

Differential Effects of Bridge Program Participation on Perceived Belonging and Peer Support for STEM Degree Seekers during the COVID-19 Pandemic

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Abstract

This NSF S-STEM Grantee poster examines the impact of participation in the Rice Emerging Scholars Program (RESP), Rice University's comprehensive undergraduate science, technology, engineering, and mathematics (STEM) summer bridge program, on student perceptions of university belongingness within the context of the COVID-19 pandemic. Within a quasi-experimental design, the researchers examined whether RESP participants experienced different levels of belongingness utilizing two measures: The Psychological Sense of School Membership Scale, as well as a measure of perceived peer support. Additionally, the researchers examined whether family income impacted students, regardless of RESP program participation. Finally, researchers examined whether family income moderated the relationship between belongingness outcomes and program participation. Results did not support the hypotheses; there were no significant relationships found between RESP participation and sense of school membership ($r = -.02, p > .05$), RESP participation and perceived peer support ($r = .05, p > .05$), family income and sense of school membership ($r = -.05, p > .05$), or family income and perceived peer support ($r = -.06, p > .05$), nor was evidence found for family income moderating the relationship between belongingness outcomes and RESP participation. Implications for future work in this area are discussed.

Introduction

Increasing rates of undergraduate STEM degree attainment, particularly for students from groups historically underrepresented in STEM, has long been a focus of policy makers, industry, and university administrators alike [1]–[3]. Much attention has been paid to whether and how students are made to feel welcome in STEM as a result of classroom and extracurricular experiences and, secondarily, how these experiences impact STEM retention outcomes [4]–[6]. One psychological dimension that has emerged as particularly relevant is belongingness, or a student's "subjective feeling of fitting in and being included as a valued and legitimate member of a particular setting" [7:421].

Experimental results exploring students' decisions to stay within or leave STEM fields can be understood within the context of student retention literature more broadly, specifically Tinto's Model of Institutional Departure [8]. This model theorizes the academic realm of the college and the social realm of the college as two key environments for experiences that either affirm a student's belongingness to the college community, which helps the student align their goals and identity with college membership, or the absence of those affirming experiences, which pushes students to conceptualize themselves and their goals as separate from university membership [8].

Bridge programs, or programs specifically designed to help incoming undergraduates successfully transition into college, are often designed by universities in part to improve students' sense of belonging as a mechanism to improve retention outcomes [9]. The current

study explores what effect, if any, participation in the Rice Emerging Scholars bridge program had on student sense of belonging during the COVID-19 pandemic.

Rice University's Emerging Scholars Program

The Rice Emerging Scholars Program (RESP) is a comprehensive summer bridge program for a select group of Rice University STEM undergraduates. Founded in 2012, RESP has two major components: (1) an intensive six-week program conducted the summer before students' freshman year, and (2) ongoing term-time support continuing through students' graduation [10]–[12]. To date, RESP has supported more than 200 students.

RESP uses traditional measures such as high school curriculum and standardized test performance, as well as a novel internal diagnostic exam testing prior exposure to STEM concepts and complex word problems, to identify students of high ability and potential who enter Rice without a comparable level of K-12 STEM preparation than that of the average incoming Rice STEM student [13]. For example, some RESP Scholars did not have access to AP coursework in high school. STEM students who enter Rice with weak math skills are at a particular disadvantage, as most STEM degree plans require students to complete calculus and calculus-based physics courses simultaneously in the first year.

This disparity in educational access and preparation was identified as a contributing factor to inequitable STEM degree attainment outcomes at the university, precipitating RESP's founding. To address these disparities, the residential summer component of RESP is not remedial, but rather is designed to match the pace, rigor, and depth of the term-time STEM curriculum.

Scholars complete three non-credit bearing courses and take two midterms and a final for each course. Additionally, Scholars select one of three problem-based learning sequences designed to give students hands-on exposure to natural science, engineering, or computer science research. Scholars partake in extracurricular activities targeting three goals: to help scholars (1) build relationships with each other, faculty, and staff, (2) increase navigational and study skills, and (3) help students feel comfortable both at Rice and within STEM. Scholars are guided through each component of the summer program by a team of trained upperclassmen mentors (many of whom are program alumni), professional staff dedicated to the program, and STEM faculty.

The term time component of RESP consists of individualized advising conducted by two full-time RESP staff members. The advising is proactive, in that advisors are actively monitoring student performance with the goal of helping students identify and address any challenges that arise before those challenges lead to serious negative consequences, such as failing a course, delayed degree progression, or attrition from the university. These sessions address both academic issues and skill-building as well as non-academic issues that may impact Scholar performance and retention [10]. Through these dual streams of intervention, RESP aims to comprehensively address any barrier students might face on their path to degree attainment, while providing students with the support and skills needed to both achieve their goals and understand themselves as valued members of the Rice STEM community.

The Current Study

The current study analyzes survey data collected in May 2020 as part of an on-going research project funded by an NSF S-STEM grant exploring RESP's efficacy as an intervention. These May 2020 data represent the first snapshot illustrating how RESP and comparison group students (a quasi-experimental matched group of Rice STEM matriculants who either did not accept the offer of RESP participation or were not offered the opportunity due to limited resources) experienced the COVID-19 pandemic. Program administrators hope that the skills, on-going support, community, and resources provided by the RESP program will serve as a buffer for students experiencing acute stress. Prior to the current study, RESP has not been able to systematically measure the relationship between program participation and participant experience of stressors.

The current study examines the effect of stressors related to the COVID-19 pandemic on student perceptions of belongingness. Further, we anticipate that these relationships are a function of student socio-economic status (SES). At the time of writing, the COVID-19 pandemic's apparent disparate impact on low-SES communities in the United States is well documented [14], [15]. Social class background has been found to negatively impact students' sense of belonging at college which, in turn, mediates students' social and academic outcomes [16].

In response to the public health crisis, Rice University went fully remote on March 25th, 2020, a significant change for an overwhelmingly residential campus. All undergraduates were required to either move out of campus housing or petition for an exemption if students' available off-campus living situations would make it difficult to complete the semester. At the time of survey collection, campus was still remote.

Although RESP program administrators do not have access to student financial information during participant selection, during the 2019-2020 academic year 53% of RESP Scholars reported a family income of less than \$65,000; the same was true for only 15% of the general undergraduate population during the same timeframe.

Research Methods

We examined the impact of RESP participation on students' sense of belonging through two measures: The Psychological Sense of School Membership Scale and a measure of perceived support from peers [17], [18]. We partnered these data with each students' confirmed family income amount via the Office of Financial Aid at Rice University for the 2019-2020 academic year (AY19-20). We identified three specific hypotheses:

Hypothesis 1: Participation in RESP increased participant belongingness outcomes compared to a quasi-experimental control group of non-participants.

Hypothesis 2: Regardless of RESP program membership, students with a lower family income during AY19-20 experienced reduced belongingness outcomes during this early timepoint in the COVID-19 pandemic.

Hypothesis 3: Income moderated the interaction between belongingness outcomes and RESP program membership during this early timepoint in the COVID-19 pandemic.

Participants: In May of 2020, 172 RESP participants and 141 quasi-experimental matched non-participants who matriculated at Rice in Fall 2016, 2017, 2018, or 2019 were invited to complete a survey. Of 79 RESP Scholars and 53 members of the comparison group completed the survey. A breakdown of RESP respondents and comparison group respondents by demographics (i.e. gender and race or ethnicity) can be found in Table 1. A comparison of RESP respondents and comparison group respondents by matriculation year can be found in Table 2.

Table 1. *RESP vs comparison group respondents by gender and race or ethnicity.*

| Group | Gender | | Race or Ethnicity | | | | | | | | |
|--------------------|--------|------|-------------------|----------------|-----------|------------------|-------------|---|----------------|---------|--|
| | Female | Male | African American | Asian American | Caucasian | Mexican American | Multiracial | Native Hawaiian or Other Pacific Islander | Other Hispanic | Unknown | |
| RESP | 50 | 29 | 17 | 0 | 11 | 28 | 2 | 0 | 6 | 15 | |
| Matched Comparison | 28 | 25 | 7 | 6 | 7 | 16 | 4 | 1 | 5 | 7 | |

Table 2. *RESP vs comparison group respondents by year of undergraduate matriculation.*

| Group | Fall 2016 | Fall 2017 | Fall 2018 | Fall 2019 |
|--------------------|-----------|-----------|-----------|-----------|
| RESP | 18 | 20 | 20 | 21 |
| Matched Comparison | 15 | 10 | 9 | 19 |

Participants are not randomly assigned to condition; rather, RESP staff offer the program to students identified as best fit and offers continue until all spaces are filled. Once the cohort has been filled, a matched comparison group is created from non-participant students. These non-participant students may have declined the opportunity to participate in RESP or may not have been offered a space due to limited resources. The study complies with university-approved IRB procedure.

Quasi-independent variables. The process by which students become RESP participants or are entered into the matched comparison group renders group membership a quasi-independent variable.

Independent variables. Students' household income is determined by the Rice University Office of Financial Aid for all students who complete the FAFSA and CCS Profile in order to be considered for need-based financial aid. These data are confirmed against tax documents by the Office of Financial Aid using "prior prior year" income taxes (i.e. AY19-20 uses 2017 tax documents).

Dependent variables. Students completed two measures to assess belongingness: the Psychological Sense of School Membership Scale and a measure of perceived support from peers [17], [18]. These measures allowed examination of perceived belongingness at two levels: belonging to the institution generally, as well as specifically among peers. Items for both school membership and perceived peer support are measured on a 1-5 Likert scale. Items from the Psychological Sense of School Membership Scale and the perceived support from peers' measure can be found in appendices 1 and 2, respectively. Instructions for both measures were modified slightly to instruct students to answer in the context of their experiences since Rice switched to online courses.

Statistical Methods. Statistical analyses were conducted in RStudio, version 1.3. We conducted independent samples *t*-tests to understand any mean-level difference by RESP membership across income, psychological sense of school membership, and peer support. We then used regression analysis to test whether and how income moderated the relationship between RESP participation and the belongingness measures.

Results

Table 3 shows descriptive statistics for the three study variables by RESP participant and matched comparison group.

Table 3. *Descriptive statistics of three variables of interest (mean +/- standard deviation).*

| Variable | RESP Mean (SD) | Matched Comparison Mean (SD) |
|----------------------------|-----------------------|---------------------------------|
| Sense of School Membership | 3.64 (.66) | 3.66 (.71) |
| Perceived Peer Support | 3.90 (.91) | 4.00 (.85) |
| Income (AY19-20) | 89,226.08 (71,308.35) | 90,924.30 (86,102.25) |

RESP N=79, Matched Comparison N=53

Table 4 shows the descriptive statistics and inter-correlations for the four study variables. There are no significant correlations between RESP participation and any of the variables. The only significant correlation is between sense of school membership and perceived peer support ($r=.48, p<.01$).

Table 4. *Intercorrelations of predictors and outcomes*

| Variable | Mean(SD) | 1. RESP participation | 2. Sense of School Membership | 3. Perceived Peer Support |
|----------|----------|-----------------------|-------------------------------|---------------------------|
| | | | | |

| | | | | |
|-------------------------------|-----------------------|------|-------|------|
| 1. RESP participation | | | | |
| 2. Sense of School Membership | 3.65 (.068) | -.02 | | |
| 3. Perceived Peer Support | 3.96 (0.88) | .05 | .48** | |
| 4. Income (AY19-20) | 89,910.85 (77,278.33) | -.01 | -.05 | -.06 |

** indicates $p < .01$

Linear regressions were conducted to test hypothesis 3, investigating AY19-20 income as a moderator for the relationship between RESP participation and students' sense of school membership as well as between RESP participation and students' perceived peer support. The Model 1 regression equation for sense of school membership is $Y' = 3.64 + .02X + -0.00Z + -0.00XZ$. The Model 2 regression equation for perceived peer support is $Y' = 3.91 + .10X + -0.00Z + 0.00XZ$. Results for each equation can be found in Table 3. Neither model was statistically significant.

Discussion and Future Directions

This study sought to evaluate three questions, each set within the context of the early COVID-19 pandemic. First, did participation in the RESP program impact student sense of belonging in the context of this stressful event? Next, did students' familial income, regardless of program participation, impact student sense of belonging? Finally, did familial income moderate the relationship between program participation and belongingness outcomes? The answer to each of these questions appears to be no; neither program participation, family income, nor the relationship between the two impacted students' sense of belongingness.

Because this study was cross-sectional, the totality of the unexpected results is difficult to interpret. One possible explanation is that these results reflect university policies and choices designed to support low-income students and mitigate many of the challenges they faced in this early period of adjustment. Not only could students petition to live on campus, but students could additionally request aid covering the cost of moving off campus if they had a desirable place to be but lacked the funds to fly home or move their belongings. Rice also offered resources including laptops, video cameras, and internet access to address digital divide issues. Campus policies may have reduced any non-belongingness students experienced with an increased awareness of SES during the early weeks of the pandemic.

An alternative explanation could be that any difference caused by RESP participation, income, or the interaction between RESP participation and income may appear in future data collected later in the pandemic. We will be collecting additional data during the Spring2021 semester, while the COVID-19 pandemic is still ongoing. These additional data gathered near the one-year

anniversary of online learning will help us understand whether these early results remained stable over time.

Future areas for research include putting these results in the context of our longitudinal project to better understand students' belongingness experiences both 'typically,' i.e. outside of the context of a major stressor such as the COVID-19 pandemic, as well as intra-individually between university enrollment and degree attainment. An additional conceptual avenue for future inquiry is the qualitative research framework of counterspaces [19]. These "safe spaces" exist formally or informally within the broadly construed university experience and affirm the belongingness of underrepresented or marginalized students, aiding in their STEM retention [19:210]. The defining feature of a counterspace is that it allows a student to experience their STEM identity within the context of their marginalized identity or identities. In so doing, counterspaces offer a psychological buffer against non-belonging experiences students may have within the university and, specifically, within STEM. Some examples of possible counterspaces include bridge programs such as RESP, mentor relationships, professional or pre-professional organizations, identity-based groups, or a friend group [19]. Future work will seek to explore counterspace membership and measure its effect on RESP and matched comparison students.

A lack of differentiation in belongingness experiences longitudinally in each of these constructions would raise additional questions about whether this lack of replication reflects positive traits of Rice University, opportunities for RESP program development, or the file drawer problem [20].

Limitations

Our SES measure is limited; the university's use of "prior prior year" tax data makes administrative sense but is not necessarily a snapshot of students' financial experiences at the time of the survey. We did not have a measure that would capture the rapid income changes many families have experienced during the pandemic. Response rates were lower than desired, particularly among matched comparison group members.

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Appendices

Appendix 1. *Items from the Psychological Sense of School Membership Scale*

Instructions: Please consider the following items in context of your experiences since Rice switched to online courses.

1. I feel like a real part of Rice.
2. People at Rice notice when I’m good at something.
3. It is hard for people like me to be accepted at Rice.
4. Other students at Rice take my opinions seriously.
5. Most professors at Rice are interested in me.
6. Sometimes I feel as if I don’t belong at Rice.
7. There’s at least one professor or staff member at Rice I can talk to if I have a problem.
8. People at Rice are friendly to me.
9. Professors at Rice are not interested in people like me.
10. I am included in lots of activities at Rice.
11. I am treated with as much respect as other Rice students.
12. I feel very different from most other students at Rice.
13. I can really be myself at Rice.
14. The professors at Rice respect me.
15. People at Rice know I can do good work.

16. I wish I were at a different university.
17. I feel proud of belonging to Rice.
18. Other students here at Rice like me the way I am.

Appendix 2: Items given as part of the perceived sense of peer support measure

Instructions: Please consider the following items in context of your experiences since Rice switched to online courses.

1. I can solicit my peers' help when working on difficult assignments.
2. My peers care about my academic success.
3. My peers would be supportive in helping me to deal with college-related problems.
4. My peers encourage me to talk about any academic struggles I have.
5. I trust my peers to help me if I am struggling with a difficult assignment.