Goal-Congruity Theory Predicts Students' Sense of Belonging in Computing Across Racial/Ethnic Groups

Kathleen Isenegger
kti3@illinois.edu
University of Illinois at Urbana-Champaign
Urbana, IL, USA

Kari L. George
klgeorge@illinois.edu
University of Illinois at Urbana-Champaign
Urbana, IL, USA

Paul Bruno
pbruno@illinois.edu
University of Illinois at Urbana-Champaign
Urbana, IL, USA

Colleen M. Lewis
colleenl@illinois.edu
University of Illinois at Urbana-Champaign
Urbana, IL, USA

ABSTRACT

Students' goals may be one of many factors contributing to the underrepresentation of women, people who identify as Black, Hispanic, Latinx/a/o/*, or Native, and first-generation college students in computing. This study examines whether students who desire a career that enables them to pursue *communal goals*: goals of working with or for the benefit of others (e.g., have a social impact, serve humanity, help others, or give back to their community) may be deterred from computing if they perceive it as incompatible with those goals. Using survey data from over 45,000 undergraduate students, results show that women, compared to men of their same racial/ethnic identity, endorse social impact goals at higher rates, and that the relationship between a student's sense of belonging in computing and their goals is moderated by their perception of the communal goal affordances of computing.

CCS CONCEPTS

• **Social and professional topics** → **Computing education programs**; **Computer science education**.

KEYWORDS

belonging, diversity, inclusion, social impact, communal goals

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1 INTRODUCTION

Among computer science (CS) degree earners in the U.S., there is a longstanding pattern of overrepresentation of white and Asian/Asian American men[1]. In contrast, people who identify as women, Black or African American[2], Hispanic or Latinx/a/o/*[3], Native American, Native Alaskan, Native Hawaiian, and/or Pacific Islander are underrepresented[4] in CS [11]. This paper leverages goal-congruity theory [7, 8, 13, 16] to understand and address these disparities.

Goal-congruity theory posits that individuals select a career field based, in part, on their perception of if they can accomplish their personal goals in that career field. Prior research has used goal-congruity theory to explain patterns of underrepresentation in Science, Technology, Engineering and Math (STEM) fields [5, 7, 8, 16] and in CS more specifically [3, 4, 10, 13]. Undergraduate students perceive that, compared to non-STEM fields, STEM fields present less opportunities to accomplish communal goals [7]. Communal goals are those related to "communion, or an orientation to care about other people" [7]. As prior research has shown that people from groups underrepresented in STEM are more likely to endorse communal goals [7, 8, 13, 16], their perception that communal goal affordances — the extent to which they can achieve their communal goals in a particular field — are lower in STEM fields may partially explain why they are deterred from pursuing those career fields.

Research indicates that undergraduate students from racial/ethnic groups underrepresented in computing, along with Asian/Asian American students, are more likely than white students to endorse communal goals [13, 16]. Additionally, women are more likely to endorse communal goals than men [3, 7, 8, 13] and first-generation students are more likely than continuing-generation students to endorse communal goals [13]. Our previous research found that communal goal endorsement negatively predicted CS students' sense of belonging, and, importantly, that this relationship was moderated by the extent to which students believe computing affords communal goals [13]. This is pertinent to broadening participation in computing (BPC) as a greater sense of belonging is predictive of persistence in computing majors [12] and career aspirations in

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[1] We refer to gender identities of "man" and "woman" instead of referring to terms such as "male" and "female," which describe a person's biological sex. This is appropriate because our work relates to social contexts and not biology.
[2] The racial and ethnic categories listed here are defined by the "Integrated Postsecondary Education Data System (IPEDS)" https://nces.ed.gov/ipeds/report-your-data/race-ethnicity-definitions
[3] We use "Hispanic or Latinx/a/o/*" instead of "Hispanic or Latino/a" because Latinx is used by some individuals who do not identify as Latina or Latino [15]. The * "is used to create and promote an inclusive space for all genders" [15].
[4] We will refer to people from these groups as "people from groups underrepresented in CS/STEM".

computing [9]. Thus, the extent to which students' endorsement of communal goals align with their perceptions of what computing affords, is one factor that may influence who persists in computing.

This study examines differences in undergraduate CS students' values and perceptions across intersecting gender identities, racial/ethnic identities, and levels of parental education. Our prior work [13] reported differences in communal goal endorsements between racial/ethnic groups, first-generation and continuing-generation students, and men and women, using a sample of undergraduate students' survey responses from the U.S. and Canada. To expand on our work, this study aims to highlight differences in communal goal endorsement and communal goal affordances for intersecting identity groups. Intersectionality illuminates how multiple forms of discrimination interact and compound challenges [6], particularly for women of color[5] who may experience unique challenges from their position within the double bind (i.e., the simultaneous effects of racism and sexism) [14]. We investigate the relevance of goal-congruity theory for more specific groups of students, many of which describe students who report multiple identities that are underrepresented in computing. Additionally, this study uses an expanded sample to explore differences across eight racial/ethnic groups and three gender identities, whereas the previous study excluded some of these groups. We examine how the moderating effect of perceptions of communal goal affordances on students' endorsement of communal goals and their sense of belonging in computing exists across racial subgroups as previous findings across for students could have been driven by the overrepresentation of white students in the sample.

The present study is guided by the following research questions:

- **RQ1**: To what extent do students' endorsement of communal goals vary across gender, race/ethnicity, and first-generation status?
- **RQ2**: In what racial/ethnic groups do students' perceptions of the communal affordances of computing moderate the relationship between their communal goal endorsement and their sense of belonging in computing, as predicted by goal-congruity theory?

In order to leverage goal-congruity theory for BPC, it is important to understand patterns of communal goal endorsement and how student perceptions of CS' communal goal affordances impacts the relationship between communal goal endorsement and sense of belonging. In our full sample, which includes n = 46,249 undergraduate computing majors at 360 institutions, communal goal endorsement was negatively related to a sense of belonging in computing. Additionally, in each racial/ethnic group, women were more likely to endorse communal goals than men. Differential patterns of communal goal endorsement are not limited to gender. Considering all racial groups, white students were least likely to endorse communal goals. Further, communal goal endorsement and sense of belonging moderated by communal goal affordances for our full sample and for 4 of the 8 racial/ethic groups analyzed. This suggests that communal goal endorsement may be contributing to underrepresentation of women, Black, Latinx, and Native students in computing. Therefore, perceptions of communal goal affordances are a factor which could be targeted to potentially reduce the negative impact communal goal endorsement has on a sense of belonging.

[5] African American, Asian American/Pacific Islander, Chicana/Latina, and Native American women [14]

2 PREVIOUS RESEARCH

A growing body of research suggests that goal-congruity theory may explain patterns of disinterest in STEM [7, 8, 13, 16]. Researchers found that communal goal endorsement negatively predicted students' interest in STEM careers and had no effect on students' interest in male-stereotypic non-STEM careers (e.g., law) [7, 8]. In CS, researchers found that students who left the CS major perceived CS to be an asocial field with little connection to the outside world [2] meaning that their perceptions of CS's role in society may have contributed to their leaving.

Goal-congruity theory and the perception of computing as having low communal goal affordances is relevant to BPC because people from groups underrepresented in computing are more likely to endorse communal goals. Previous research primarily examines women as its population of interest, and finds that women have higher levels of communal goal endorsement [3, 7, 8], and this negatively impacts their lower sense of belonging in computing [13]. Further, Black/African American, Native, and Hispanic or Latinx/a/o/* students had higher communal goal endorsement than their white peers [13, 16]. Although not a population underrepresented in computing, our previous findings also show Asian/Asian American students have higher communal goal endorsement than their white peers [13]. First-generation college students were likely to have higher communal goals than continuing-generation students [1]. Therefore, it may be important to consider if student perceptions of the communal goal affordances of computing are an impediment to BPC.

Prior research on goal-congruity theory has found trends within gender, race, ethnicity, and parental education demographics independently, though the extent to which communal goal endorsement or perceptions vary across intersecting identities is unclear. Evidence of the importance of considering communal goal endorsement across intersecting identities is shown in Smith et al.'s [16] finding that Native undergraduate students in STEM, unlike their white peers, strongly endorse communal goals regardless of gender. Given this finding, and since previous findings of differences in communal goal endorsement may be driven by the higher representation of white students, we hypothesize that differences in communal goal endorsement by gender or by first- or continuing-generation status will only be present among white students (hypothesis 1). Further, given the theoretical considerations discussed above and consistent empirical support for goal-congruity theory, we hypothesize that the relationship between communal goal endorsements and sense of belonging for students will be moderated by communal goal affordances across all racial/ethnic groups (hypothesis 2). We also expand on previous work by considering the relationships between communal goal endorsement and gender and parental education attainment within racial/ethnic groups.

Goal-congruity theory elucidates a promising mechanism to support BPC efforts as students' perceptions of computing's communal goal affordances may be malleable and responsive to interventions. Towards that goal, research on what shapes students' beliefs about

computing's communal goal affordances found that views were shaped by the belief that CS can benefit society because of its ubiquitous influence in modern society [10]. Still, interventions to highlight the communal goal affordances of computing may be helpful for BPC, as evidenced by a study that found a greater matriculation of undergraduate women and students from racial/ethnic groups underrepresented in CS in a communal goals oriented CS program compared to a typical CS program [4].

3 DATA

The Computing Research Association (CRA)'s Center for Evaluating the Research Pipeline (CERP) administers an annual survey to undergraduate CS students in the U.S. and Canada through computing departments, program participants, and past participants who consent to receive follow-up surveys. Incentives vary by institution and year. Data for this study are drawn from the 2014-2020 academic years, encompassing 46,249 undergraduate CS majors.

Respondents were asked to indicate their gender[6]. Respondents could select from: woman, man, non-binary, self-identify, transgender, and gender-queer/non-conforming[7]. In this analysis, we aggregate non-binary, self-identify, transgender, and gender-queer/non-conforming students into one group referred to as *non-binary* to indicate they identify outside the man/woman gender binary. First-generation college students refer to students whose parents did not attend a 4-year college or university. Certain responses for race/ethnicity have been grouped together in the dataset because the racial/ethnic categories that respondents could select have not been consistent over the years; see Table 1 for groupings. Respondents with missing or unknown values for gender, race/ethnicity, and parent education, or who did not receive a value for one or more of the measures below, were excluded from the analyses.

3.1 Measures

3.1.1 Sense of Belonging in Computing. The dependent variable, sense of belonging in computing, was calculated by averaging measures of three survey items using 5-point Likert scales ("strongly disagree" to "strongly agree"; Cronbach's alpha = 0.76): *I feel like I belong in computing, I feel welcome in the computing community*[8], and *I feel like an outsider in the computing community* (reverse coded). The average score was calculated from the items they answered and if a respondent did not answer any of these three items, they did not receive a value for this variable.

3.1.2 Communal Goal Endorsement. Communal goal endorsement was calculated by averaging four survey items using 5-point Likert scales (not important to extremely important; Cronbach's alpha = 0.87) asking how important it is that your future career allows you to: *give back to my community*[9], *have a social impact*10[0], *serve humanity*[10], and *help others*. The average score was calculated for the items they answered, and if a respondent did not answer any of these four items, they did not receive a value for this variable.

[6]The 2014-2017 survey versions ask respondents to "Please indicate your gender", while the 2018-2020 versions ask "What is your gender identity?"
[7]In 2019, the options were "woman", "man","self-identify/something else", and "gender-queer/non-conforming"
[8]This statement did not appear on the 2020 survey.
[9]This statement did not appear on the 2019 or 2020 survey.
[10]This statement did not appear on the 2019 survey.

3.1.3 Perception of Communal Goal Affordances in CS. Perception of communal goal affordances in CS represents respondents' answers to this survey item using a 5-point Likert scale (not at all to very much): *In your opinion, to what extent would a career in computing allow you to serve humanity?* Respondents who did not answer this survey item did not receive a value for this variable.

Table 1 shows descriptive statistics of the sample data, overall and by race/ethnicity, as well as the means of communal goal endorsement, perceptions of communal goal affordances of computing, and sense of belonging for each racial group. Though we standardize these variables in the regressions below, they are presented with their unstandardized values in Table 1.

4 METHODS

The analysis includes 25 regression models. Equations 1-9 (Table 2) take the following form:

$$CGE_{ist} = \alpha_1 woman_{ist} + \alpha_2 nonbinary_{ist} + \alpha_3 firstgen_{ist} + \delta_{st} + \epsilon_{ist}$$

CGE_{ist} is the communal goal endorsement of student i in institution (i.e., school) s in year t; *woman* and *nonbinary* are binary variables that equal 1 if a respondent is a woman or non-binary, respectively (with men serving as the omitted reference group), and *firstgen* is a binary variable indicating first-generation college students (with continuing-generation students serving as the omitted reference group). Including institution-by-year fixed effects (δ_{st}) in all of our regression models accounts for the multiple institutions and years combined in our dataset. This controls for average differences between institutions as well as average differences within institutions over time, essentially comparing students only to other students in the same school in the same year. We estimate this model for all students, as well as separately for eight racial subgroups.

In all models, we cluster standard errors on institutions to account for non-independence of observations drawn from the same institution. We draw conclusions about differences between white students and other groups of students by combining white students with each other racial subgroup in turn to estimate seven separate models. We then interact each predictor (in this case, gender and first-generation status) with a dummy variable indicating students from the non-white group (*race*). Therefore, equations 10-16 (Table 3) take the following form:

$$\begin{aligned} CGE_{ist} = {} & \beta_1 woman_{ist} + \beta_2 nonbinary_{ist} + \beta_3 firstgen_{ist} \\ & + \beta_4 race_{ist} + \beta_5 (race * woman)_{ist} + \beta_6 (race * nonbinary)_{ist} \\ & + \beta_7 (race * firsgen)_{ist} + \delta_{st} + \epsilon_{ist} \end{aligned}$$

The interaction terms allow the relationships between the predictors and communal goal endorsement to vary between white students and the other students in the sample. The coefficients on the interaction terms can thus provide a direct test of whether the relationships differ significantly between white students and students in other racial/ethnic groups.

To examine RQ2, equations 17-25 (Table 4) take the following form:

$$\begin{aligned} belong_{ist} = {} & \gamma_1 CGE_{ist} + \gamma_2 CGA_{ist} + \gamma_3 (CGE * CGA)_{ist} + \gamma_4 woman_{ist} \\ & + \gamma_5 nonbinary_{ist} + \beta_6 firstgen_{ist} + \delta_{st} + \epsilon_{ist} \end{aligned}$$

Table 1
Sample demographics and descriptive statistics of independent variables, by racial/ethnic group

	All Students (n=46,249)	Arab/Middle Eastern (n=658)	Asian (n=14,057)	Black (n=2,111)	Latinx (n=2,479)	Multi-Majority (n=1,997)	Multi-Minority (n=3,530)	Native (n=106)	White (n=21,311)
Sample:									
Men	66%	69%	58%	64%	69%	59%	67%	63%	71%
Women	32%	31%	41%	35%	30%	39%	31%	33%	27%
Non-binary	2%	1%	1%	1%	1%	3%	2%	4%	2%
First-generation	26%	28%	25%	41%	62%	18%	39%	43%	19%
Mean(SD):									
Communal Goal	3.59	3.88	3.69	3.91	3.78	3.56	3.67	3.69	3.45
Endorsement	(0.96)	(0.94)	(0.92)	(0.91)	(0.90)	(0.97)	(0.98)	(0.96)	(0.97)
Communal Goal	3.61	3.83	3.64	3.86	3.82	3.59	3.71	3.59	3.52
Affordances	(1.03)	(1.09)	(1.01)	(1.02)	(1.02)	(1.02)	(1.06)	(1.08)	(1.03)
Sense of	3.72	3.77	3.62	3.60	3.69	3.64	3.67	3.52	3.82
Belonging	(0.93)	(0.97)	(0.88)	(0.94)	(0.92)	(0.93)	(0.98)	(0.95)	(0.94)

Note: CERP grouped students as: white, Caucasian, or European America; Asian or Asian American; Hispanic or Latina/o; Arab, Middle Eastern, or Persian; Black, African American; Native American; Native Hawaiian or other Pacific Islander; other; mixed, minority (selected more than one race/ethnicity and at least one was not white or Asian); mixed, majority only (selected both white and Asian), mixed, unknown (selected more than one race/ethnicity including other); and Indigenous or First Nations. We further group together Native American, Native Hawaiian or Other Pacific Islander, and Indigenous or First Nations into one group referred to as Native.

The variable *belong* is the students' sense of belonging computing, and we again estimate this model for all students as well as for each racial/ethnic subgroup separately. CGE_{ist} is the communal goal endorsement of students, CGA_{ist} is the perception of the communal goal affordances of computing.

5 RESULTS

Contrary to hypothesis 1, women have higher communal goal endorsements than men of the same race/ ethnicity across all racial/ethnic groups, as shown in the first row of Table 2. Compared to men in the same school at the same time with the same first-generation status, women have higher communal goal endorsement by 11-43% of a standard deviation, depending on the racial subgroup. Our dataset has 772 students who we classify as non-binary; across racial/ethnic groups the number ranges from four to 128. As shown in the regression containing all students in Table 2, being a non-binary student was found to predict higher communal goal endorsement than men by 0.10 standard deviations (SDs). Consistent with hypothesis 1, this difference is particularly large for white students, for whom the difference is nearly three times as large (0.27 SDs), and that is the only race-specific estimate that reaches statistical significance at conventional levels. Differences in communal goal endorsement between men and non-binary students are not statistically significant for other racial groups. Given the small number of non-binary students represented in these subgroups, these results should be interpreted cautiously, though they provide little evidence of consistently higher communal goal endorsement among non-binary students relative to men.

In Table 3, we compare these patterns for each racial/ethnic group directly to the patterns for white students as they are the comparison group in all models. The coefficient on the non-interacted terms captures differences between white students, with the coefficients on the interaction terms estimating the extent to which those differences vary in the other racial/ethnic groups. Thus, despite small differences in the number of institutions included across models, white women have higher communal goal endorsement than men by roughly one quarter of a standard deviation. This gap is smaller among every other racial/ethnic group (i.e., the coefficients on the woman-race interaction terms are almost always negative and never meaningfully positive). However, these differences are statistically significant only for Black, Asian/Asian American, and multiracial majority students. Among these groups, the gap in communal goal endorsement between men and women is smaller by 0.12-0.17 SDs than in white students. These findings are at least partially in line with the argument made by Smith et al. [16] that the relationship between gender and communal goal endorsements may be different for students who identify with racial/ethnic groups other than white.

In contrast to hypothesis 1, our sample shows the relationship between first-generation status and communal goal endorsement is negative and not significant for white students. Rather than being driven by white students, the relationship between first-generation status and communal goal endorsement is driven by Latinx, multiracial, and Arab/Middle Eastern students, though the estimate is not statistically significant for Arab/Middle Eastern students, even at the 10% level. As shown in Table 3, this difference between first- and continuing-generation Latinx and multiracial-minority students can also be distinguished statistically from the analogous relationship for white students. As shown in columns four and six, the first-generation/continuing-generation gap in communal goal endorsement is 0.17 SDs larger for Latinx students than for white students, and 0.11-13 SDs larger for multiracial students, even after controlling for institution-by-year fixed effects. While hypothesis 2 predicted that goal-congruity theory would be applicable to all racial/ethnic groups, as shown in Table 4, perceptions of computing's communal goal affordances is a statistically significant moderator of the relationship between communal goal endorsement and sense of belonging for many - but not all - racial/ethnic groups. Note that because of the presence of the interaction term,

Table 2
Regression Models Predicting Communal Goal Endorsement

	All Students	Arab/Middle Eastern	Asian	Black	Latinx	Multi-Majority	Multi-Minority	Native	White
Women	0.21***	0.43***	0.11***	0.19***	0.20***	0.12*	0.23***	0.56	0.25***
	(0.01)	(0.13)	(0.02)	(0.05)	(0.05)	(0.05)	(0.05)	(0.44)	(0.02)
Non-binary	0.10*	0.58+	-0.08	-0.36	-0.02	-0.24	-0.03	0.26	0.27***
	(0.04)	(0.33)	(0.09)	(0.39)	(0.20)	(0.15)	(0.11)	(0.41)	(0.06)
First-generation	0.07***	0.12	-0.01	0.01	0.15***	0.17*	0.11**	-0.00	-0.01
	(0.01)	(0.10)	(0.02)	(0.05)	(0.04)	(0.08)	(0.04)	(0.41)	(0.02)
Observations	45977	515	138900	1877	2276	1829	3341	32	21117
Institutions	360	85	257	180	156	188	225	9	297
Institution-Years	894	133	606	309	293	356	458	12	757
R-sq.	0.05	0.29	0.06	0.22	0.17	0.22	0.17	0.29	0.08

Note: Standard errors clustered on institutions in parentheses. All models include institution-by-year fixed effects. Outcome is communal goal endorsement in standard deviation units. + p<.10, *p<.05, **p<.01, ***p<.001

Table 3
Differences in Communal Goal Endorsement Compared to White Students

	Arab/Middle Eastern	Asian	Black	Latinx	Multi-Majority	Multi-Minority	Native
Race	0.40***	0.28***	0.45***	0.23***	0.08*	0.17***	0.40**
	(0.06)	(0.02)	(0.03)	(0.04)	(0.03)	(0.03)	(0.15)
Woman	0.25***	0.26***	0.25***	0.25***	0.25***	0.25***	0.25***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Non-binary	0.27***	0.28***	0.27***	0.27***	0.28***	0.27***	0.27***
	(0.06)	(0.06)	(0.06)	0(.05)	(0.06)	(0.05)	(0.06)
First-generation	-0.01	-0.03+	-0.02	-0.01	-0.01	-0.01	-0.01
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Woman x Race	0.00	-0.17***	-0.12*	-0.04	-0.12*	-0.04	-0.01
	(0.09)	(0.03)	(0.05)	(0.05)	(0.05)	(0.04)	(0.20)
Non-binary x Race	-0.15	-0.37***	-0.60	-0.08	-0.38**	-0.30*	-1.14**
	(0.46)	(0.10)	(0.37)	(0.20)	(0.14)	(0.12)	(0.42)
First-generation x Race	0.07	0.05+	0.07	0.17***	0.11+	0.13***	-0.24
	(0.07)	(0.03)	(0.05)	(0.05)	(0.07)	(0.04)	(0.22)
Observations	21773	35138	23194	23576	23124	24633	21227
Institutions	297	317	325	312	304	313	299
Institution-Years	759	806	805	792	774	791	762
R-sq.	0.08	0.07	0.09	0.08	0.07	0.08	0.08

Note: Standard errors clustered on institutions in parentheses. All models include institution-by-year fixed effects. Outcome is communal goal endorsement in standard deviation units. + p<.10, *p<.05, **p<.01, ***p<.001

the coefficients for each of the uninteracted communal goal endorsement and affordances variables are interpreted as the relationship when the other variable is zero, and because we have standardized these variables across all students, zero represents the global mean.

Across all racial subgroups, for students whose communal goal endorsement is at the global mean, a SD increase in the perceptions of the communal affordances of computing predicts a greater sense of belonging in computing of 0.10 to 0.39 SDs, though for the smallest groups (e.g. Native) these estimates do not reach significance. However, only for white, Asian/Asian American, Black/African American, is this relationship moderated by students' own endorsement of communal goals. Among these groups, the relationship between perceptions of communal goal affordances of computing and belonging in computing increases in magnitude by 0.03 to 0.07 SDs (14-35%) for each SD increase in a student's own communal goal endorsement. Two additional patterns suggest that goal-congruity theory is an important perspective for understanding barriers to BPC. First, for students with mean perceptions of the communal affordances of computing, higher communal goal endorsement often significantly predicts a lower sense of belonging in computing. Second, racial groups that tend to be underrepresented in computing also report relatively high levels of communal goal endorsement (i.e., relative to white students).

6 LIMITATIONS

A limitation on the analysis is the small number of survey questions (< 5) relevant to each variable of interest. Another limitation is that the number of students in certain populations were markedly smaller, such as first-generation college students who identify as Native American or Alaska Native/Native Hawaiian or other Pacific

Table 4
Regressions Predicting Sense of Belonging

	All Students	Arab/Middle Eastern	Asian	Black	Latinx	Multi-Majority	Multi-Minority	Native	White
Communal Goal	-0.08***	0.01	-0.01	-0.01	0.02	-0.10***	-0.08**	0.11	-0.10***
Endorsement	(0.01)	(0.07)	(0.01)	(0.03)	(0.03)	(0.03)	(0.03)	(0.12)	(0.01)
Communal Goal	0.21***	0.10	0.19***	0.20***	0.17***	0.26***	0.21***	0.39	0.22***
Affordances	(0.01)	(0.07)	(0.01)	(0.03)	(0.02)	(0.03)	(0.03)	(0.24)	(0.01)
CG Endorsement	0.04***	-0.03	0.04***	0.07*	0.02	0.02	0.03+	-0.37	0.04***
x CG Affordances	(0.00)	(0.04)	(0.01)	(0.03)	(0.02)	(0.03)	(0.02)	(0.38)	(0.01)
Woman	-0.62***	-0.41***	-0.51***	-0.48***	-0.63***	-0.67***	-0.56***	-0.12	-0.71***
	(0.01)	(0.12)	(0.02)	(0.06)	(0.05)	(0.05)	(0.04)	(0.83)	(0.02)
Non-binary	-0.64***	-0.76*	-0.69***	-0.69**	-0.37*	-0.64***	-0.51***	-2.29**	-0.65***
	(0.04)	(0.33)	(0.09)	(0.23)	(0.18)	(0.16)	(0.14)	(0.51)	(0.05)
First-generation	-0.09***	0.03	-0.09***	0.09*	-0.09+	-0.11	-0.12**	-0.22	-0.01
	(0.01)	(0.14)	(0.02)	(0.05)	(0.05)	(0.07)	(0.04)	(0.60)	(0.02)
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Institutions	360	85	257	180	156	188	225	9	297
Institution-Years	894	133	606	309	293	356	458	12	757
R-sq.	0.16	0.33	0.16	0.29	0.27	0.35	0.25	0.48	0.19

Note: Standard errors clustered on institutions in parentheses. All models include institution-by-year fixed effects.
Outcome is communal goal endorsement in standard deviation units. + p<.1 * p<.05, ** p<.01, *** p<.001

Islander/Indigenous or First Nations and accounted for only 48 of the 46,249 observations. Further, the models in this work are unable to demonstrate causality, but they do provide strong evidence as they control for certain confounding variables. Additionally, our data only captures the opinions of students in computing and neglects students who may have left computing majors, meaning there is a survivorship bias. We expect that the population of students who left a computing major, and students in other majors, may perceive the communal goal affordances of computing differently than those who persist in a computing major.

7 FUTURE WORK

Findings of this study extend existing literature on goal-congruity theory's applicability for increasing representation of students from groups underrepresented in computing. In light of this, a logical next step is to explore if the moderating effect we estimate is causal by researching the impact of an intervention.

As such, future research will explore possible brief interventions for increasing undergraduate students' perceptions of the communal goal affordances of computing since students' perceptions of the communal goal affordances of STEM careers are malleable [5, 8]. An interesting question to explore in future work is, can a brief intervention be adapted to influence perceptions of the communal goal affordances of CS?

8 CONCLUSION

This work furthers our understanding of goal-congruity theory by analyzing the sense of belonging, communal goal endorsements, and communal goal affordances of a large sample of computing student survey respondents. Our results align with previous research findings that women have higher mean communal goal endorsements than men [7, 8, 13, 16], first-generation students have higher mean communal goal endorsements than continuing-generation students [1, 13], and that Black/African American, Asian/Asian American, and Latinx students have higher mean communal goal endorsements than white students [13].

We also extend previous work in several ways. We show that the gender gaps in communal goal endorsement are not limited to white students. The consistency of these patterns across racial subgroups is important because our previous work [13] relied on aggregate patterns across all students to justify the application of goal-congruity theory to problems of underrepresentation in computing. Additionally, the moderating effect of communal affordances of computing on the often negative relationship between communal goal endorsement and sense of belonging in computing applies not only to white students, but to many racial subgroups.

These findings provide additional motivation for developing communal goal interventions to promote BPC. Not only does this study provide further evidence that perceptions of computing as allowing for communal goals can bolster students' sense of belonging, we also present some of the most detailed evidence to date that such interventions may be particularly important for promoting equitable participation. Given our findings of higher rates of communal goal endorsement among underrepresented groups of students, consistently positive relationships between perceptions of computing's communal affordances and sense of belonging in computing, and evidence generally in line with related predictions of goal-congruity theory, there are reasons to be optimistic that strengthening students' perceptions of the communal affordances of computing can be a strong mechanism in driving efforts to diversify the field.

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