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STEM Inqueery: How Communion and Feminine Gender Expression Affects LGBTQ Individuals Pursuing STEM

Jasmine Elise Graham
University of North Florida, jasmine.elise.graham@unf.edu

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by

Jasmine Elise Graham

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Table of Contents

List of Tables

List of Figures

Abstract

Previous research has examined why some US students, Black, Latinx, and women are underrepresented in science, technology, engineering, and mathematics (STEM). However, at least 7.1% lesbian, gay, bisexual, transgender, and queer (LGBTQ) individuals live in the US, so what about the LGBTQ community pursuing STEM? We know that STEM careers are stereotypically seen as agentic and masculine instead of communal and feminine although LGBTQ individuals desire community within STEM and want to express their femininity. The current study examines how perceived communal opportunities in STEM and feminine gender expression are related to feelings of belonging and motivation to pursue STEM. Across a sample of university students (Study 1) and a sample of participants recruited through MTurk (Study 2), we found that LGBTQ individuals and non-LGBTQ women expressed less belonging in STEM than non-LGBTQ men (Study 1, 2). Further, LGBTQ individuals who were more open about their identity expressed more belonging in STEM (Study 1). Path analysis models show the relationships between communal opportunities, femininity, expectations for success in STEM, belonging in STEM, and motivation to pursue STEM. We found that LGBTQ individuals' femininity (Study 1) was negatively while communal opportunities (Study 2) were positively related to belonging in STEM; further, belonging in STEM positively predicted motivation to pursue STEM (Study 1, 2). Uniquely for non-LGBTQ women, perceived communal opportunities (Study 1, 2) were positively and femininity (Study 2) was negatively related to expectations for success in STEM; expectations for success in STEM positively predicted motivation to pursue STEM (Study 1). We discuss the importance of integrating more communion and femininity into STEM to bolster LGBTQ individuals pursuing STEM.

Keywords: LGBTQ, STEM, utility value, communion, motivation, belonging, gender expression

STEM Inqueery: How Communion and Feminine Gender Expression Affects LGBTQ Individuals Pursuing STEM

Science, technology, engineering, and mathematics (STEM) are growing fields in the United States (National Science Foundation [NSF], 2019). Previous research has examined why some US students (E. R. Brown et al., 2018), Black (Byars-Winston & Rogers, 2019; Unfried et al., 2015), Latinx (C. S. Brown & Leaper, 2010; Byars-Winston & Rogers, 2019; Unfried et al., 2015), and women (Cheryan et al., 2011; Kim et al., 2018; Master et al., 2016; Stout & Wright, 2016) are underrepresented in STEM fields. For instance, only 20 to 30 percent of the bachelor's degree holders in computer science, engineering, and physics are women, and only 20 percent of the doctorate degree holders in mathematics are women (NSF, 2019). Because men are overrepresented in STEM fields, STEM is stereotyped as a masculine cisgender (same gender as birth) straight male field (Miller et al., 2020). Students who do not fit the STEM stereotype often experience challenges progressing through and staying motivated in STEM degree programs (Cheryan et al., 2013; Cundiff et al., 2013; Starr, 2018). However, despite there being about 7.1% lesbian, gay, bisexual, transgender, and queer (LGBTQ) individuals within the US (Jones, 2022), little is known about LGBTQ individuals going into STEM fields (Miller et al., 2020). The current study examines how LGBTQ individuals become interested in and motivated to pursue STEM fields.

Expectancy Value Theory

Expectancy value theory states that expectations for success and how individuals value a field are significant factors in the motivation to pursue a specialization or major (Eccles & Wigfield, 1995). Expectancies are how well an individual is expected to do on a given task or within a given area, and values are how valuable the given specialization or major is to the person (Eccles & Wigfield, 2002). These expectancies and values help shape individuals' lives and affect their choices and decisions (Eccles et al., 1999; Eccles & Wigfield, 2002). Much research has investigated how expectancies influence motivation (Eccles et al., 1984, 1990;

Eccles & Wigfield, 1995; Meece et al., 1990). For instance, women who have low expectancies for success in mathematics classes perceive that they lack ability in mathematics, and these low expectations for success result in low performance (Meece et al., 1990). Interestingly, when individuals have high expectancies for success in mathematics, no difference in performance exists between men and women (Meece et al., 1990). Women who have low expectancies for STEM also have reduced feelings of belonging and motivation in STEM (Smith et al., 2013). However, less research has investigated how values influence motivation (Eccles, 2009).

Many different types of values have been identified: attainment value is the amount of importance placed on task performance, intrinsic value is the interest or desire for a given task, and utility value is how helpful the task is for one's future goals (Eccles & Wigfield, 1995). Out of these three values, utility value has been studied the least in the motivation for future achievement and goals literature (Eccles et al., 1999; Hulleman et al., 2008). Utility value is shaped by gender stereotypes and cultural values and can override a person's perception of their abilities (Eccles & Wigfield, 1995). For instance, when children have conversations with their parents about the utility value of STEM classes, they are more likely to take more STEM classes in high school (Harackiewicz et al., 2012).

Utility value can be subdivided into a sense of communion (working with others and thinking more about what benefits the group than you; Bakan, 1966) and a sense of agency (self-focused and only thinking about what may benefit you instead of others; Bakan, 1966; Smith et al., 2015). Communal goals include helping others, connecting with other people, spiritual rewards, and serving the community, while agentic goals include aiming for status and success, financial incentive, self-direction, and achievement (Pöhlmann, 2001). Women are generally socialized to have or seek communion (Clark et al., 2016), so women are more likely to desire career fields that give them communal opportunities like elementary teachers or registered nurses (Boucher et al., 2017; Evans & Diekman, 2009).

STEM careers have been stereotypically seen as agentic and not communal (Diekman et al., 2010). Looking further into stereotypes, this belief about STEM being agentic (Master et al., 2016) can start as early as elementary school (Carlone et al., 2014). Conveying the masculine stereotype, which is consistent with agency, of STEM within the environment (science fiction books and posters, tech magazines) decreases women's feelings of belonging in STEM and discourages STEM interest (Cheryan et al., 2011; Master et al., 2016). Further, STEM is stereotypically viewed as agentic and not communal, resulting in differential parental encouragement; specifically, parents encourage boys more than girls to pursue STEM because STEM is perceived as a male-stereotypic and agentic domain (Rice et al., 2013). Thus, when women pursue STEM, they face many implicit or explicit gender STEM stereotypes, which decreases their motivation to go into or continue in STEM (Starr, 2018).

Communion within STEM is important as some individuals want to have communion in their careers (E. R. Brown et al., 2018). When fields offer communal opportunities, individuals who desire communion will be more motivated to stay in the field (Diekman et al., 2010). For example, when students perceive science as having high communion, they express enhanced motivation to pursue science (E. R. Brown et al., 2015). Thus, having communal opportunities in STEM boosts positive perceptions of STEM careers (E. R. Brown et al., 2018). Furthermore, when STEM fields are framed as not having communal opportunities, women are deterred from going into STEM fields (Clark et al., 2016). Most women desire community within their school and workplace (Good et al., 2012). LGBTQ individuals also desire a sense of community in their school and workplace where they can be themselves (Kersey & Voigt, 2020; Kosciw et al., 2015).

LGBTQ in STEM

When looking at stereotypes of LGBTQ and STEM, people stereotype STEM as a cis-heteronormative environment (Miller et al., 2020; Miller & Downey, 2020). These stereotypes feed into beliefs that gay men and lesbian women will be less successful in a mathematics field

than straight men and women (Hudson, 2020); thus, LGBTQ individuals feel their LGBTQ identity influences their choice in going into academia or other careers (Schneider & Dimito, 2010). Further, LGBTQ individuals are less likely to adhere to STEM stereotypes (such as working alone) since LGBTQ individuals typically express more desire for community within STEM (Kersey & Voigt, 2020).

So what happens when LGBTQ individuals go into STEM fields? Openness refers to how out an LGBTQ individual is about their identity to individuals within their social circle (family/friends, school, workplace; Yoder & Mattheis, 2016). To the extent that STEM fields have a higher percentage of women going into or are currently in those fields, more LGBTQ individuals are open about their identity (except for psychology; Yoder & Mattheis, 2016). By not being out as LGBTQ, LGBTQ individuals in STEM fields seek to 'pass' as (cis) straight (Cech & Waidzunas, 2011), cannot talk about their relationships, and only hear about straight relationships (Cech & Waidzunas, 2011).

To the extent that very few LGBTQ people work within science and engineering, LGBTQ faculty feel isolated (Bilimoria & Stewart, 2009). For instance, LGBTQ individuals might feel invisible (Bilimoria & Stewart, 2009; Miller et al., 2020), with the need to bottle up their identity to hide who they are, which creates unnecessary stress (Cech & Waidzunas, 2011). Further, LGBTQ individuals might be motivated to conceal their identity based on the messages they receive from others in the field because being open about their LGBTQ identity may result in fewer career opportunities, being devalued as a professional, and poorer health (Cech & Waidzunas, 2021). LGBTQ individuals may receive direct or indirect hostility in science or engineering workplaces because they are LGBTQ (Bilimoria & Stewart, 2009). Non-LGBTQ people in STEM may make stereotypical jokes related to the LGBTQ community, which decreases comfort and feelings of safety in STEM (Cech & Waidzunas, 2011; Miller et al., 2020). However, with identities that may have beneficial stereotypes about being in STEM, like trans men, would result in greater desire to pursue STEM. Trans men may have similar current

and future motivation and expectations for success in STEM as non-LGBTQ men (Dispenza et al., 2012; Nagoshi et al., 2012).

Moreover, LGBTQ individuals are less likely to receive encouragement than non-LGBTQ individuals (Cech & Pham, 2017), which means that LGBTQ individuals are less likely to stay in STEM fields than straight individuals (Hughes, 2018). Thus, it is unsurprising that undergraduate students that are LGBTQ feel like they do not fit within STEM and often consider leaving STEM (Stout & Wright, 2016). Further, LGBTQ individuals more often indicated lower satisfaction within STEM careers than non-LGBTQ individuals (Cech & Pham, 2017). This research is the first to examine how communion and feminine gender expression affect LGBTQ individuals' pursuit of STEM.

Research Question

This research examines whether LGBTQ individuals perceive that STEM fields allow for communal and agentic opportunities. It also looks at how these perceptions affect their motivation to pursue STEM, belonging within STEM, and their expectations for success within STEM. We investigated how LGBTQ individuals compared to non-LGBTQ women and non-LGBTQ men. LGBTQ individuals are referred to as one group because to split LGBTQ into two groups when there are smaller numbers of non-binary and transgender individuals is challenging.

Hypotheses

We hypothesized that LGBTQ individuals would have less motivation, expectations for success, and feelings of personal belonging in STEM than non-LGBTQ men. However, LGBTQ individuals will have more motivation and expectations for success in STEM than non-LGBTQ women, but LGBTQ individuals will have fewer feelings of personal belonging in STEM than non-LGBTQ women. Replicating previous findings, we anticipate that non-LGBTQ women will have less motivation, expectations for success, and feelings of personal belonging in STEM than non-LGBTQ men.

We also propose that LGBTQ individuals' openness about their LGBTQ identity will affect their current and future motivation, expectations for success, and feelings of personal belonging in STEM. LGBTQ individuals with low openness about their LGBTQ identity will have less current and future motivation, expectations for success, and feelings of personal belonging in STEM than LGBTQ individuals with high openness.

Further, we hypothesize that LGBTQ individuals will desire more communal goals than non-LGBTQ individuals, with non-LGBTQ women having more communal goals than non-LGBTQ men; we expect no difference between any of the groups for agentic goals.

Study 1

Method

Preregistration and Power Analysis

We preregistered this study through AsPredicted (https://aspredicted.org/2fu3f.pdf). The minimal sample size, with an effect size of 0.20 at 0.80 power based on an ANOVA, was 246; the ideal sample size, with an effect size of 0.20 at 0.95 power based on an ANOVA, was 390, but we also put a hard stop on the data collection period of December 4, 2020.

Participants

From July 2020 through December 2020, 228 students from the University of North Florida (UNF) were recruited through a flier with a QR code directing them to the survey (n = 14) and through the SONA system with a link to the survey (n = 214). Participants who were recruited through SONA received course credit for their participation, of which 79 participants identified as LGBTQ, 124 identified as non-LGBTQ women, and 25 identified as non-LGBTQ men (see Table 1). Forty-eight participants were excluded from the data analysis for the following reasons: 46 failed at least one of the three attention checks and two were under the age of 18.

Procedure

UNF non-SONA system participants first completed a pre-survey to determine their eligibility for the study. The presurvey assessed the participants' current student status, gender identity, and whether they identified as LGBTQ. Participants who qualified were invited to participate in the survey. UNF SONA participants signed up for their participant group (LGBTQ, non-LGBTQ women, and non-LGBTQ men) and were sent directly to the study.

All participants first completed the communal and agentic goal endorsement and trait gender expression. Then, if they indicated they identified as an LGBTQ individual, they completed an openness measure. Next, participants indicated their perceptions of communal and agentic opportunities in STEM fields (mathematics, engineering, computer science, physics, biology, psychology), current motivation to pursue STEM, future motivation to pursue STEM, expectations for success in STEM, and personal belonging in STEM measures, presented in random order. Finally, participants entered their demographics and were debriefed. Participants also completed measures asking about their perceptions of communal and agentic opportunities, current motivation to pursue, future motivation to pursue, expectations for success, and personal belonging to female-dominated fields (education, nursing, social work) and male-dominated fields (law, business, dentist, physician).

Materials

Measures.

Gender Expression. Participants completed the A/B Apparel Styles measure to assess their gender expression (Tate et al., in press). This measure contained two statements where participants responded with how much a style would fit them. There were two styles, 'A' (feminine) and 'B' (masculine). Style 'A' was described as a pretty and fanciful apparel style or feminine style, while style 'B' was described as a minimalist and understated apparel style or masculine style. Participants indirectly rated their style on scales ranging from 0 (*Not at all 'A'/'B'*) to 6 (*Very 'A'/'B'*). The relationship between feminine and masculine was negativity correlated (r = -0.34, p = .001).

Openness. LGBTQ participants completed ten items from a modified Outness Inventory (OI; Mohr & Fassinger, 2000) using scales ranging from 0 (*Not applicable; there is no such person in your life*) to 1 (*Person definitely does NOT know*) to 7 (*Person definitely knows, and it is OPENLY talked about*). This measure is valid (Vaughan & Waehler, 2010) and has high reliability (Dyar et al., 2016; Meidlinger & Hope, 2014). Specifically, LGBTQ participants rated how open they were to their parents/guardians, siblings, extended family/relatives, old straight friends, new straight friends, work peers, work supervisors, religious community, strangers/new acquaintances, and college peers. Responses were averaged to create a composite variable (α = .88).

Communal vs. Agentic Goal Endorsement. Participants rated 23 items (14 agentic; 9 communal; validated by Diekman et al., 2010, 2011) using scales ranging from 1 (*Not at all important*) to 7 (*Extremely important*). The agentic goals items were power, recognition, achievement, mastery, self-promotion, independence, individualism, status, focus on the self, success, financial rewards, self-direction, demonstrating skill or competence, and competition. The communal goals items were helping others, serving humanity, serving community, working with others, attending to others, caring for others, intimacy, and spiritual rewards. The agentic goal items were averaged to create a composite variable (α = .87), and communal goal items were averaged to create a composite variable (α = .81).

Communal and Agentic Opportunities. Participants rated different STEM, male-stereotypical, and female-stereotypical careers on communal (intimacy, affiliation, and altruism) and agentic (power, achievement, and seeking new experiences or excitement) opportunities (Diekman et al., 2010) on scales ranging from 1 (*Not at all*) to 7 (*Extremely*). This measure was validated and reliable for communal and agentic opportunities (E. R. Brown et al., 2018). The STEM occupations that participants rated were mathematics, engineering, computer science, physics, biology, and psychology (36 items). The female-stereotypical occupations were nursing, social work, and education (18 items). The male-stereotypical occupations were law,

business, medical (physicians), and dentistry (24 items). For communal opportunities, STEM fields were averaged to create a composite variable (α = .90), female-stereotypical fields were averaged to create a composite variable (α = .82), and male-stereotypical fields were averaged to create a composite variable (α = .86). For agentic opportunities, STEM fields were averaged to create a composite variable (α = .88), female-stereotypical fields were averaged to create a composite variable (α = .79), and male-stereotypical fields were averaged to create a composite variable (α = .85).

Current Motivation to Pursue STEM. Participants rated twelve statements modified from the STEM Career Motivation Scale (Starr, 2018), which is a modified version of the Motivation for a Science Career Scale (Stake & Mares, 2001), on scales ranging from 1 (*Strongly disagree*) to 7 (*Strongly agree*). This measure was reliable for STEM career motivation (Starr, 2018). These statements asked how participants may enjoy a career, have good feelings about a career, likely to have a career, and are interested in a career in science, technology, engineering, or mathematics. STEM statements were averaged to create a composite variable (α = .95), female-stereotypical statements were averaged to create a composite variable (α = .96), and male-stereotypical statements were averaged to create a composite variable (α = .94).

Future Motivation to Pursue STEM. Participants rated eighteen statements modified from the Future Motivation Scale (E. R. Brown et al., 2015), which was initially created by Harackiewicz and Elliot (1993). This measure was further validated by Smith et al. (2007) and accessed for reliability by Smith et al. (2007) and E. R. Brown et al. (2015). Six of these questions asked how willing participants were to work in the future or look into a job in science, technology, engineering, or mathematics; these statements were on a seven-point Likert-type scale ranging from 1 (*Not at all willing*) to 7 (*Very willing*). Twelve of these questions asked about interest in applying or learning more about a job or graduate school in science, technology, engineering, or mathematics; these statements were on a seven-point Likert-type scale ranging from 1 (*Very slightly or not at all*) to 7 (*Extremely*). The STEM statements were

averaged to create a composite variable (α = .97), female-stereotypical statements were averaged to create a composite variable (α = .96), and male-stereotypical statements were averaged to create a composite variable (α = .97).

Expectations for Success in STEM. Participants were asked twelve statements modified from Eccles and Wigfield (1995) on scales that ranged from 1 (*worse; worst; very poorly*) to 7 (*better; best; very well*). These questions asked them how well participants do in science, technology, engineering, or mathematics in general and as compared to other students. STEM statements were averaged to create a composite variable (α = .94), female-stereotypical statements were averaged to create a composite variable (α = .91), and male-stereotypical statements were averaged to create a composite variable (α = .93).

Personal Belonging in STEM. Participants completed the twelve statements for the personal belonging measure that was modified from Smith et al. (2013; the measure combined a university belonging scale by Cabrera et al., 1992, and an academic belonging scale by Walton and Cohen, 2007). These statements are a seven-point Likert-type scale ranging from 1 (*Strongly disagree*) to 7 (*Strongly agree*). The statements asked if participants agreed to statements about their personal belonging in their classes, university, and academic experiences. STEM statements were averaged to create a composite variable (α = .88), female-stereotypical statements were averaged to create a composite variable (α = .90), and male-stereotypical statements were averaged to create a composite variable (α = .84).

Results

First, we ran separate mixed analyses of variance (ANOVA) for gender expression (femininity vs. masculinity; see Figure 1A, Table 2), goal endorsement (communal vs. agentic; see Figure 2A, Table 3), and opportunities (communal vs. agentic; see Figure 3A, Table 4) with a group (LGBTQ individuals vs. non-LGBTQ women vs. non-LGBTQ men) as the between-participants variable. Next, we ran separate one-way ANOVAs for current motivation to pursue STEM (see Figure 4A, Table 5), future motivation to pursue STEM (see Figure 5A, Table 6),

expectations for success in STEM (see Figure 6A, Table 7), and personal belonging in STEM (see Figure 7A, Table 8) with the group as the between-participants variable. We used robust standard errors when homoscedasticity was violated within the ANOVAs. Additionally, for LGBTQ individuals, we ran a series of regressions with identity openness predicting current motivation to pursue STEM, future motivation to pursue STEM, expectations for success in STEM, and personal belonging in STEM (see Figure 8A, Table 9).

Finally, we ran an indirect effect analysis with expressions of femininity and perceived communal opportunities in STEM predicting expectations for success in STEM and personal belonging in STEM. We also examined whether expectations for success in STEM and personal belonging in STEM predicted current motivation to pursue STEM as well as future motivation. We ran the overall model (see Figure 9A, Table 10, Table 11) and group models (non-LGBTQ men, non-LGBTQ women, LGBTQ individuals; see Figure 10, Table 10, Table 11). For clarity, we tabled all statistical results and only explain the results that pertain to our hypotheses (see Tables 2 – 10).

Goal Endorsement

A main effect of a group emerged. LGBTQ individuals endorsed fewer goals than non-LGBTQ women; however, non-LGBTQ men showed similar goals compared to non-LGBTQ women and LGBTQ individuals. Further, individuals endorsed more communal goals than agentic goals. No interaction emerged between a group and goals.

Current Motivation and Future Motivation

A group difference emerged in individuals' current motivation to pursue STEM. Non-LGBTQ men expressed more current motivation to pursue STEM than non-LGBTQ women. However, LGBTQ individuals had a similar current motivation to pursue STEM as non-LGBTQ men and women.

A group difference emerged in individuals' future motivation to pursue STEM; however, Levene's Test for Homoscedasticity indicated heteroscedasticity, so we used robust standard

errors via regressions, which only allows for pairwise comparisons. LGBTQ individuals expressed more future motivation to pursue STEM than non-LGBTQ women. Non-LGBTQ men expressed more future motivation to pursue STEM than non-LGBTQ women and LGBTQ individuals.

Expectations for Success

A group difference emerged in individuals' expectations for success in STEM; however, Levene's Test for Homoscedasticity indicated heteroscedasticity, which we corrected accordingly. LGBTQ individuals expressed similar expectations for success in STEM compared to non-LGBTQ women. Non-LGBTQ men expressed more expectations for success in STEM than non-LGBTQ women and LGBTQ individuals.

Personal Belonging

A group difference emerged in individuals' personal belonging within STEM. We found that non-LGBTQ men expressed more personal belonging in STEM than non-LGBTQ women and LGBTQ individuals. LGBTQ individuals expressed more personal belonging in STEM compared to non-LGBTQ women.

LGBTQ Individuals' Openness

LGBTQ individuals' openness about their identity did not predict their current motivation to pursue STEM, future motivation to pursue STEM, or expectations for success in STEM. However, LGBTQ individuals with higher openness expressed more personal belonging in STEM.

Indirect Model

Overall Model. Individuals who perceived STEM as having higher communal opportunities reported higher expectations for success and higher personal belonging in STEM. Interestingly, individuals with a higher expression of femininity reported fewer expectations for success in STEM. In addition, individuals with high expectations for success in STEM and high personal belonging in STEM reported higher current motivation to pursue STEM and higher

future motivation to pursue STEM. Further, an individual's current motivation to pursue STEM and future motivation to pursue STEM were positively associated with each other. All other relationships were not significant.

Group Model.

Non-LGBTQ Women. Non-LGBTQ women who perceived STEM as having higher communal opportunities reported higher expectations for success in STEM. Non-LGBTQ women with high expectations for success and high personal belonging in STEM reported higher current motivation and future motivation to pursue STEM. Further, non-LGBTQ women's current motivation to pursue STEM and future motivation to pursue STEM were positively associated with each other. All other connections were not significant.

LGBTQ Individuals. LGBTQ individuals who perceived STEM as having higher communal opportunities reported higher expectations for success in STEM. Interestingly, LGBTQ individuals' higher expression of femininity reported less personal belonging in STEM. LGBTQ individuals with high expectations for success in STEM reported higher current motivation and future motivation to pursue STEM. Moreover, LGBTQ individuals who expressed high personal belonging in STEM reported higher current and future motivation to pursue STEM. Further, LGBTQ individuals' current motivation to pursue STEM and future motivation to pursue STEM were positively associated. All other relationships were not significant.

Non-LGBTQ Men. Non-LGBTQ men with high expectations for success in STEM reported higher current motivation and future motivation to pursue STEM. Moreover, non-LGBTQ men that expressed high personal belonging in STEM reported higher future motivation to pursue STEM; however, their personal belonging did not affect their current motivation to pursue STEM. Further, non-LGBTQ men's current motivation to pursue STEM and future motivation to pursue STEM were positively associated with each other. All other relationships were not significant.

Discussion

Supporting our hypotheses, non-LGBTQ men had the highest current and future motivation to pursue STEM, followed by LGBTQ individuals, then non-LGBTQ women. Further supporting our hypotheses, LGBTQ individuals' openness about their LGBTQ identity was associated with more personal belonging in STEM.

Partially consistent with our hypotheses, non-LGBTQ men had higher expectations for success and personal belonging in STEM than non-LGBTQ women and LGBTQ individuals, but LGBTQ individuals and non-LGBTQ women had similar expectations for success in STEM and personal belonging in STEM. Further, participants endorsed more communal than agentic goals.

However, inconsistent with our hypotheses, openness was not a factor in LGBTQ individuals' current motivation to pursue STEM, future motivation to pursue STEM, and expectations for success in STEM. Further, LGBTQ individuals, non-LGBTQ women, and non-LGBTQ men did not differ in endorsing communal goals. LGBTQ individuals endorsed the fewest goals, and non-LGBTQ women endorsed the most goals compared to non-LGBTQ men.

Exploratory analyses found that individuals generally viewed STEM as having more agentic opportunities compared to communal opportunities. Additionally, supporting previous research stating LGBTQ individuals value both masculinity and femininity (Hoskin, 2019, 2020), LGBTQ individuals expressed masculinity and femininity equally, whereas non-LGBTQ men expressed more masculinity than femininity and non-LGBTQ women expressed more femininity than masculinity.

In addition to those exploratory analyses, we created some path analysis models. The overall model showed feminine gender expression was negatively related to expectations for success in STEM, which related to current and future motivation to pursue STEM. The overall model also showed communal opportunities were positively related to expectations for success in STEM and personal belonging in STEM, which related to current and future motivation to pursue STEM. For non-LGBTQ women, communal opportunities were positively related to

expectations for success in STEM, which was related to current and future motivation to pursue STEM. For LGBTQ individuals, feminine gender expression was negatively related to personal belonging in STEM, which related to current and future motivation to pursue STEM. LGBTQ individuals also showed that communal opportunities were positively related to expectations for success in STEM, which related to current and future motivation to pursue STEM. For non-LGBTQ men, feminine gender expression and communal opportunities did not predict personal belonging or expectations for success in STEM.

Additionally, in this study, we found that LGBTQ individuals also believed that STEM values masculinity and discourages femininity (Miller et al., 2020); however, consistent with previous research, LGBTQ individuals similarly valued masculinity and femininity (Hoskin, 2019, 2020).

Study 2

In Study 2, we wanted to replicate and extend the exploratory indirect effect analyses we conducted in Study 1. Specifically, in Study 2, we added a measure of communal goals and perceived gender expression in STEM. Because LGBTQ individuals believe that STEM values masculinity and discourages femininity (Miller et al., 2020), we wanted to investigate whether perceived gender expression in STEM affects personal belonging in STEM. We hypothesized that for LGBTQ individuals (but not for non-LGBTQ men or women), femininity (of self) and perceived femininity in STEM would reduce their personal belonging in STEM, which in turn would reduce their current and future motivation to pursue STEM. We hypothesized that for non-LGBTQ women and LGBTQ individuals, communal opportunities and communal goals would increase their expectations for success in STEM, which in turn would increase their current and future motivation to pursue STEM.

In Study 2, we hypothesized that LGBTQ individuals would desire fewer communal goals than non-LGBTQ individuals, with non-LGBTQ women having more communal goals than non-LGBTQ men; we hypothesized that LGBTQ individuals would also desire fewer agentic goals

than non-LGBTQ women. We hypothesized that group differences would not emerge for perceptions that STEM provides communal opportunities. Further, we hypothesized that LGBTQ individuals would have less feminine gender expression than non-LGBTQ women; we also predicted that LGBTQ individuals would have more masculine gender expression than non-LGBTQ women. Additionally, in Study 2, we collected data from a national sample using Amazon's Mechanical TURK (MTURK), which allowed us to balance our sample such that approximately the same number of participants were in each group (LGBTQ individuals, non-LGBTQ men, and non-LGBTQ women).

Method

Preregistration and Power Analysis

We preregistered this study through AsPredicted (https://aspredicted.org/ts2fp.pdf). The goal sample size of 246 was calculated with an effect size of 0.20 at 0.80 power based on an ANOVA.

Participants

From March 25, 2021, through July 26, 2021, 254 university/college students within the United States were recruited through Amazon Mechanical Turk (MTurk) and were paid $1.60 in exchange for their participation, of which 85 participants identified as LGBTQ, 84 identified as non-LGBTQ women, and 85 identified as non-LGBTQ men (see Table 12). Eighty participants were excluded from the data analysis for the following reasons: 46 indicated they were not university/college students, 24 failed one of the five attention checks, and 21 failed the number bot check (i.e., what is 42 + 32? Provide your answer reverse).

Procedure

Participants had first completed a pre-survey to determine their eligibility for the study, for which they received $0.10. The presurvey assessed the participants' current student status, gender identity, whether they identified as LGBTQ, and completed an attention check. For individuals to qualify for the primary survey, they had to indicate whether they were a current

college/university student and pass the number bot check (i.e., what is 32 + 47? Provide your answer reverse). They would then be informed via a message through CloudResearch (https://www.cloudresearch.com/) that they qualify for the primary survey and given a link to their participant group (LGBTQ individuals, non-LGBTQ women, non-LGBTQ men).

Participants who qualified were invited to participate in the survey. Similar to Study 1, they completed trait gender expression (r = -0.35, p < .001), openness about their identity (for LGBTQ individuals only; α = .92), communal goal endorsement (α = .90), agentic goal endorsement (α = .89), perceptions of communal opportunities in STEM (α = .84), perceptions of agentic opportunities in STEM (α = .86), current motivation to pursue STEM (α = .95), future motivation to pursue STEM (α = .97), expectations for success in STEM (α = .93), and personal belonging in STEM (α = .92). Participants also completed a measure assessing perceived gender expression in STEM but did not complete measures pertaining to male- and female-dominated fields.

Materials

Measures.

Gender Expression in STEM. Participants completed a modified A/B Apparel Styles (Tate et al., in press) to measure perceived gender expression in STEM, which contained two questions where participants responded with how much gender expression they perceive within STEM ('How likely is it that people use style "A"/"B" to visually present themselves in STEM careers?'). These two questions followed the two questions for their gender expression, respectively. Participants rated their style on scales ranging from 0 (*Not likely*) to 6 (*Very likely*). The relationship between perceived femininity and masculinity in STEM was negativity correlated (r = -0.14, p = .026).

Results

First, we ran separate mixed ANOVA for gender expression (femininity vs. masculinity; see Figure 1B, Table 2), perceived gender expression in STEM (femininity vs. masculinity; see

Figure 11, Table 13), goal endorsement (communal vs. agentic; see Figure 2B, Table 3), and opportunities (communal vs. agentic; see Figure 3B, Table 4) with a group (LGBTQ individuals vs. non-LGBTQ women vs. non-LGBTQ men) as the between-participants variable. Next, we ran separate one-way ANOVAs for current motivation to pursue STEM (see Figure 4B, Table 5), future motivation to pursue STEM (see Figure 5B, Table 6), expectations for success in STEM (see Figure 6B, Table 7), and personal belonging in STEM (see Figure 7B, Table 8) with the group as the between-participants variable. We used robust standard errors for violations of homoscedasticity within the ANOVAs. Additionally, for LGBTQ individuals, we ran a series of regressions with identity openness predicting current motivation to pursue STEM, future motivation to pursue STEM, expectations for success in STEM, and personal belonging in STEM (see Figure 8B, Table 9).

Finally, we ran an indirect effect analysis with expressions of femininity, perceived communal opportunities in STEM, perceived femininity in STEM, and endorsement of communal goal predicting expectations for success in STEM and personal belonging in STEM. We also examined whether expectations for success in STEM and personal belonging in STEM predicted current and future motivation to pursue STEM. We ran both an overall model (see Figure 9B, Table 14, Table 11) and the model for each group (non-LGBTQ men, non-LGBTQ women, LGBTQ individuals; see Figure 12, Table 14, Table 11). Consistent with Study 1, we tabled all statistical results and only explain the results that pertain to our hypotheses for clarity (see Tables 2 – 10).

Gender Expression

Individuals expressed less femininity (of self) compared to masculinity. A main effect of group emerged, such that LGBTQ individuals reported more gender expression than non-LGBTQ men; however, no difference emerged for non-LGBTQ women compared to LGBTQ individuals and non-LGBTQ men. However, an interaction emerged between groups and their gender expression. Non-LGBTQ men expressed more masculinity compared to femininity, while

both LGBTQ individuals and non-LGBTQ women expressed an equal amount of masculinity and femininity.

Gender Expression in STEM

Individuals viewed STEM as having less femininity than masculinity. No group difference emerged between LGBTQ individuals, non-LGBTQ women, and non-LGBTQ men. Further, no interaction emerged between a group and perceived gender expression in STEM.

Goal Endorsement

No main effects of group or goal endorsement emerged. An interaction emerged between a group and goal endorsement. However, no different group difference emerged between perceived communal goals and agentic goals.

Perceived Opportunities in STEM

No main effect of a group emerged. Participants perceived more agentic than communal opportunities in STEM. Further, an interaction emerged between a group and perceived opportunities in STEM. However, we found no different group difference for perceived communal opportunities in STEM and perceived agentic opportunities in STEM.

Current Motivation, Future Motivation, and Expectations for Success

No group differences emerged in current and future motivation to pursue STEM. In addition, no group differences emerged in expectations for success in STEM.

Personal Belonging

Group differences emerged for individuals' personal belonging in STEM; however, Levene's Test for Homoscedasticity indicated heteroscedasticity, which we adjusted accordingly. Non-LGBTQ men expressed more personal belonging in STEM than non-LGBTQ women and LGBTQ individuals. No difference emerged between LGBTQ individuals and non-LGBTQ women.

LGBTQ Individuals' Openness

LGBTQ individuals' openness did not predict current and future motivation to pursue STEM, expectations for success in STEM, and personal belonging in STEM.

Indirect Model

Overall Model. Individuals who perceived STEM as having higher communal opportunities reported higher expectations for success and higher personal belonging in STEM. Interestingly, individuals with a higher expression of femininity reported fewer expectations for success in STEM. Contrary to Study 1, individuals with higher expression of femininity reported less personal belonging in STEM. Further, individuals with high expectations for success in STEM and high personal belonging in STEM reported higher future motivation to pursue STEM. In addition, individuals with high personal belonging in STEM reported higher current motivation to pursue STEM. Further, an individual's current motivation to pursue STEM and future motivation to pursue STEM were positively associated with each other. All other relationships were not significant.

Group Model.

Non-LGBTQ Women. Non-LGBTQ women who perceived STEM as having higher communal opportunities reported higher expectations for success in STEM and higher personal belonging. Further, non-LGBTQ women with higher expression of femininity reported fewer expectations for success in STEM and personal belonging in STEM. Non-LGBTQ women with high expectations for success in STEM reported higher current and future motivation to pursue STEM. Moreover, non-LGBTQ women who expressed high personal belonging in STEM reported higher current and future motivation to pursue STEM. Further, non-LGBTQ women's current and future motivation to pursue STEM were positively associated. All other relationships were not significant.

LGBTQ Individuals. LGBTQ individuals who perceived STEM as having higher communal opportunities reported higher personal belonging in STEM. Interestingly, LGBTQ individuals wanting more communal goals reported more expectations for success in STEM.

Contrary to Study 1, LGBTQ individuals' higher expression of femininity was not related to personal belonging in STEM or expectations for success in STEM. LGBTQ individuals who expressed high personal belonging in STEM reported higher current and future motivation to pursue STEM. Further, an LGBTQ individual's current and future motivation to pursue STEM were positively associated with each other. All other relationships were not significant.

Non-LGBTQ Men. Non-LGBTQ men with high personal belonging in STEM reported higher current and future motivation to pursue STEM. Further, non-LGBTQ men's current and future motivation to pursue STEM were positively associated. All other relationships were not significant.

Discussion

Supporting our hypotheses, LGBTQ individuals expressed masculinity and femininity equally, while non-LGBTQ men expressed more masculinity than femininity. However, contrary to Study 1, non-LGBTQ women expressed masculinity and femininity equally. LGBTQ individuals had more gender expression, while non-LGBTQ men had less gender expression. LGBTQ individuals, non-LGBTQ men, and non-LGBTQ women groups perceived STEM as having a similar number of communal opportunities.

Partially consistent with our hypotheses, for personal belonging in STEM, we found that non-LGBTQ men had higher personal belonging in STEM than non-LGBTQ women and LGBTQ individuals; however, not fully supporting our hypothesis, LGBTQ individuals and non-LGBTQ women had similar personal belonging in STEM.

For LGBTQ individuals, personal belonging in STEM was related to current and future motivation to pursue STEM, which is consistent with the hypotheses; however, inconsistent with the hypotheses, feminine gender expression and perceived femininity in STEM were not related to personal belonging. Communal goals were positively related to expectations for success in STEM, which is consistent with the hypotheses; however, inconsistent with the hypotheses, perceived communal opportunities in STEM were positively related to personal belonging in

STEM, but not expectations for success in STEM. Further, inconsistent with the hypotheses, expectations for success in STEM were not related to current and future motivation to pursue STEM.

For non-LGBTQ women, communal opportunities were positively related to expectations for success in STEM, which is consistent with the hypotheses; however, inconsistent with the hypotheses, expectations for success were not related to current or future motivation to pursue STEM. Contrary to Study 1, feminine gender expression was negatively related to personal belonging, which related to current and future motivation to pursue STEM. Contrary to Study 1, communal opportunities were positively related to personal belonging in STEM, which was positively related to current and future motivation to pursue STEM.

Inconsistent with our hypotheses, openness was not a factor in LGBTQ individuals' current and future motivation to pursue STEM, expectations for success in STEM, and personal belonging in STEM. No differences emerged between LGBTQ individuals, non-LGBTQ men, and non-LGBTQ women on current and future motivation to pursue STEM, expectations for success in STEM, communal goal endorsement, and agentic goal endorsement.

In some exploratory analyses, individuals viewed STEM as having less femininity and more masculinity. Like Study 1, STEM was viewed as having more agentic than communal opportunities. An exploratory analysis with the path models, similar to Study 1, the overall model showed that feminine gender expression was negatively related to expectations for success in STEM, which was related to future motivation to pursue STEM but was not related to current motivation to pursue STEM. Contrary to Study 1, the overall model showed that feminine gender expression was negatively related to personal belonging in STEM, and personal belonging in STEM was positively related to current and future motivation to pursue STEM. Similar to Study 1, the overall model also showed that communal opportunities were positively related to expectations for success in STEM, which were positively related to future motivation to pursue STEM but unrelated to current motivation to pursue STEM. Similar to Study 1, the overall model

also showed that communal opportunities were positively related to personal belonging in STEM, which was positively related to current and future motivation to pursue STEM. Like Study 1 with non-LGBTQ men, factors of femininity or communion had no relation to their personal belonging or expectations for success in STEM.

General Discussion

Partially supporting our hypotheses, for LGBTQ individuals, personal belonging in STEM was particularly important; LGBTQ individuals expressed less belonging in STEM than non-LGBTQ men (Study 1, 2). Consistent with our hypothesis, LGBTQ individuals with high openness about their identity expressed higher personal belonging in STEM (Study 1); however, inconsistent with our hypothesis, LGBTQ individuals' openness about their identity did not affect their current and future motivation to pursue STEM or expectations for success in STEM (Study 1, 2). Further supporting our hypothesis, to the extent that LGBTQ individuals were open about their identity, they expressed more personal belonging in STEM (Study 1). As we predicted, for LGBTQ individuals, feminine gender expression (Study 1) was negatively related to personal belonging, and perceived communal opportunities (Study 2) were positively related to personal belonging in STEM. Moreover, personal belonging in STEM positively predicted current and future motivation to pursue STEM (Studies 1, 2). Partially supporting our hypothesis, non-LGBTQ women's perceived communal opportunities in STEM (Studies 1, 2) were positively related to expectations for success, and feminine gender expression (Study 2) was negatively related to expectations for success in STEM. Expectations for success in STEM positively predicted current and future motivation to pursue STEM (Study 1). However, consistent with our hypothesis, the results for LGBTQ individuals and non-LGBTQ women were not replicated with non-LGBTQ men. Instead, for non-LGBTQ men, communal opportunities (Studies 1, 2) and feminine gender expression (Studies 1, 2) were unrelated to expectations for success in STEM (Study 1) and personal belonging in STEM (Studies 1, 2). However, personal belonging in STEM positively predicted current and future motivation to pursue STEM (Studies 1, 2).

Additionally, expectations for success in STEM positively predicted current and future motivation to pursue STEM (Study 1).

While all groups perceived the same number of communal opportunities within STEM, as predicted, no communal goal endorsement differences between LGBTQ individuals, non-LGBTQ women, and non-LGBTQ men were identified (Studies 1, 2), which is inconsistent with our hypotheses. Instead, as predicted, LGBTQ individuals, non-LGBTQ women, and non-LGBTQ men equally endorsed agentic goals (Studies 1, 2).

Further, mixed results emerged for current and future motivation to pursue STEM and expectations for success in STEM. Consistent with our hypotheses, non-LGBTQ men had the most future motivation to pursue STEM, followed by LGBTQ individuals and non-LGBTQ women (Study 1). However, partially consistent with our hypothesis, non-LGBTQ men had more current motivation to pursue STEM than non-LGBTQ women, but LGBTQ individuals did not differ from non-LGBTQ men or women (Study 1). Partially supporting our hypothesis, non-LGBTQ men had more expectations for success in STEM than non-LGBTQ women and LGBTQ individuals, but non-LGBTQ women and LGBTQ individuals were equivalent in their expectations for success in STEM (Study 1). However, in Study 2, no differences between the groups were identified for current motivation, future motivation, and expectations for success in STEM, which is inconsistent with our hypotheses (Study 2).

In exploratory analyses, we found that STEM was perceived as high in masculinity and low in femininity (Study 2). In addition, STEM was perceived as having more agentic opportunities and fewer communal opportunities (Studies 1, 2). Further, we found that feminine gender expression (Study 2) was negatively related to personal belonging, and perceived communal opportunities (Studies 1, 2) were positively related to personal belonging in STEM. Further, individuals' personal belonging in STEM positively predicted their current and future motivation to pursue STEM (Studies 1, 2). In addition, we found that perceived communal opportunities (Studies 1, 2) were positively related to expectations for success, and feminine

gender expression (Studies 1, 2) was negatively related to expectations for success in STEM. Expectations for success in STEM positively predicted current and future motivation to pursue STEM (Studies 1, 2).

Implications

Our finding of the importance of belonging for LGBTQ individuals was related to LGBTQ individuals desiring a community where they can belong and be themselves (Kersey & Voigt, 2020). When LGBTQ individuals (particularly in STEM) have to 'pass' as (cis) straight or feel socially excluded (Cech & Waidzunas, 2011, 2021), they can experience poor health (Cech & Waidzunas, 2021), unnecessary stress (Cech & Waidzunas, 2011, 2021), isolation or feelings of invisibility (Bilimoria & Stewart, 2009; Miller et al., 2020), and indirect or direct hostility (Bilimoria & Stewart, 2009). Given that lacking belonging would have some thinking about leaving STEM (Cech & Waidzunas, 2021), our study indicates that to the extent that LGBTQ individuals experienced personal belonging in STEM, they also expressed more current and future motivation to pursue STEM (Figure 10B, 12B).

While LGBTQ individuals valued both femininity and masculinity (consistent with the literature; Hoskin, 2019, 2020), having feminine gender expression was related to less belonging, likely because STEM discourages femininity (Miller et al., 2020). While expressing their gender the way they want is beneficial, they also desire communal opportunities to interact with others (Kersey & Voigt, 2020; Kosciw et al., 2015). With the previous literature (Diekman et al., 2010), individuals viewed STEM as having less communal opportunities than agentic opportunities. Among LGBTQ individuals, perceptions of communal opportunities in STEM bolstered personal belonging in STEM, consistent with findings that communal opportunities are associated with feelings of personal belonging (Mattheis et al., 2019). However, among non-LGBTQ women, perceptions of communal opportunities in STEM bolstered motivation to pursue STEM through personal belonging, which is consistent with utility value literature (E. R. Brown et al., 2015; Clark et al., 2016) and STEM belonging and motivation literature (Leaper & Starr,

2019). Thus, more communion and femininity in STEM could enable more LGBTQ individuals and non-LGBTQ women to experience more belonging in STEM and boost their motivation to pursue STEM.

Future Direction and Limitations

While the current grouping of LGBTQ individuals together enabled a large sample of LGBTQ individuals for the current study, certain LGBTQ identities experience more belonging in STEM (like trans men; Dispenza et al., 2012; Nagoshi et al., 2012), while other identities experience less belonging in STEM (like trans women; C. Brown et al., 2012; Nagoshi et al., 2012). Future research should sub-divide LGBTQ individuals into appropriate smaller identity groups. We predict that LGBTQ women and LGBTQ non-binaries would probably show femininity and communion being a factor in personal belonging in STEM, while LGBTQ men may show an effect with communal but not femininity towards their personal belonging in STEM.

While the current study looked at LGBTQ individuals' openness about their LGBTQ identity, it did so as one combined variable. The openness measure we used had different social groups that LGBTQ individuals could be open to (parents/guardians, siblings, extended family/relatives, old straight friends, new straight friends, work peers, work supervisors, religious community, strangers/new acquaintances, and college peers). While grouping social groups into one variable provides a general sense of LGBTQ individuals' openness about their LGBTQ identity, whether openness is universal in all contexts is unclear. The results might look different by analyzing the openness measure based on the groups LGBTQ individuals interact with (like parents/guardians, siblings, and extended family/relatives as one variable and work peers, work supervisors, and college peers as another variable). For instance, we expect that openness to family (parents/guardians, siblings, and extended family/relatives) would not show an effect on belonging in STEM; however, openness to work and college peers (work peers, work supervisors, and college peers) would have higher belonging in STEM the more open they were

about their identity. Future research should investigate what role openness to different groups plays in feelings of belonging in STEM and STEM motivation.

Additionally, future research should examine how perceived gender expression in STEM may affect personal gender expression. LGBTQ individuals feel STEM values masculinity and devalues femininity, while LGBTQ individuals highly value femininity (Hoskin, 2019, 2020; Miller et al., 2020). If STEM is viewed as higher in masculinity, does this affect LGBTQ individuals' gender expression? We predict that if LGBTQ individuals actively pursue STEM and perceive that STEM has low femininity, they may be less likely to express femininity.

While the current study used an unadjusted p-value of .05 or an unadjusted 95 percent confidence interval for our analyses, this is not ideal for the number of analyses we ran. We decided not to adjust the p-value and confidence interval as little research has investigated LGBTQ individuals pursuing STEM and none with expectancy-value theory and LGBTQ individuals, so future research seeking to replicate results should consider familywise or adjusted p-value and adjusted confidence intervals when doing multiple tests.

Conclusion

In closing, we showed that more femininity and communal opportunities in STEM could lead to more individuals pursuing STEM, as they would feel more belonging and have higher expectations to succeed in STEM. If we can do that, we will have more LGBTQ individuals and non-LGBTQ women entering STEM fields and diversifying STEM careers, research, and ideas.

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Table 1

Participant Demographics for Study 1

	LGBTQ Individuals (*n* = 79)	Non-LGBTQ Women (*n* = 124)	Non-LGBTQ Men (*n* = 25)
Sex Assigned at Birth			
Female	71	124	-
Male	6	-	25
Intersex	1	-	-
Gender Identity			
Women	63	124	-
Men	7	-	25
Non-Binary	6	-	-
Transgender	3	-	-
Sexual Orientation			
Lesbian	9	-	-
Gay	5	-	-
Bisexual	36	-	-
Asexual	8	-	-
Pansexual	13	-	-
Questioning	1	-	-
Straight/Heterosexual	7	124	25
Romantic Orientation			
Homoromantic	16	-	-
Biromantic	29	-	-
Asexual	1	-	-
Panromantic	18	-	-
Heteroromantic	15	124	25
Ally to LGBTQ Community			
Yes	73	100	15
No	5	23	10
Race			
Asian	5	10	4
Black	4	11	3
Hispanic	5	9	3
Latinx/Latina/Latino	2	1	0
Native American	1	0	0
White	53	86	13
Other	2	3	1
Mix	7	4	1
Age			
Median	21.0	19.5	20.0
Range	18 – 51	18 – 50	18 – 40
STEM			
Major	53	78	17
Minor	9	9	2

Table 2

Mixed ANOVA Results for Gender Expression of Self for Study 1 and 2

	Study 1						Study 2					
	F	*df*	*p*	*d*	*M*	*SD*	*F*	*df*	*p*	*d*	*M*	*SD*
Groups	6.97	2, 225	.001	-	-	-	3.24	2, 251	.041	-	-	-
LGBTQ Individuals	-	-	-	-	3.26	0.97	-	-	-	-	3.00	0.94
Non-LGBTQ Women	-	-	.976	0.03	-	-	-	-	.052	0.21	-	-
Non-LGBTQ Women	-	-	-	-	3.29	0.98	-	-	-	-	2.79	1.02
Non-LGBTQ Men	-	-	< .001	0.71	-	-	-	-	.112	0.17	-	-
Non-LGBTQ Men	-	-	-	-	2.48	1.29	-	-	-	-	2.61	1.07
LGBTQ Individuals	-	-	.003	0.68	-	-	-	-	< .001	0.39	-	-
Gender Expression	5.41	1, 225	.021	0.23	-	-	23.70	1, 251	< .001	0.47	-	-
Femininity	-	-	-	-	3.39	1.79	-	-	-	-	2.38	1.82
Masculinity	-	-	-	-	2.99	1.81	-	-	-	-	3.22	1.75
Interaction	26.54	2, 225	< .001	-	-	-	18.91	2, 251	< .001	-	-	-
LGBTQ Individuals	0.04	1, 78	.850	0.04	-	-	0.89	1, 84	.347	0.17	-	-
Femininity	-	-	-	-	3.29	1.78	-	-	-	-	2.85	1.83
Masculinity	-	-	-	-	3.23	1.75	-	-	-	-	3.15	1.69
Non-LGBTQ Women	33.08	1, 123	< .001	0.81	-	-	0.12	1, 83	.731	0.06	-	-
Femininity	-	-	-	-	3.94	1.42	-	-	-	-	2.85	1.70
Masculinity	-	-	-	-	2.65	1.73	-	-	-	-	2.74	1.80
Non-LGBTQ Men	34.89	1, 25	< .001	1.62	-	-	81.53	1, 84	< .001	1.45	-	-
Femininity	-	-	-	-	1.04	1.54	-	-	-	-	1.45	1.57
Masculinity	-	-	-	-	3.92	1.98	-	-	-	-	3.76	1.62

Table 3

Mixed ANOVA Results for Goal Endorsement for Study 1 and 2

	Study 1						Study 2					
	F	*df*	*p*	*d*	*M*	*SD*	*F*	*df*	*p*	*d*	*M*	*SD*
Groups	5.09	2, 225	.007	-	-	-	0.18	2, 251	.195	-	-	-
LGBTQ Individuals	-	-	-	-	5.34	0.67	-	-	-	-	5.09	0.87
Non-LGBTQ Women	-	-	.005	0.46	-	-	-	-	.713	0.07	-	-
Non-LGBTQ Women	-	-	-	-	5.62	0.57	-	-	-	-	5.10	0.87
Non-LGBTQ Men	-	-	.429	0.26	-	-	-	-	1.000	0.08	-	-
Non-LGBTQ Men	-	-	-	-	5.45	0.75	-	-	-	-	5.03	0.85
LGBTQ Individuals	-	-	.707	0.16	-	-	-	-	.991	0.01	-	-
Goal Endorsement	58.03	1, 225	< .001	0.73	-	-	1.38	1, 251	.242	0.08	-	-
Communal Goals	-	-	-	-	5.79	0.74	-	-	-	-	5.11	1.10
Agentic Goals	-	-	-	-	5.23	0.79	-	-	-	-	5.03	0.94
Interaction	0.46	2, 225	.635	-	-	-	4.57	2, 251	.011	-	-	-
Communal Goals	3.11	2, 225	.046	-	-	-	1.93	2, 251	.147	-	-	-
LGBTQ Individuals	-	-	-	-	5.65	0.79	-	-	-	-	5.22	1.08
Non-LGBTQ Women	-	-	-	-	5.90	0.65	-	-	-	-	5.20	1.13
Non-LGBTQ Men	-	-	-	-	5.67	0.94	-	-	-	-	4.92	1.07
Agentic Goals	4.07	2, 225	.018	-	-	-	0.73	2, 251	.481	-	-	-
LGBTQ Individuals	-	-	-	-	5.03	0.76	-	-	-	-	4.97	0.96
Non-LGBTQ Women	-	-	-	-	5.35	0.78	-	-	-	-	5.13	0.95
Non-LGBTQ Men	-	-	-	-	5.24	0.80	-	-	-	-	5.00	0.90

Table 4

Mixed ANOVA Results for Perceived Opportunities in STEM for Study 1 and 2

	Study 1						Study 2					
	F	*df*	*p*	*d*	*M*	*SD*	*F*	*df*	*p*	*d*	*M*	*SD*
Groups	0.09	2, 224	.918	-	-	-	1.65	2, 251	.194	-	-	-
LGBTQ Individuals	-	-	-	-	4.17	1.04	-	-	-	-	4.72	1.01
Non-LGBTQ Women	-	-	.938	0.05	-	-	-	-	.297	0.13	-	-
Non-LGBTQ Women	-	-	-	-	4.12	0.92	-	-	-	-	4.59	0.96
Non-LGBTQ Men	-	-	.989	0.04	-	-	-	-	.245	0.14	-	-
Non-LGBTQ Men	-	-	-	-	4.09	0.73	-	-	-	-	4.45	0.98
LGBTQ Individuals	-	-	.936	0.09	-	-	-	-	.006	0.27	-	-
Opportunities	72.78	1, 224	< .001	0.64	-	-	127.69	1, 251	< .001	0.77	-	-
Communal Opportunities	-	-	-	-	3.80	1.01	-	-	-	-	4.13	1.20
Agentic Opportunities	-	-	-	-	4.47	1.08	-	-	-	-	5.04	1.16
Interaction	0.91	2, 224	.406	-	-	-	5.35	2, 251	.005	-	-	-
Communal Opportunities	0.03	2, 224	.970	-	-	-	2.72	2, 251	.068	-	-	-
LGBTQ Individuals	-	-	-	-	3.78	1.10	-	-	-	-	4.37	1.32
Non-LGBTQ Women	-	-	-	-	3.80	1.00	-	-	-	-	3.95	1.09
Non-LGBTQ Men	-	-	-	-	3.84	0.83	-	-	-	-	4.08	1.15
Agentic Opportunities	0.43	2, 224	.650	-	-	-	2.81	2, 251	.062	-	-	-
LGBTQ Individuals	-	-	-	-	4.56	1.20	-	-	-	-	5.08	1.04
Non-LGBTQ Women	-	-	-	-	4.45	1.04	-	-	-	-	5.24	1.28
Non-LGBTQ Men	-	-	-	-	4.35	0.89	-	-	-	-	4.82	1.14

Table 5

ANOVA Results for Current Motivation to Pursue STEM for Study 1 and 2

	Study 1						Study 2					
	F	*df*	*p*	*d*	*M*	*SD*	*F*	*df*	*p*	*d*	*M*	*SD*
Groups	5.29	2, 224	.006	-	-	-	1.64	2, 251	.196	-	-	-
LGBTQ Individuals	-	-	-	-	3.42	1.96	-	-	-	-	5.04	1.56
Non-LGBTQ Women	-	-	.328	0.21	-	-	-	-	.912	0.06	-	-
Non-LGBTQ Women	-	-	-	-	3.03	1.81	-	-	-	-	4.94	1.73
Non-LGBTQ Men	-	-	.005	0.68	-	-	-	-	.196	0.26	-	-
Non-LGBTQ Men	-	-	-	-	4.36	2.09	-	-	-	-	5.36	1.52
LGBTQ Individuals	-	-	.082	0.46	-	-	-	-	.382	0.21	-	-

Table 6

ANOVA Results for Future Motivation to Pursue STEM for Study 1 and 2

	Study 1						Study 2					
	β	χ^2	*p*	*d*	*M*	*SD*	*F*	*df*	*p*	*d*	*M*	*SD*
Groups	-	-	-	-	-	-	2.46	2, 251	.087	-	-	-
LGBTQ Individuals	-	-	-	-	3.18	2.05	-	-	-	-	4.81	1.78
Non-LGBTQ Women	0.55	3.99	.046	0.30	-	-	-	-	.714	0.12	-	-
Non-LGBTQ Women	-	-	-	-	2.61	1.66	-	-	-	-	4.59	1.88
Non-LGBTQ Men	1.47	12.09	.001	0.76	-	-	-	-	.075	0.23	-	-
Non-LGBTQ Men	-	-	-	-	4.01	2.01	-	-	-	-	5.19	1.63
LGBTQ Individuals	0.91	4.27	.039	0.41	-	-	-	-	.337	0.22	-	-

Table 7

ANOVA Results for Expectations for Success in STEM for Study 1 and 2

	Study 1						Study 2					
	β	χ^2	*p*	*d*	*M*	*SD*	*F*	*df*	*p*	*d*	*M*	*SD*
Groups	-	-	-	-	-	-	1.98	2, 251	.140	-	-	-
LGBTQ Individuals	-	-	-	-	3.61	1.72	-	-	-	-	4.60	1.28
Non-LGBTQ Women	0.06	0.06	.809	0.05	-	-	-	-	.986	0.02	-	-
Non-LGBTQ Women	-	-	-	-	3.53	1.44	-	-	-	-	4.63	1.33
Non-LGBTQ Men	1.15	10.12	.002	0.74	-	-	-	-	.233	0.25	-	-
Non-LGBTQ Men	-	-	-	-	4.62	1.51	-	-	-	-	4.95	1.19
LGBTQ Individuals	1.09	8.34	.004	0.62	-	-	-	-	.172	0.28	-	-

Table 8

ANOVA Results for Personal Belonging in STEM for Study 1 and 2

	Study 1						Study 2					
	F	*df*	*p*	*d*	*M*	*SD*	β	χ^2	*p*	*d*	*M*	*SD*
Groups	3.92	2, 225	.021	-	-	-	-	-	-	-	-	-
LGBTQ Individuals	-	-	-	-	3.86	1.89	-	-	-	-	4.72	1.54
Non-LGBTQ Women	-	-	.987	0.02	-	-	0.29	1.35	.246	0.16	-	-
Non-LGBTQ Women	-	-	-	-	3.90	1.67	-	-	-	-	4.46	1.74
Non-LGBTQ Men	-	-	.022	0.64	-	-	0.82	10.89	.010	0.53	-	-
Non-LGBTQ Men	-	-	-	-	4.91	1.50	-	-	-	-	5.28	1.31
LGBTQ Individuals	-	-	.024	0.62	-	-	0.53	4.60	.032	0.39	-	-

Table 9

Regressions for LGBTQ Openness for Study 1 and 2

	Study 1				Study 2			
	β	*t*	*df*	*p*	β	*t*	*df*	*p*
Current Motivation to Pursue STEM	0.19	1.14	65	.258	0.04	0.40	81	.692
Future Motivation to Pursue STEM	0.23	1.29	65	.201	-0.05	-0.36	81	.721
Expectations for Success in STEM	0.11	0.72	65	.475	0.14	1.61	81	.111
Personal Belonging in STEM	0.35	2.23	65	.029	0.13	1.16	81	.249

Table 10

Indirect Effect Confidence Intervals for Study 1

	Overall Model	Group Model		
		Non-LGBTQ Men	LGBTQ Individuals	Non-LGBTQ Women
	95% CI	95% CI	95% CI	95% CI
Indirect Effect Model	(lower, upper)	(lower, upper)	(lower, upper)	(lower, upper)
Feminine Expression → Personal Belonging → Future Motivation to Pursue STEM	-0.08, 0.00	-0.12, 0.36	**-0.16, -0.00**	-0.02, 0.09
Feminine Expression → Expectations for Success → Future Motivation to Pursue STEM	**-0.15, -0.01**	0.04, 0.40	-0.25, 0.02	-0.10, 0.10
Communal Opportunity → Personal Belonging → Future Motivation to Pursue STEM	**0.00, 0.09**	-0.26, 0.34	-0.01, 0.14	-0.02, 0.05
Communal Opportunity → Expectations for Success → Future Motivation to Pursue STEM	**0.08, 0.24**	-0.36, 0.04	**0.01, 0.28**	**0.07, 0.26**
Feminine Expression → Personal Belonging → Current Motivation to Pursue STEM	-0.08, 0.00	-0.05, 0.39	**-0.17, -0.01**	-0.03, 0.10
Feminine Expression → Expectations for Success → Current Motivation to Pursue STEM	**-0.17, -0.01**	0.01, 0.46	-0.25, 0.02	-0.12, 0.10
Communal Opportunity → Personal Belonging → Current Motivation to Pursue STEM	**0.00, 0.10**	-0.20, 0.28	-0.01, 0.16	-0.02, 0.07
Communal Opportunity → Expectations for Success → Current Motivation to Pursue STEM	**0.09, 0.26**	-0.37, 0.06	**0.01, 0.27**	**0.09, 0.28**

Note. Bold confidence interval (CI) are significant indirect effects.

Table 11

R^2 Values for Indirect Effect Models for Study 1 and 2

	Study 1				Study 2			
Model	Personal Belonging in STEM	Expectations for Success in STEM	Current Motivation to Pursue STEM	Future Motivation to Pursue STEM	Personal Belonging in STEM	Expectations for Success in STEM	Current Motivation to Pursue STEM	Future Motivation to Pursue STEM
Overall	0.04	0.10	0.50	0.44	0.11	0.06	0.49	0.53
Non-LGBTQ Women	0.02	0.13	0.45	0.34	0.15	0.12	0.43	0.51
LGBTQ Individuals	0.14	0.13	0.55	0.54	0.19	0.15	0.55	0.47
Non-LGBTQ Men	0.05	0.21	0.47	0.63	0.05	0.04	0.54	0.63

Table 12

Participant Demographics for Study 2

	LGBTQ Individuals (*n* = 85)	Non-LGBTQ Women (*n* = 84)	Non-LGBTQ Men (*n* = 85)
Sex Assigned at Birth			
Female	53	84	-
Male	31	-	85
Intersex	1	-	-
Gender Identity			
Women	36	84	-
Men	18	-	85
Non-Binary	17	-	-
Transgender	13	-	-
Sexual Orientation			
Lesbian	13	-	-
Gay	18	-	-
Bisexual	30	-	-
Asexual	6	-	-
Pansexual	13	-	-
Queer	1	-	-
Straight/Heterosexual	4	84	85
Romantic Orientation			
Homoromantic	26	-	-
Biromantic	29	-	-
Asexual	3	-	-
Panromantic	15	-	-
Queer	1	-	-
Heteroromantic	11	84	85
Ally to LGBTQ Community			
Yes	82	59	63
No	3	25	22
Race			
Asian	10	10	20
Black	12	14	8
Hispanic	3	4	4
Latinx/Latina/Latino	0	1	0
Native American	0	0	1
White	59	49	49
Other	0	0	0
Mixed	1	6	2
Age			
Median	26.0	28.0	25.0
Range	18 – 50	18 – 49	18 – 42
STEM			
Major	45	33	53
Minor	17	14	11

Table 13

Mixed ANOVA Results for Perceived Gender Expression in STEM for Study 2

	Study 2					
	F	*df*	*p*	*d*	*M*	*SD*
Groups	1.65	2, 250	.195	-	-	-
LGBTQ Individuals	-	-	-	-	2.98	1.09
Non-LGBTQ Women	-	-			-	-
Non-LGBTQ Women	-	-	-	-	2.81	1.01
Non-LGBTQ Men	-	-			-	-
Non-LGBTQ Men	-	-	-	-	2.69	1.00
LGBTQ Individuals	-	-			-	-
Perceived Gender Expression in STEM	33.92	1, 250	< .001	0.55	-	-
Femininity	-	-	-	-	2.39	1.58
Masculinity	-	-	-	-	3.26	1.59
Interaction	1.90	2, 250	.152	-	-	-
Femininity	3.62	2, 250	.028		-	-
LGBTQ Individuals	-	-	-	-	2.73	1.59
Non-LGBTQ Women	-	-	-	-	2.36	1.47
Non-LGBTQ Men	-	-	-	-	2.08	1.62
Masculinity	0.04	2, 250	.962		-	-
LGBTQ Individuals	-	-	-	-	3.23	1.59
Non-LGBTQ Women	-	-	-	-	3.26	1.64
Non-LGBTQ Men	-	-	-	-	3.29	1.55

Table 14

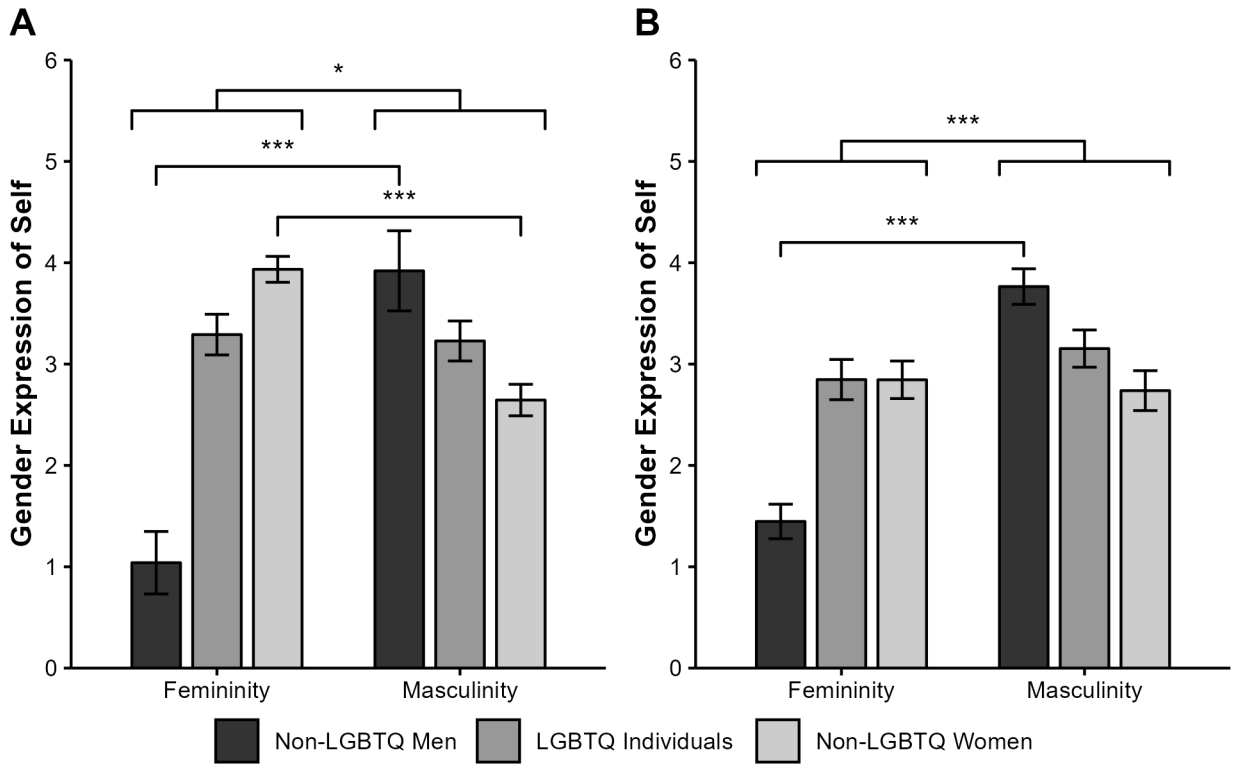
Indirect Effect Confidence Intervals for Study 2

	Overall Model	Group Model		
		Non-LGBTQ Men	LGBTQ Individuals	Non-LGBTQ Women
	95% CI	95% CI	95% CI	95% CI
Indirect Effect Model	(lower, upper)	(lower, upper)	(lower, upper)	(lower, upper)
Feminine Expression → Personal Belonging → Future Motivation to Pursue STEM	**-0.23, -0.05**	-0.23, 0.14	-0.12, 0.13	**-0.32, -0.05**
Feminine Expression → Expectations for Success → Future Motivation to Pursue STEM	-0.06, 0.00	-0.04, 0.01	-0.08, 0.01	-0.14, 0.00
Communal Opportunity → Personal Belonging → Future Motivation to Pursue STEM	**0.08, 0.28**	-0.03, 0.44	**0.02, 0.31**	**0.03, 0.32**
Communal Opportunity → Expectations for Success → Future Motivation to Pursue STEM	**0.00, 0.08**	-0.01, 0.15	-0.02, 0.08	-0.00, 0.17
Femininity in STEM → Personal Belonging → Future Motivation to Pursue STEM	-0.07, 0.11	-0.25, 0.17	-0.02, 0.26	-0.15, 0.10
Femininity in STEM → Expectations for Success → Future Motivation to Pursue STEM	-0.02, 0.03	-0.08, 0.05	-0.02, 0.07	-0.07, 0.03
Communal Goals → Personal Belonging → Future Motivation to Pursue STEM	-0.08, 0.15	-0.21, 0.19	-0.09, 0.22	-0.05, 0.22
Communal Goals → Expectations for Success → Future Motivation to Pursue STEM	-0.03, 0.04	-0.12, 0.01	-0.03, 0.11	-0.04, 0.07
Feminine Expression → Personal Belonging → Current Motivation to Pursue STEM	**-0.22, -0.04**	-0.20, 0.13	-0.12, 0.15	**-0.31, -0.04**
Feminine Expression → Expectations for Success → Current Motivation to Pursue STEM	-0.07, 0.00	-0.06, 0.06	-0.07, 0.01	-0.17, 0.01
Communal Opportunity → Personal Belonging → Current Motivation to Pursue STEM	**0.08, 0.27**	-0.03, 0.43	**0.03, 0.32**	**0.03, 0.28**
Communal Opportunity → Expectations for Success → Current Motivation to Pursue STEM	-0.00, 0.08	-0.05, 0.13	-0.01, 0.09	-0.01, 0.18
Femininity in STEM → Personal Belonging → Current Motivation to Pursue STEM	-0.07, 0.11	-0.25, 0.15	-0.02, 0.28	-0.14, 0.09
Femininity in STEM → Expectations for Success → Current Motivation to Pursue STEM	-0.02, 0.03	-0.06, 0.06	-0.01, 0.07	-0.09, 0.03
Communal Goals → Personal Belonging → Current Motivation to Pursue STEM	-0.08, 0.15	-0.27, 0.18	-0.09, 0.22	-0.05, 0.20
Communal Goals → Expectations for Success → Current Motivation to Pursue STEM	-0.03, 0.04	-0.12, 0.04	-0.03, 0.11	-0.04, 0.08

Note. Bold confidence interval (CI) are significant indirect effects.

Figure 1

Mixed ANOVA for Gender Expression of Self for Study 1 and 2

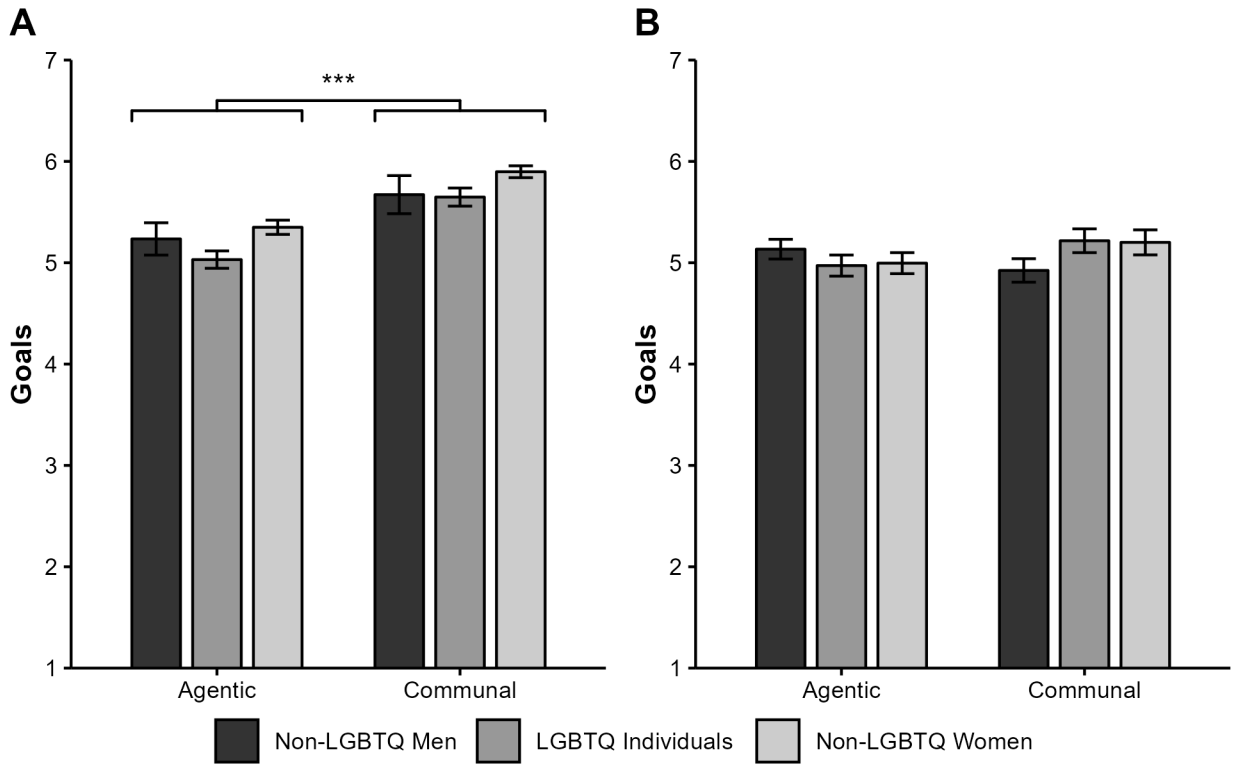


Note. A is Study 1, and B is Study 2.

*p < .05; **p < .01; ***p < .001

Figure 2

Mixed ANOVA for Goal Endorsement for Study 1 and 2

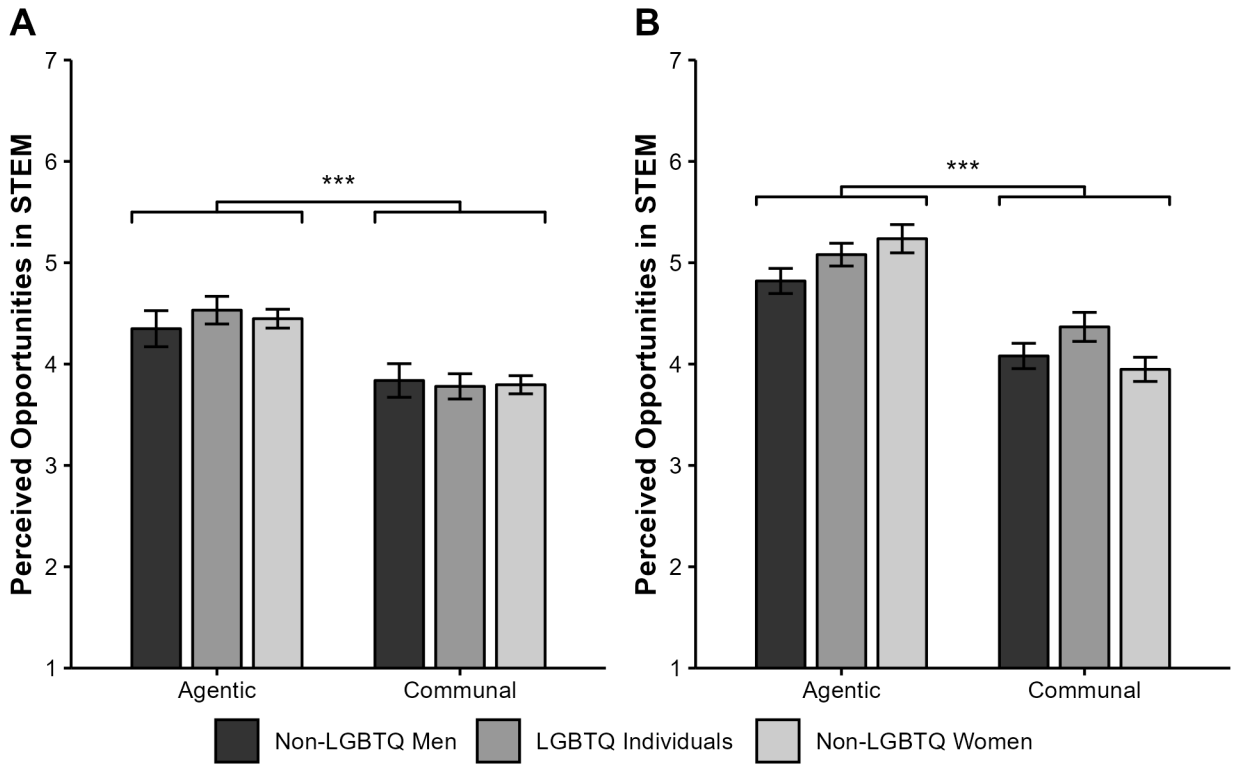


Note. A is Study 1, and B is Study 2.

*p < .05; **p < .01; ***p < .001

Figure 3

Mixed ANOVA for Perceived Opportunities in STEM for Study 1 and 2

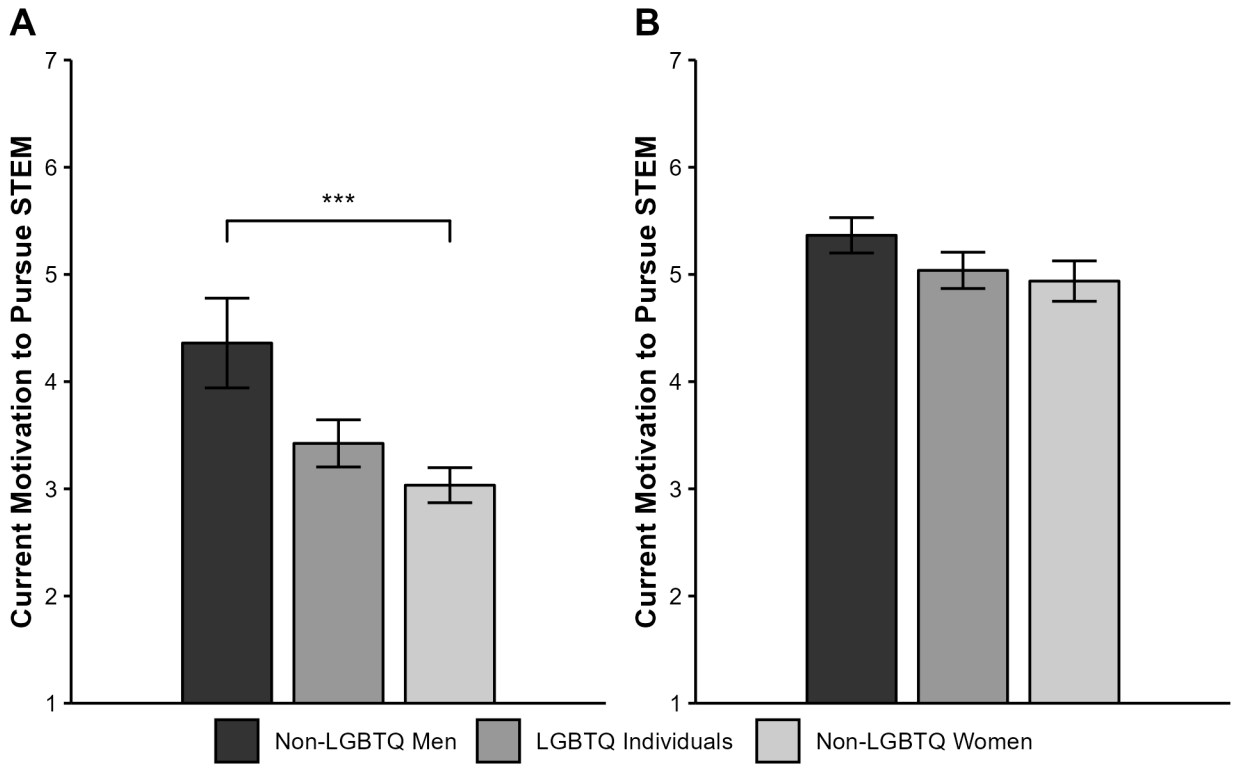


Note. A is Study 1, and B is Study 2.

*p < .05; **p < .01; ***p < .001

Figure 4

Group Differences with Current Motivation to Pursue STEM for Study 1 and 2

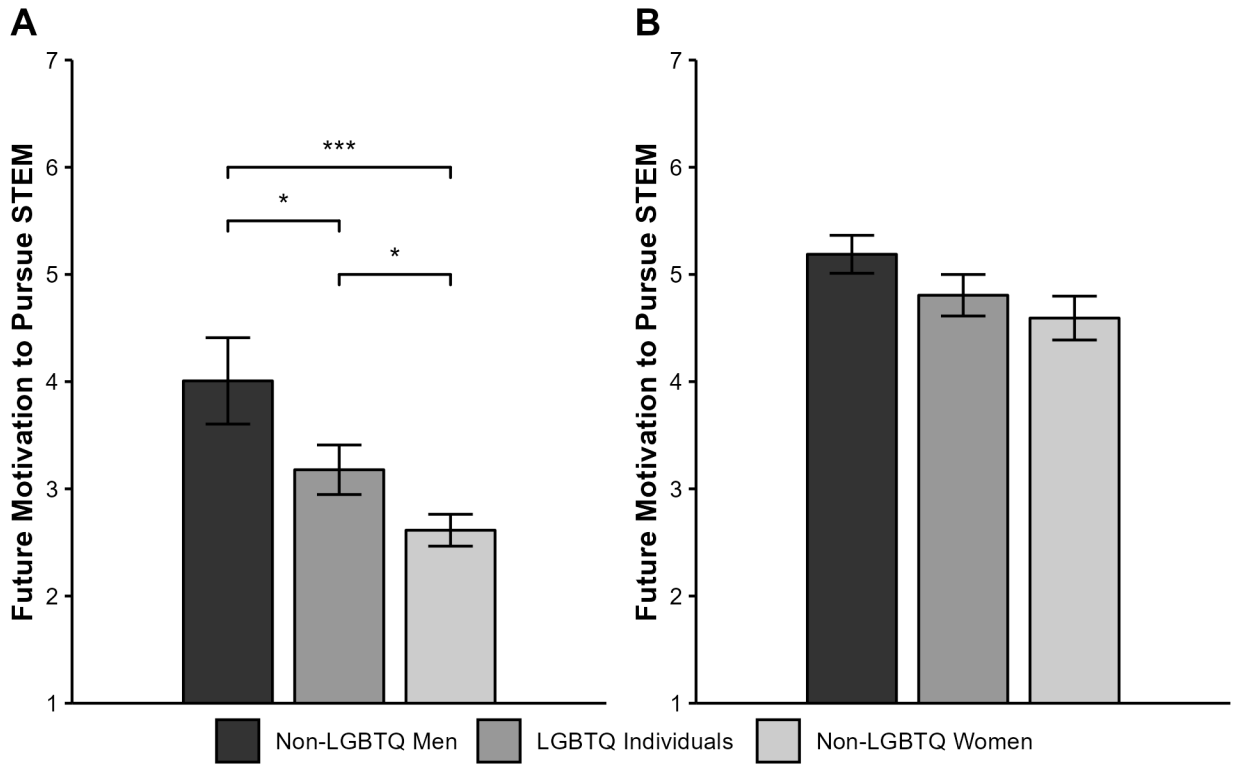


Note. A is Study 1, and B is Study 2.

*p < .05; **p < .01; ***p < .001

Figure 5

Group Differences with Future Motivation to Pursue STEM for Study 1 and 2

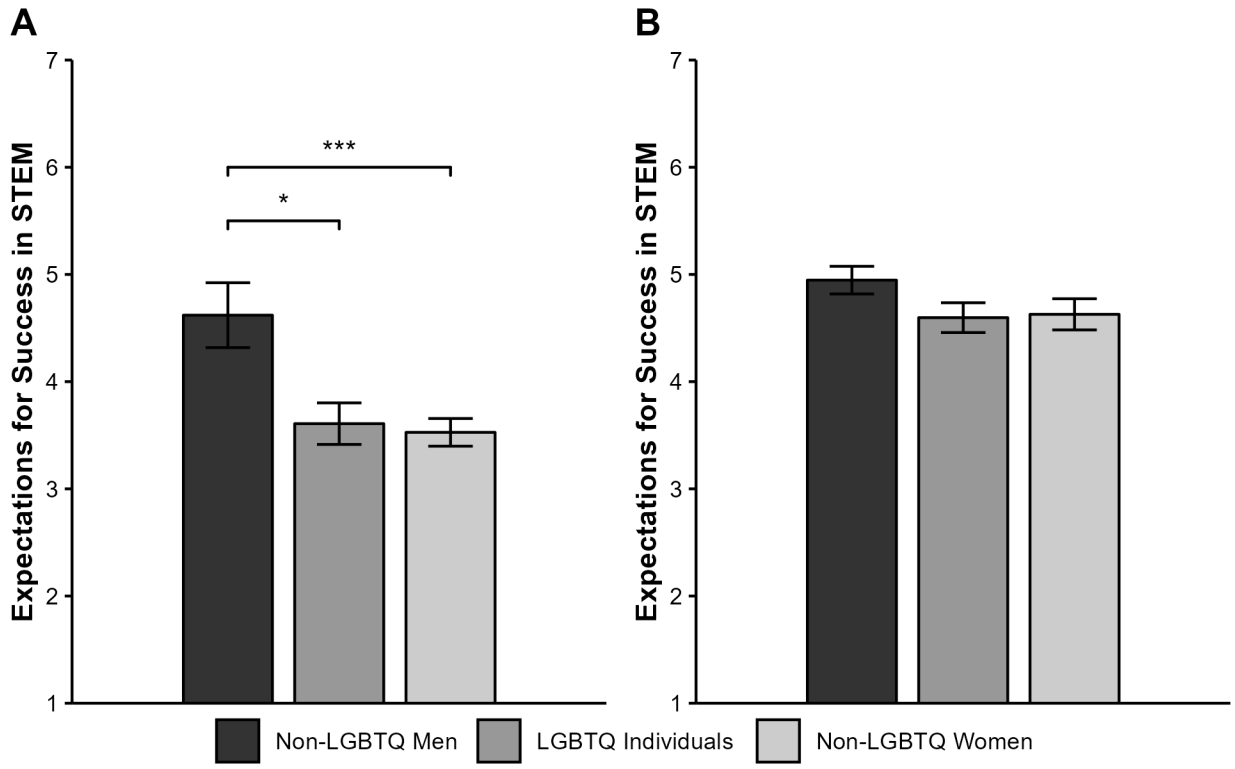


Note. A is Study 1, and B is Study 2.

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

Figure 6

Group Differences with Expectations for Success in STEM for Study 1 and 2

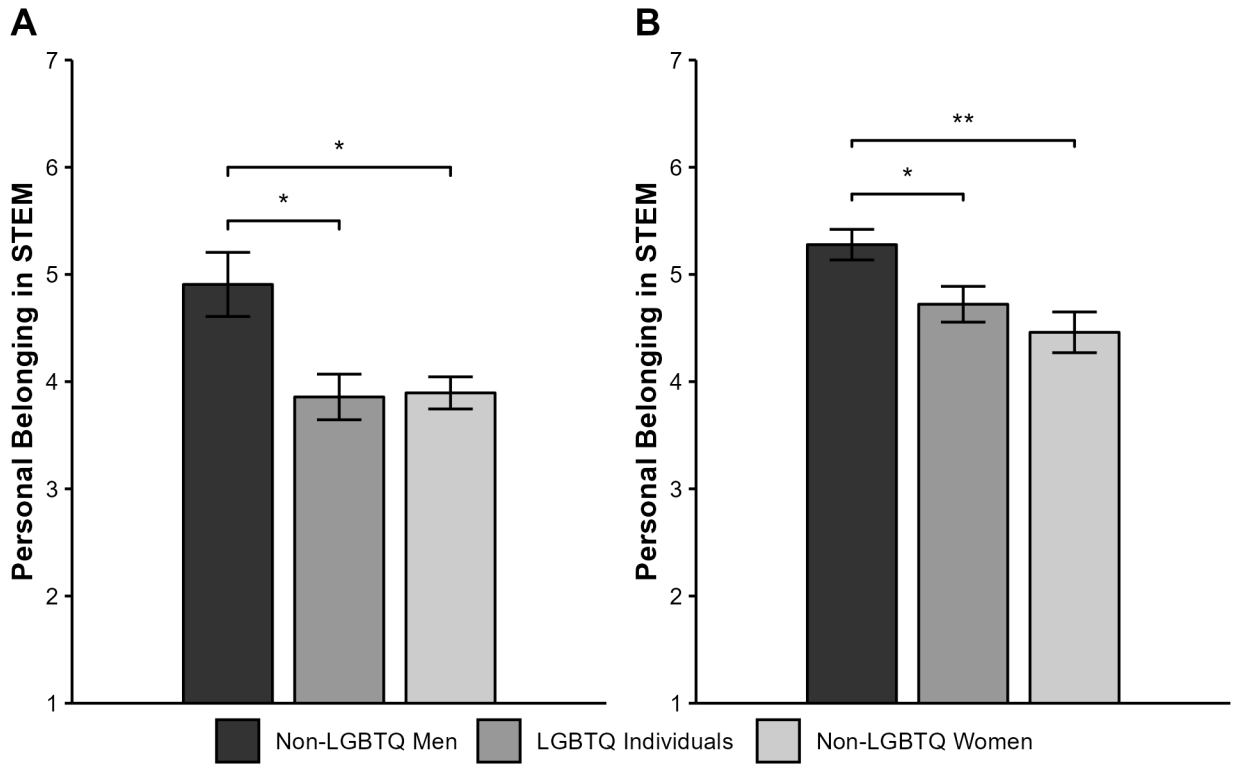


Note. A is Study 1, and B is Study 2.

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

Figure 7

Group Differences with Personal Belonging in STEM for Study 1 and 2

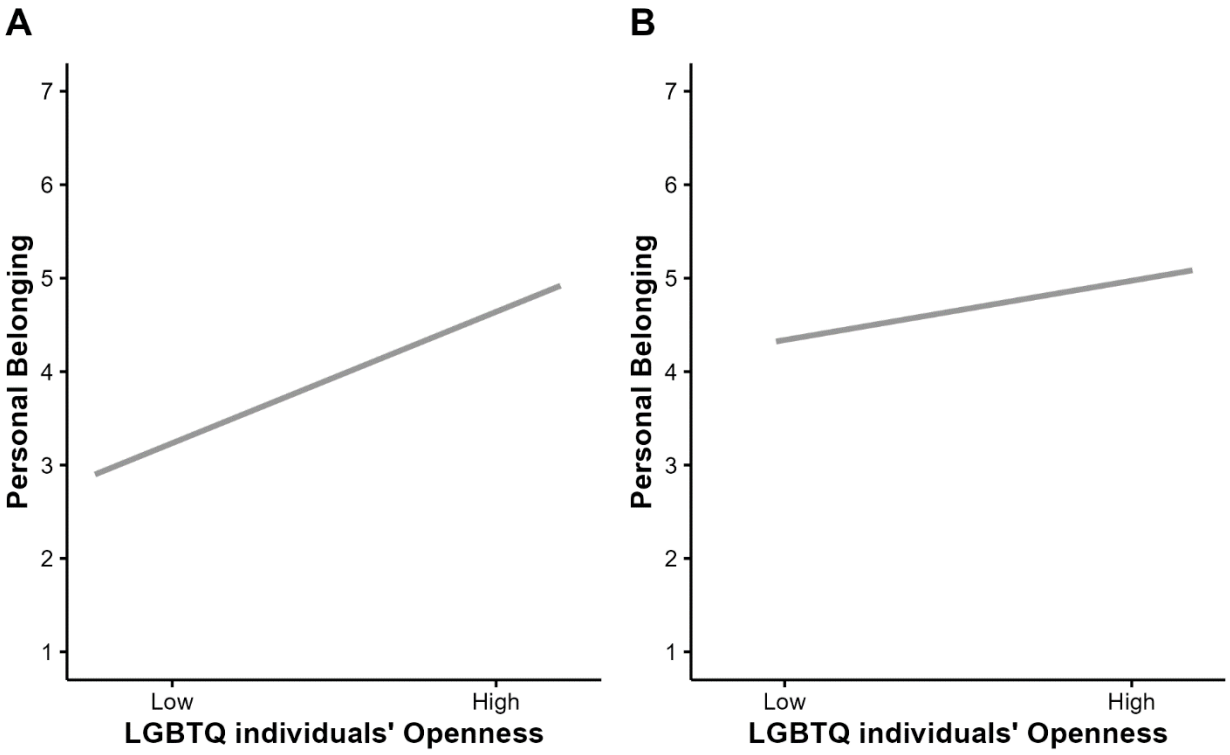


Note. A is Study 1, and B is Study 2.

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

Figure 8

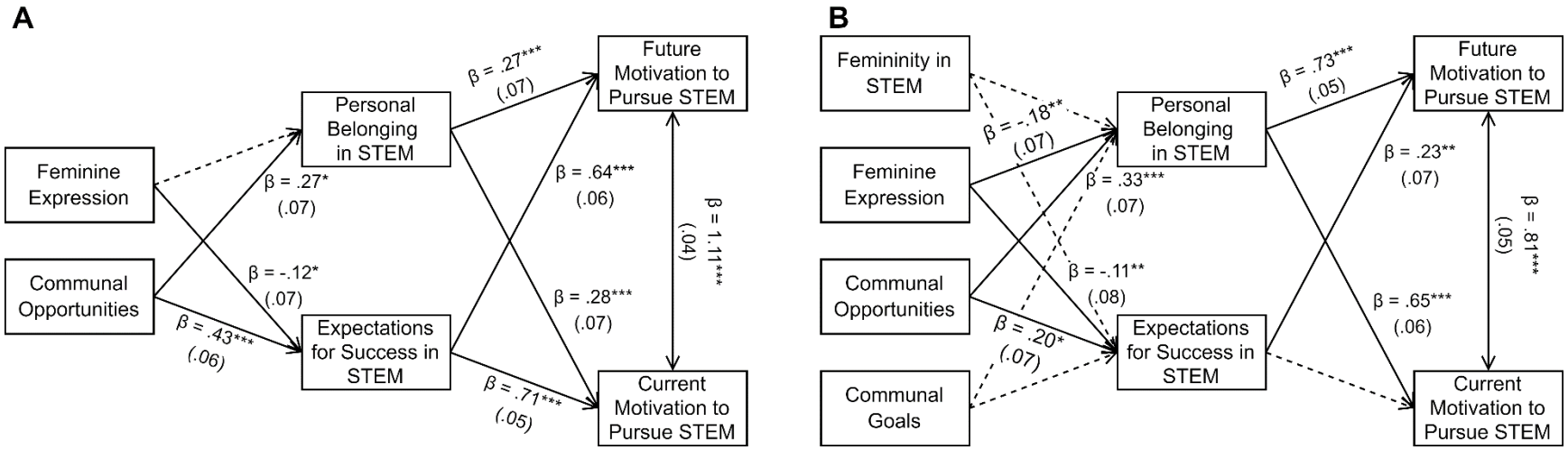
LGBTQ Openness relating to Personal Belonging in STEM for Study 1 and 2



Note. A is Study 1, and B is Study 2.

Figure 9

Overall Path Model for Study 1 and 2

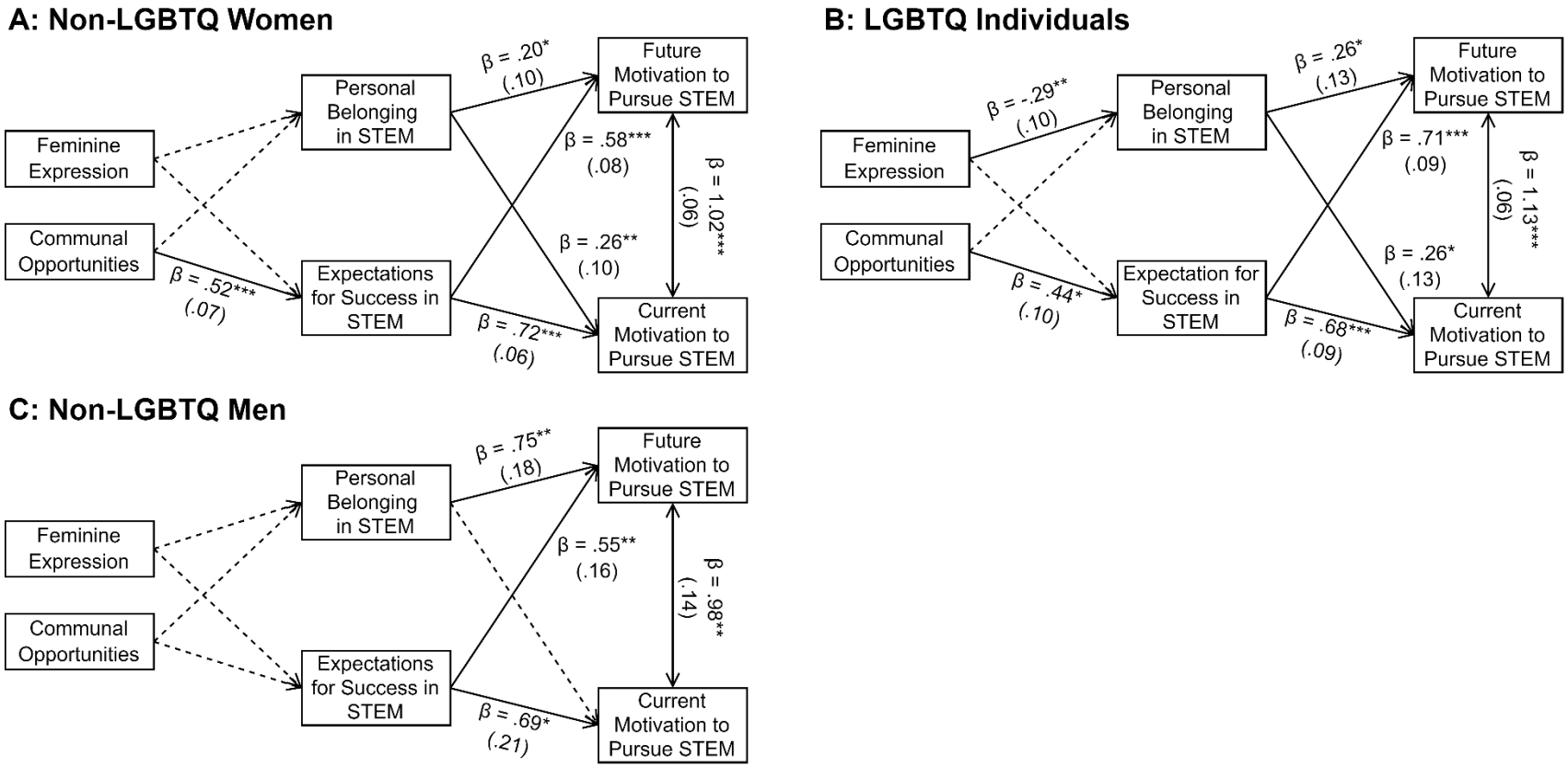


Note. A is Study 1, and B is Study 2. The path analysis coefficients are statistically significant and represent standardized estimates. Dashed lines show the non-significant paths in the model. Parentheses contain the standard error. See Table 11 for the R^2 values for the variables for each study.

*p < .05; **p < .01; ***p < .001

Figure 10

Group Path Model for Study 1

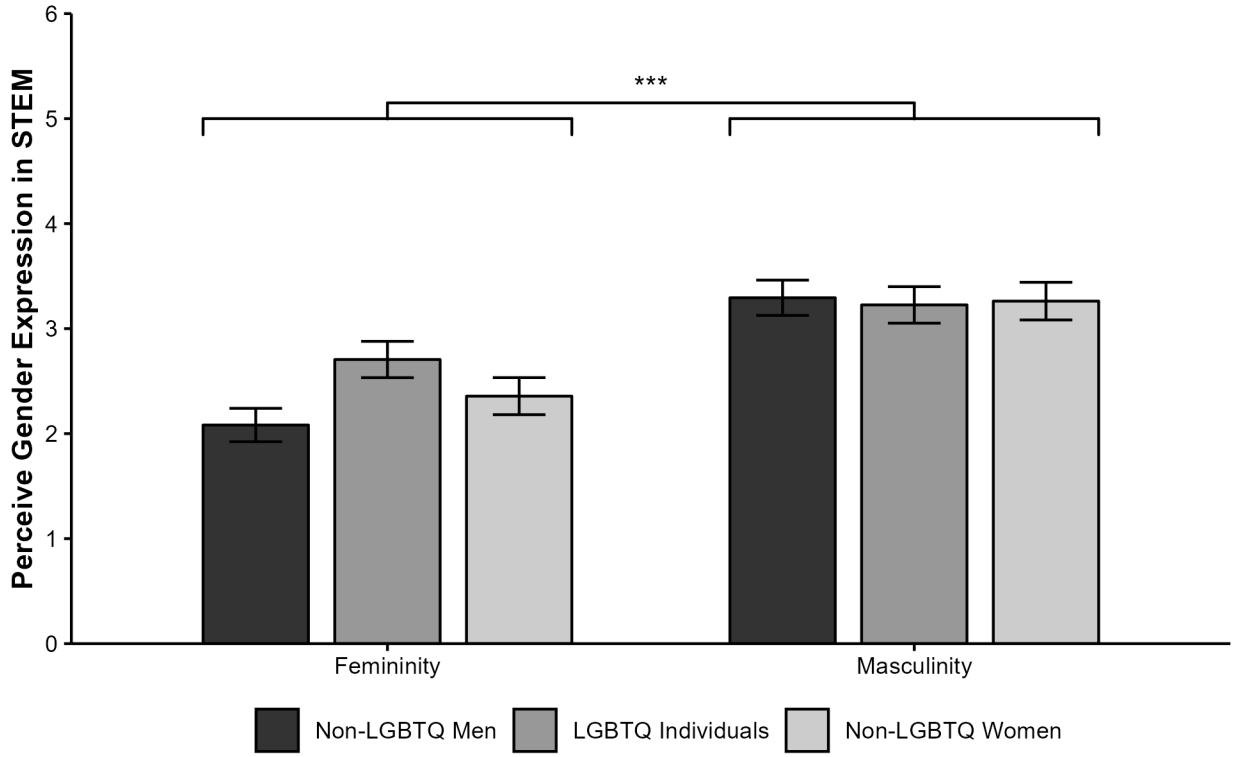


Note. A is non-LGBTQ women, B is LGBTQ individuals, and C is non-LGBTQ men. The path analysis coefficients are statistically significant and represent standardized estimates. Dashed lines show the non-significant paths in the model. Parentheses contain the standard error. See Table 11 for the R^2 values for the variables for each group.

*p < .05; **p < .01; ***p < .001

Figure 11

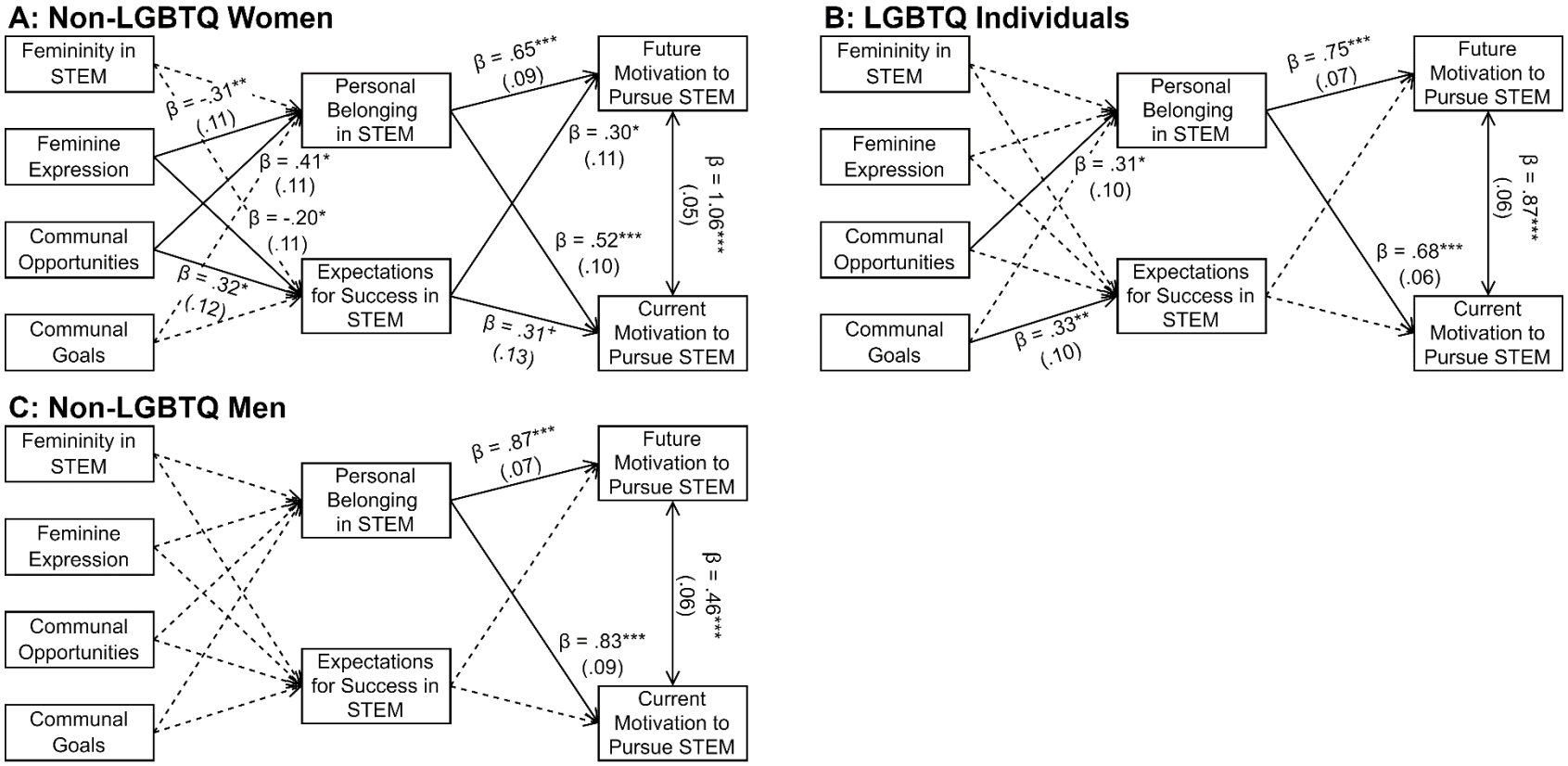
Mixed ANOVA for Perceived Gender Expression in STEM for Study 2



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

Figure 12

Group Path Model for Study 2



Note. A is non-LGBTQ women, B is LGBTQ individuals, and C is non-LGBTQ men. The path analysis coefficients are statistically significant and represent standardized estimates. Dashed lines show the non-significant paths in the model. Parentheses contain the standard error. See Table 11 for the R^2 values for the variables for each group.

$^{+}p = .05$; $*p < .05$; $**p < .01$; $***p < .001$