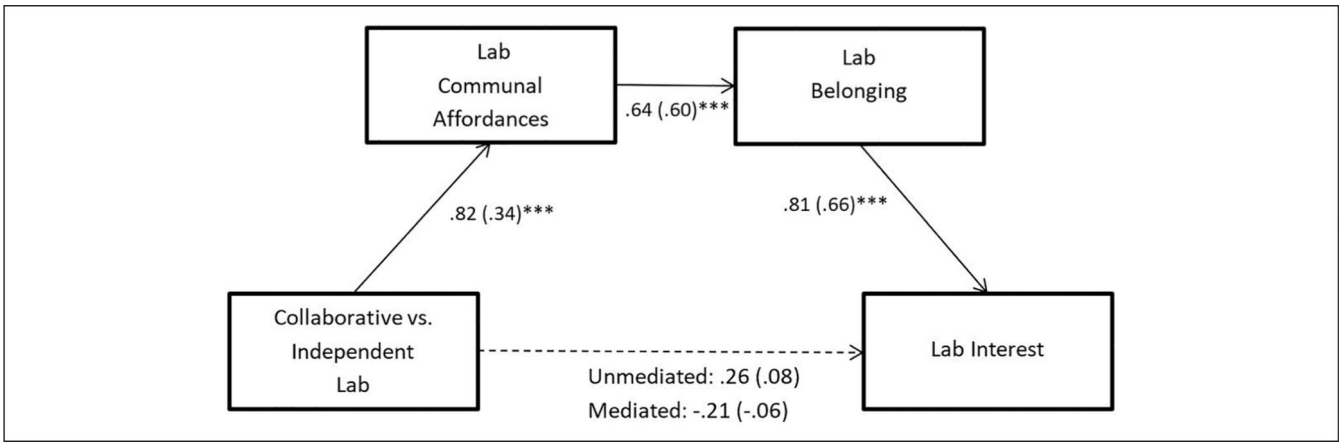

Figure 9.

Serial model of lab type predicting interest through communal affordances and belonging (Study 3)—*b*(β).

*$p < .05$. **$p < .01$. ***$p < .001$.

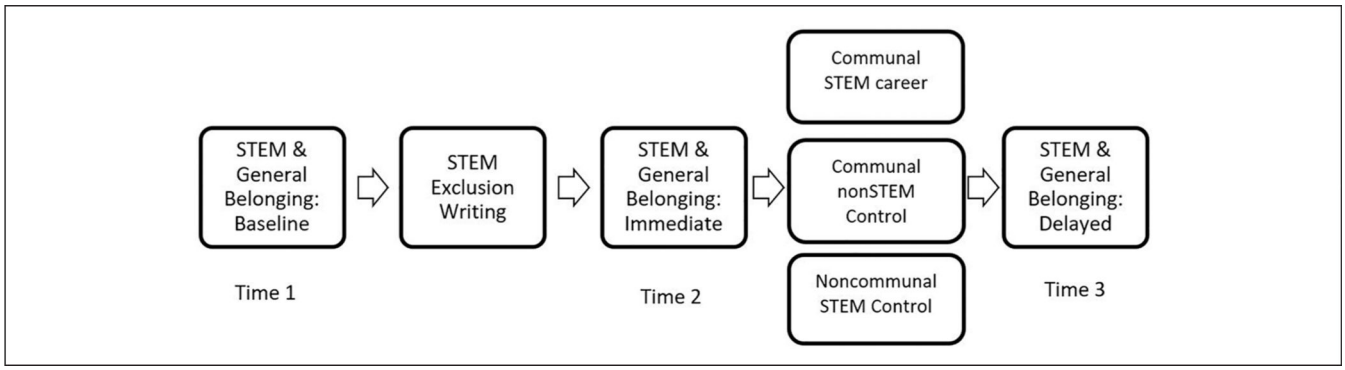

Figure 10.
Study 4 procedure.
Note. STEM = science, technology, engineering, and mathematics.

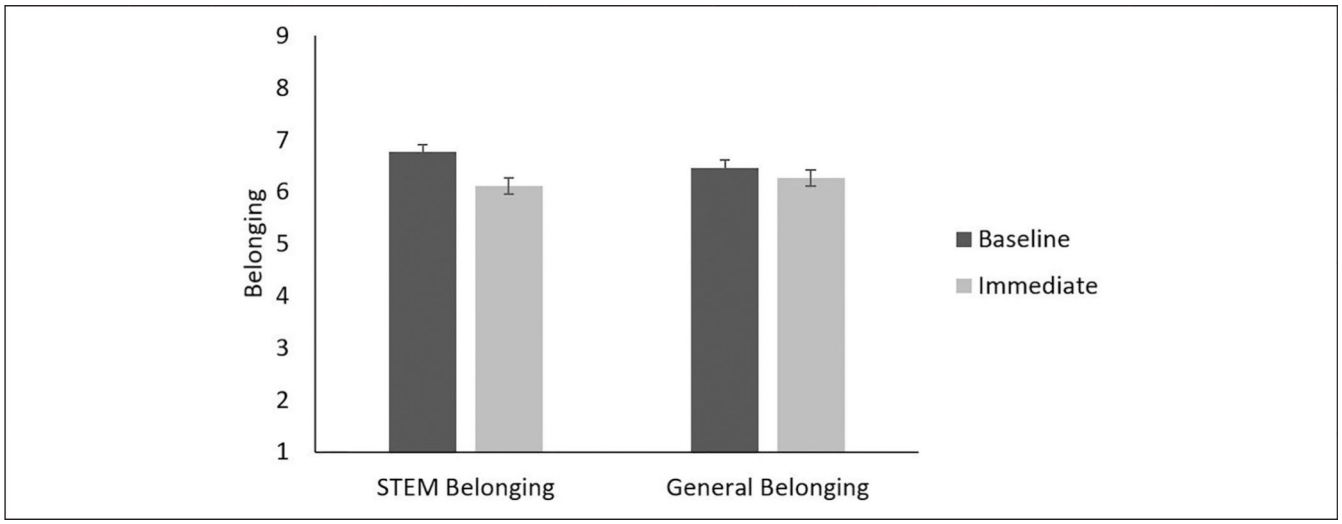

Figure 11.
Exclusion reduced belonging (Study 4).
Note. Error bars represent ±1 *SE*.

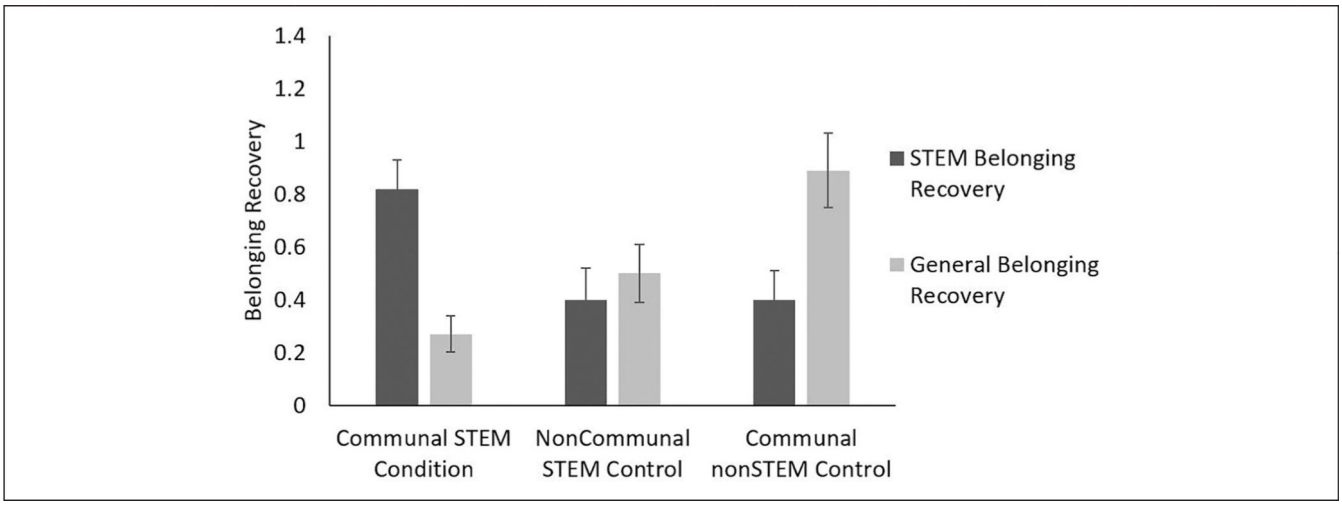

Figure 12.

The effect of role on STEM-specific and general belonging recovery (Study 4).

Note. Recovery was calculated by subtracting immediate scores from delayed scores. Error bars represent ±1 *SE*. STEM = science, technology, engineering, and mathematics.

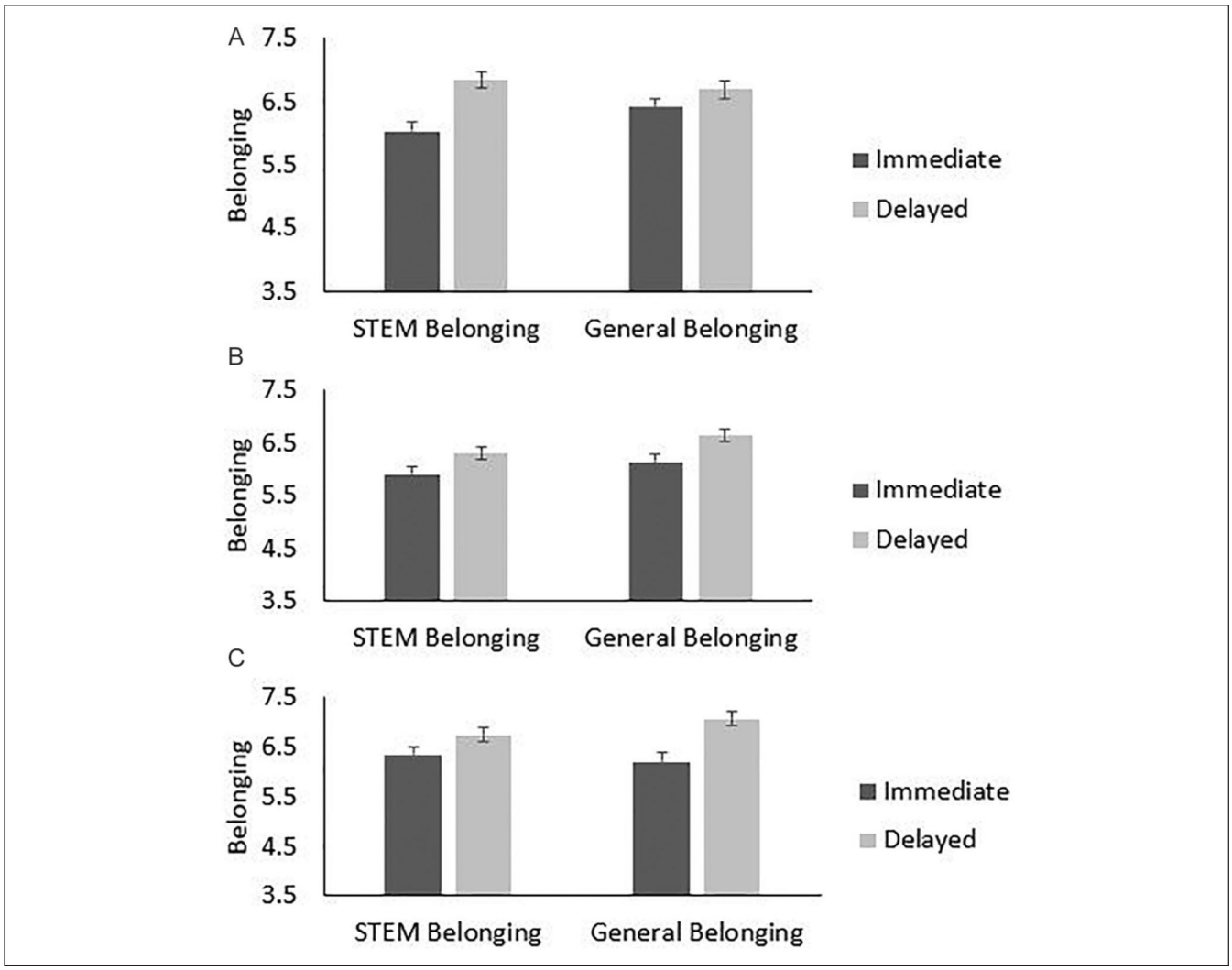

Figure 13.

Recovery of belonging by role (Study 4).

Note. Error bars represent ±1 *SE*. Immediate occurred just after exclusion; delayed occurred just after the role manipulation. Panel A: Communal STEM; Panel B: Noncommunal STEM; Panel C: Communal non-STEM. STEM = science, technology, engineering, and mathematics.