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Fostering Success in Transfer Engineering Students: The Role of the EMPOWER Program Activities and Support Services

Prof. Saharnaz Baghdadchi, University of California, San Diego

Saharnaz Baghdadchi is an Associate Teaching Professor at UC San Diego. She is interested in scholarly teaching and employs active learning techniques to empower students to attain an expert level of critical thinking. Her expertise facilitates students' journey towards connecting facts with practical knowledge to tackle intricate engineering challenges. She excels in crafting innovative assessments and explores their impact on enhancing students' learning outcomes and fostering an inclusive educational environment.

Dr. Karcher Morris, University of California, San Diego

Morris joined UC San Diego's Electrical and Computer Engineering Department within the Jacobs School of Engineering as an Assistant Teaching Professor in 2020.

Bill Lin, University of California, San Diego

Bill Lin received the B.S., M.S., and Ph.D. degrees in Electrical Engineering and Computer Sciences from the University of California at Berkeley in 1985, 1988, and 1991, respectively. He is currently a Professor and the Department Chair in Electrical and Computer Engineering at the University of California, San Diego. His research has led to more than 200 journal and conference publications, including a number of Best Paper awards and nominations. He also holds five awarded patents. He has been the General Chair and on the executive and technical program committee of many IEEE and ACM conferences, and he has been Associate and Guest Editors for several IEEE and ACM journals.

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Abstract

Transfer engineering students, particularly those from low-income backgrounds, face significant challenges during their transition to four-year institutions and throughout their academic journey. These challenges, including navigating academic support, finding mentors, and building self-efficacy, can negatively impact their academic success and sense of belonging. The EMPOWER Program, supported by the NSF S-STEM Program, is a collaboration between UC San Diego, Southwestern College, and Imperial Valley College and is developed to mitigate these challenges by offering scholarships, mentoring, networking, and research opportunities to low-income transfer engineering students. Grounded in Schlossberg's Transition Theory, this exploratory study investigates the impact of participation and engagement in various social and academic support activities. Motivation–including self-efficacy, self-determination, intrinsic motivation, career motivation, and goal motivation–and sense of belonging are explored as they are impacted by the program and school activities. Additionally, the effects of the activities on transfer engineering student transitions are investigated and discussed.

Using a survey-based mixed-method approach, we collected information on students' engagement with support activities, their transition experiences, the perceived impact of these activities, and their levels of motivation and sense of belonging. Our findings indicated no statistically significant differences in motivation and sense of belonging between students who participated in community-building, professional development, and academic support opportunities and those who did not. However, minor trends suggest that participation in these activities, particularly professional development and social events, might be linked to slightly higher intrinsic motivation and a sense of belonging. Notably, free-response data highlighted the pivotal role of friendships in supporting student transitions, with students attributing their positive experiences to networks formed through community-building events and friends transitioning from the same college.

Viewed through the lens of Schlossberg's Transition Theory, the findings suggest that optional activities within scholarship programs are particularly valuable. Additionally, a major factor in transition is found to be how well students maintain or establish new friendships, and scholarship programs can play a key role in this process.

Introduction

The transition from a community college to a four-year university is a critical time in a student's academic journey, often accompanied by significant challenges. Many students have to adjust to new academic expectations, navigate unfamiliar institutional cultures, and form connections within a new peer and faculty network. These difficulties lead to what is commonly called "transfer shock," impacting students' confidence and hindering their academic progress, particularly during their initial terms at a new institution. Prior research has shown that transfer students experience higher dropout risks and lower first-year GPAs due to these transitional barriers [1], [2].

For low-income and first-generation students, these challenges are often amplified by additional barriers. Financial strain, limited access to mentorship, and a lack of familiarity with the resources and systems at four-year universities can create substantial obstacles, as highlighted by Matyas et al. [3], Ssemata et al. [4], and Burgstahler et al. [5]. These students may also face social isolation and cultural conflict, further increasing their transition difficulties [6], [7]. Without targeted support, many students struggle to achieve their academic and career goals despite their potential and ambition.

Prior studies have demonstrated that structured support programs can enhance transfer student success by addressing these challenges. For example, the PRIMER program at East Carolina University and the Inspire Scholars Program (ISP) at Madison College have implemented mentoring, experience in research, stipend, and professional development workshops to help students integrate into the new academic environments [8], [9].

Theoretical Framework

Schlossberg's Transition Theory offers a valuable framework for understanding these challenges, emphasizing the interaction of situational, personal, and support factors that influence how

individuals experience and navigate significant life transitions [10]. By applying this framework, interventions can be designed to holistically support students as they transition "in, through, and out" of four-year institutions, as demonstrated by McGill and Lazarowicz [11] and Coston [12]. Figure 1 illustrates this process. Targeted interventions can empower transfer students to achieve success academically, professionally, and personally. Building on prior studies that have used Schlossberg's framework to examine transfer student success [12], [13], this study extends the application of transition theory by analyzing the influence of technical and non-technical program participation and informal peer networks on transfer students' motivation and sense of belonging.

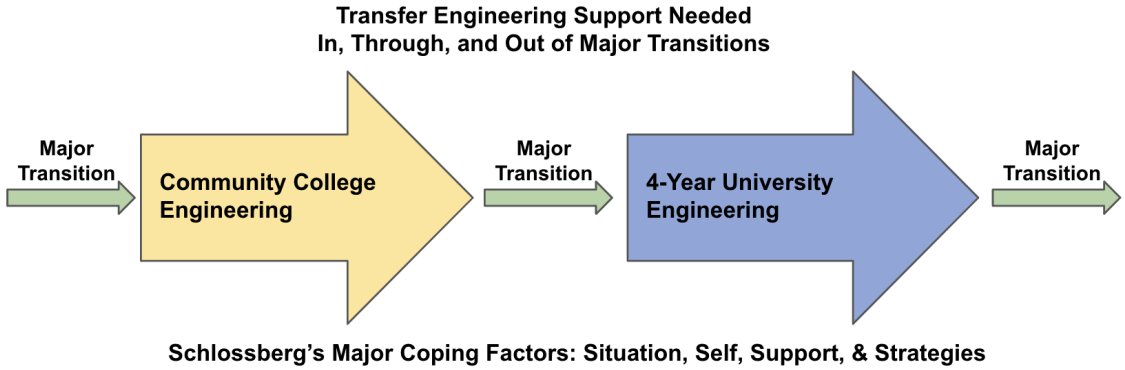


Figure 1. Illustration of the transfer engineering student support needed in, through, and out of major transitions.

Study Context

This paper focuses on the NSF S-STEM-sponsored EMPOWER Program, a collaborative initiative designed to support low-income transfer engineering students through scholarships, mentorship, research opportunities, and academic support. Through this study, we examine how participation in EMPOWER program activities, the social and professional development activities offered by the School of Engineering, and the academic support services provided by departments and other centers at UC San Diego influence motivation and sense of belonging.

Our study aims to contribute to the growing body of knowledge on effective strategies for supporting transfer students during their transitions by examining both structured programs and

informal support mechanisms. Specifically, we investigate which structured programs effectively assist students, how they provide support, and what additional factors students find most helpful in navigating their transitions. By analyzing program participation and student-reported sources of support, this research provides insights into mechanisms that foster persistence and success among low-income engineering transfer students.

This study specifically seeks to answer the following research questions:

- **How does participation in structured academic and social activities impact transfer engineering students' motivation and sense of belonging?**
- **What sources of support do transfer engineering students rely on during their transitions?**

Methods

The NSF implemented S-STEM to support "institutions of higher education to fund scholarships for academically talented low-income STEM majors and to study and implement a program of activities that support their recruitment, retention, and graduation." [14] The EMPOWER program, first introduced in [15], has leveraged funding from NSF S-STEM to understand and support, more specifically, transfer engineering students with their transitions "in, through, and out" of community college and a 4-year university bachelor of science engineering program.

EMPOWER Program Description

The EMPOWER program involves a collaboration between UC San Diego, Southwestern College, and Imperial Valley College. UC San Diego is an R1 4-year institution, while both Southwestern and Imperial Valley community colleges are 2-year institutions. UC San Diego is in La Jolla, CA, with ~6000 engineering undergraduate students currently enrolled, Southwestern College is in Chula Vista, CA, with approximately ~4000 students enrolled in STEM programs, and Imperial Valley College is in Imperial Valley, CA, with approximately ~1600 students enrolled in STEM programs.

The EMPOWER program additionally requires coordination across many existing resource centers on each campus. For example, at UC San Diego, these include the Financial Aid and

Scholarships Office, the Triton Transfer Hub, the Undergraduate Research Hub, and the IDEA Engineering Student Resource Center, among others. EMPOWER program faculty at each institution, along with their resource centers, curate their support to meet the needs of EMPOWER Program students.

Since the EMPOWER program began in the winter of 2022, there have been a total of 84 students directly impacted by the program at UC San Diego. EMPOWER program students have pursued diverse majors, including Electrical Engineering, Computer Engineering, Aerospace Engineering, Bioengineering, Computer Science, etc. The EMPOWER program students are provided with opportunities to engage in optional activities, both through the program and through other engineering communities at UC San Diego. The EMPOWER program activities are curated to meet the needs of a student in transition and guided by Schlossberg's four major coping factors, including situation, self, support, and strategies [10]. Table 1 gives examples of which activities might fall into a factor category. It is commonly the case that one activity falls into two categories.

Table 1: EMPOWER program student activity examples and their association with Schlossberg's Transition Theory factors: Situation, Self, Support, and Strategies

Program Activities and Their Association with Schlossberg's Transition Theory			
Situation	**Self**	**Support**	**Strategies**
Activities that improve students' situation or perception of their current situation	**Activities that improve students' self-identity, resilience and persistence**	**Activities that reveal existing external support systems or encourage students' use of them**	**Activities that provide students' with skills or techniques to overcome transition-oriented obstacles**
Program Examples: - Halloween Breakfast - Midterm Study Recharge - Research Lab Tours	Program Examples: - STEM Identity and Enculturation Symposium - Alumni Mentorship - Resume and Linkedin Workshops	Program Examples: - Summer Research Mentorship - Faculty Mentorship - Alumni Mentorship - Math Festival - Cross Campus Events	Program Examples: - Summer Internship Prep Program - Night with Industry - Faculty Mentorship

Survey Design

The survey was designed to collect data on student participation in structured activities across four event categories and to gather qualitative insights through open-ended questions about

students' transition experiences and the support they received. The four event categories included:

1. **Academic Support Services**: Activities included attending professor, teaching assistant, or tutor office hours, as well as sessions at the Tutoring Center or other tutoring services offered by UC San Diego.
2. **Social Events**: Events organized by the School of Engineering, such as those hosted by academic departments, engineering resource communities, or engineering student organizations.
3. **Professional Development and Technical Events**: Seminars and workshops organized by the School of Engineering, including those held by academic departments, resource communities, and student organizations.
4. **EMPOWER Program Events**: Specific activities organized for the EMPOWER Program students.

Participants were asked to indicate their frequency of participation in these activities by selecting one of the following options: Never, Rarely (a couple of times a quarter), Occasionally (a few times a month), Frequently (about once a week), or Very Frequently (multiple times a week). For the purpose of data analysis, students who selected Occasionally, Frequently, or Very Frequently were categorized as **Participants**, while those who selected Never and Rarely were categorized as **Non-Participants**.

In addition to participation frequency, the survey included Likert scale questions aimed at measuring motivation and sense of belonging. The Motivation Questionnaire II (SMQ-II) [16] was used to assess underlying aspects of motivation, including self-determination, intrinsic motivation, career motivation, and goal motivation. The New General Self-Efficacy Questionnaire [17] was used to measure the additional motivation factor, self-efficacy. Three questions designed by our team were used to assess students' sense of belonging: *I feel accepted at UC San Diego, I feel comfortable at UC San Diego, and I feel supported at UC San Diego.* These questions were designed to measure key dimensions of belongingness, including acceptance, comfort, and support within the institution.

Responses to all Likert scale questions were rated on a scale from 1 ("not at all true of me") to 7 ("very true of me"). A detailed breakdown of the survey questions is provided in Appendix A. Average scores of each factor were calculated for each participant for use in subsequent analyses.

In addition to the quantitative data, open-ended survey questions collected qualitative insights about students' transition experiences. Specifically, it is important to evaluate in what ways EMPOWER program activities supported the student's transition and in what ways these same activities contributed to their institutional sense of belonging. The questions, detailed in Appendix A, considered qualitative research design, including previous work on student sense of belonging [18], [19]. In this study, the qualitative questions complement the aforementioned quantitative questions, providing necessary context. All responses were analyzed for common themes to provide a deeper understanding of students' perspectives.

Survey Administration

The survey was created using Google Forms and was distributed to all EMPOWER program students through email. Participation in the survey was voluntary, and informed consent was obtained at the beginning of the survey. The study was reviewed and approved by UC San Diego's Institutional Review Board (IRB), ensuring compliance with ethical guidelines for research involving human subjects. A total of 33 EMPOWER program students participated in the survey. Their responses were used in the analysis of structured event participation and its relationship with motivation and sense of belonging, as well as students' transition experiences.

Data Analysis

In this exploratory study, to investigate the impact of participation in structured activities on psychosocial and motivational factors, including self-efficacy, self-determination, intrinsic motivation, career motivation, goal motivation, and sense of belonging, two kinds of statistical tests were conducted. The Mann-Whitney U test, a non-parametric statistical test, was used to compare these factors between Participants and Non-Participants within each activity category. Additionally, the Kruskal-Wallis parametric ANOVA test was conducted to compare scores for each factor across all activity types, providing a broader view of the relationship between participation and these outcomes.

Results

The internal consistency of the scales used in this study was assessed using Cronbach's alpha. The sense of belonging scale demonstrated high reliability (Cronbach's alpha = 0.962), indicating strong internal consistency among the three items measuring students' sense of acceptance, comfort, and support at the institution. Similarly, the self-efficacy subscale exhibited strong reliability (Cronbach's alpha = 0.943).

Among the motivation-related subscales, self-determination (Cronbach's alpha = 0.925), intrinsic motivation (Cronbach's alpha = 0.902), and goal motivation (Cronbach's alpha = 0.870) all demonstrated high internal consistency, suggesting that these constructs were reliably measured. The career motivation subscale showed acceptable reliability (Cronbach's alpha = 0.723), indicating a sufficient level of internal consistency for research purposes.

With these reliability tests supporting the consistency of the scales, the survey results revealed insights into the relationships between participation in structured activities and psychosocial and motivational factors, including self-efficacy, intrinsic motivation, career motivation, goal motivation, and sense of belonging. Statistical comparisons between participants and non-participants across various activity types, as well as analyses across all activity groups, revealed no statistically significant differences in these factors.

Figure 2 presents a summary of the average scores for each factor (on a 7-point scale) by participation status across different activity types. While the results of comparisons were not statistically significant, minor trends were observed. Ten of the 24 average score comparisons presented illustrated increased participant scores versus non-participants. For example, the participants in the social events held by the School of Engineering reported a slightly higher intrinsic motivation score (6.0) compared to non-participants (5.5). Additionally, career motivation had the highest average scores among all factors across various participation groups. Across all factors, non-participants in the EMPOWER program activities provided slightly higher average scores compared to participants.

Figures 3 and 4 illustrate the average Likert scale scores for self-efficacy, self-determination, intrinsic motivation, career motivation, goal motivation, and sense of belonging across

participants and non-participants in two activities selected for demonstration: professional development and social events held by the School of Engineering.

Figures 5 and 6 present the distribution of Likert scale scores for two selected factors, sense of belonging and career motivation, across participants and non-participants of all activities. These distributions provide a visual comparison of the range of responses and demonstrate the variability within each group. Figure 6 summarizes the overall distribution of scores for all factors reported by survey participants, irrespective of their event participation, offering an aggregated view of the data.

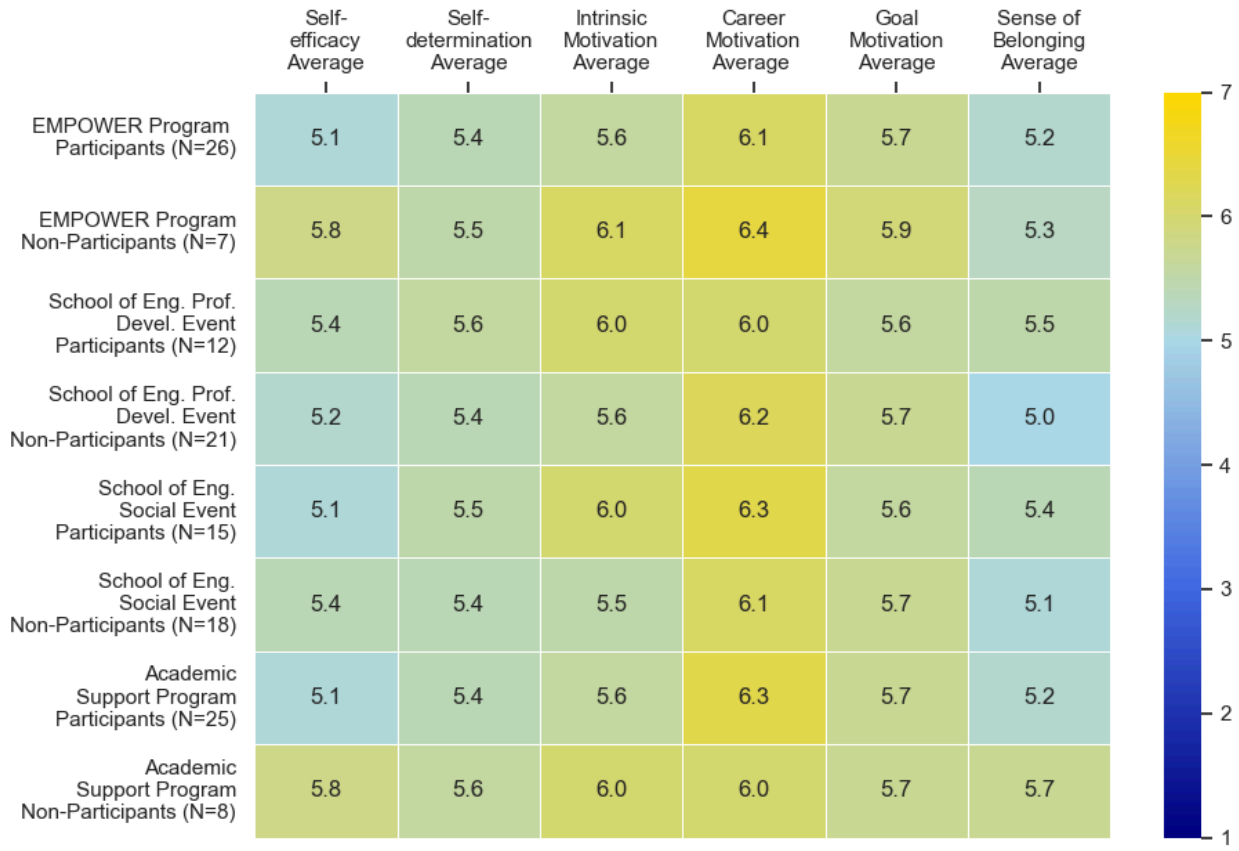


Figure 2. Average scores for psychosocial and motivational factors by participation status and activity type (7-point scale)

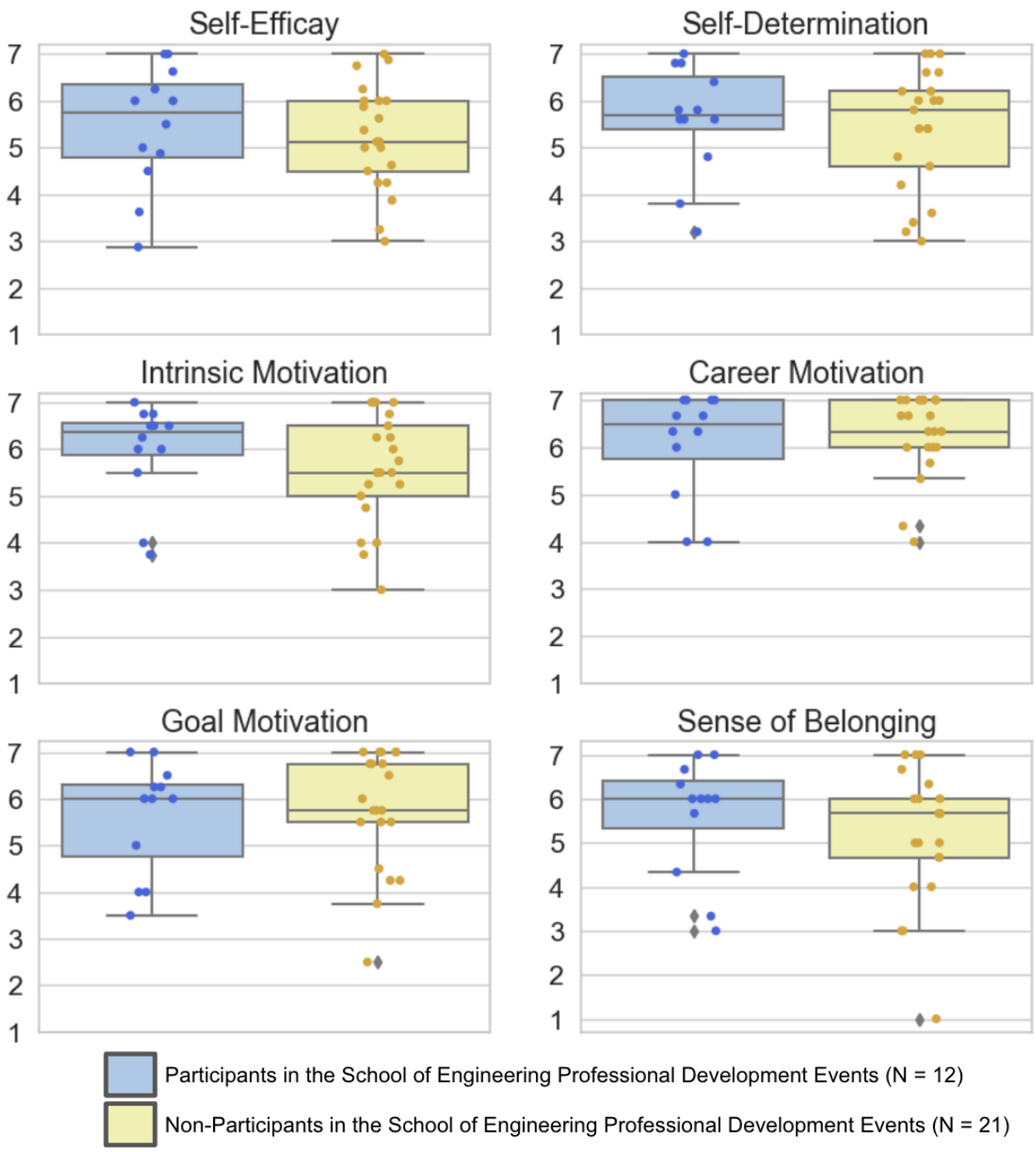
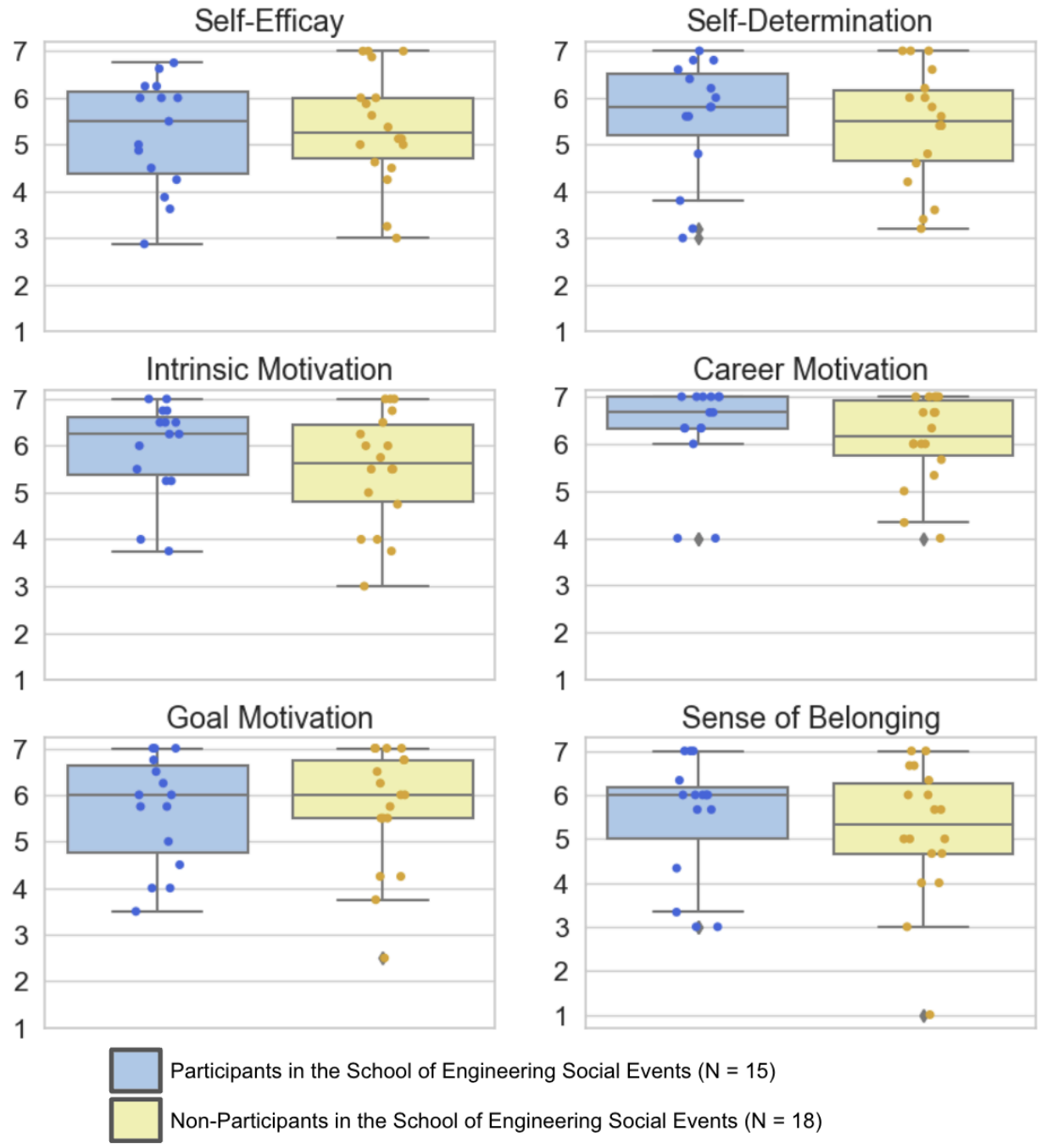


Figure 3. Comparison of average Likert scale scores for self-efficacy, self-determination, intrinsic motivation, career motivation, sense of belonging, and goal motivation between participants and non-participants in professional development events organized by the School of Engineering.



Finger 4. Comparison of average Likert scale scores for self-efficacy, self-determination, intrinsic motivation, career motivation, sense of belonging, and goal motivation between participants and non-participants in social events organized by the School of Engineering.

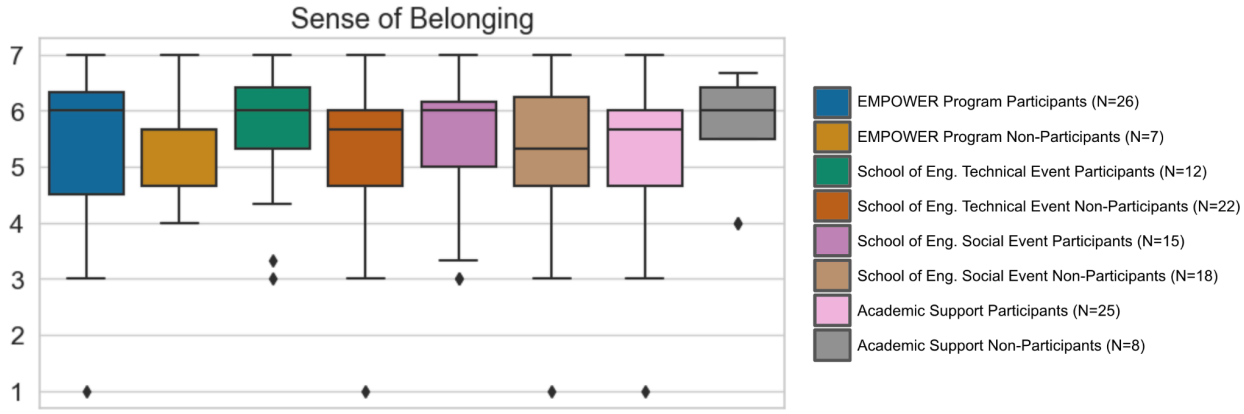


Figure 5. Sense of Belonging Likert scale scores reported by the EMPOWER Program students: Comparison of event participants and non-participants across various events.

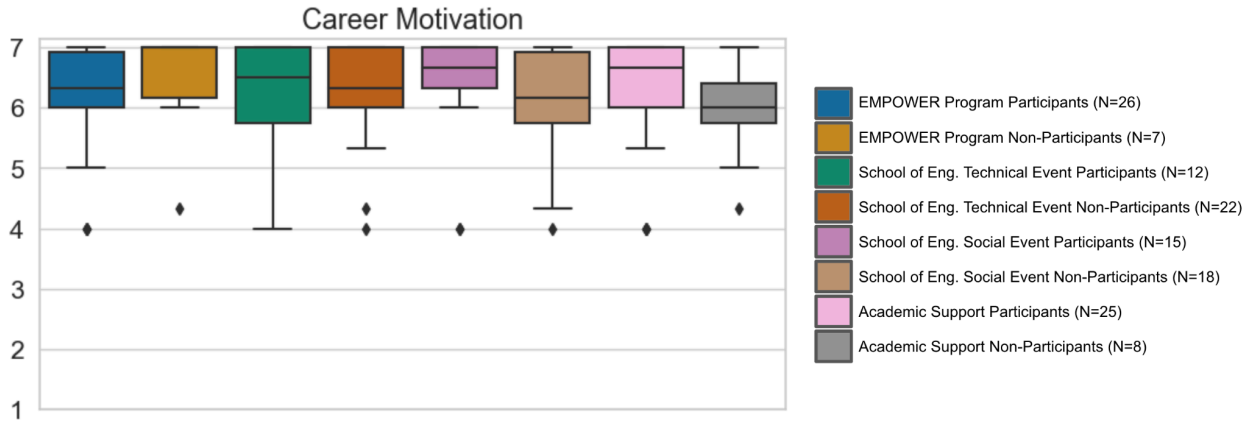


Figure 6. Career Motivation Likert scale scores reported by the EMPOWER Program students: Comparison of event participants and non-participants across various events.

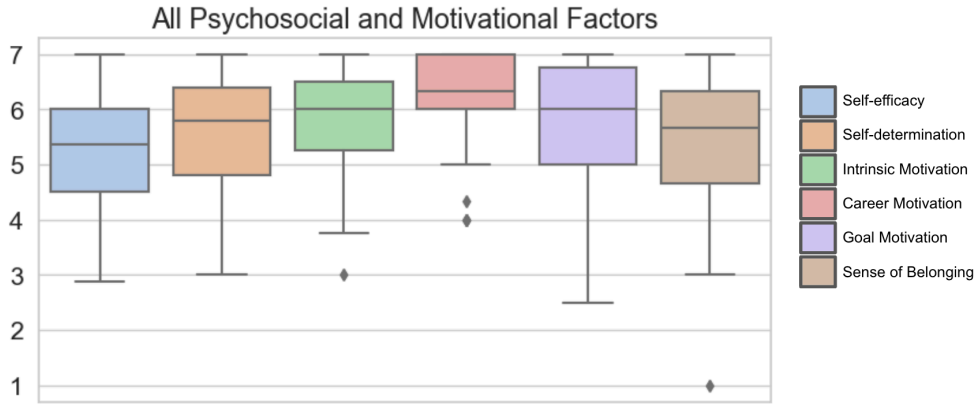


Figure 7. Distribution of Likert scale scores across all psychosocial and motivational factors as reported by the EMPOWER program survey participants, regardless of event participation.

Two survey questions asked students to describe their transition experience and transition support with a free response: **(1) Please describe your transition from college to university. How has it been so far?**, and **(2) What, if at all, has been the support you have had in your transition thus far? Can you share an example as to why or how they have been supportive in your transition?**

Common themes presented themselves throughout the free responses. 15 of the 30 students who responded to question (1), described their transition as turbulent or difficult (50%). Three students used the term "rollercoaster" in their description. Challenges that students experienced during transition included adjusting to an increased difficulty or competitiveness in the classroom (23%), the fast-paced nature of transition or new school environment (20%), difficulty transitioning to the quarter system from a semester system (17%), and difficulty managing time (10%). One student shared, "I struggled to find a pattern that worked for me, especially as a commuter, and had to work hard to adjust to certain factors that come into play (like finding parking, where to warm my food, non-crowded study areas)."

While challenges were shared in many question (1) responses, a significant number of students shared that they have had an overall positive transition from community college to university (23%). Students shared some of the reasons why they think they had positive transition experiences. For example, one student shared, "This transition was greatly aided by the fact that I have a few friends that also transferred from my community college to UC San Diego, in the same major as well" and another responded with, "I think already being part of EMPOWER Program helped a lot because I knew a lot of the resources already thanks to previously attending cohort events." Even with some students having a relatively negative view about their transition difficulties, 6 students shared a positive outlook (20%), for example, stating, "It has been rough but I persevered" or "Difficult at first but I adapted."

Support during student transitions was found through a few primary sources, shared in 25 free responses to question (2). Friends were most frequently cited as key support during student transitions from community college to the university (32%). One student shared, "The main support I have had in my transition are my friends. I have many friends from my community college here, as well as other transfer students I met this quarter which helped in my transition."

Finding students with a “common ground” was important to respondents, with many sharing that support was found through interaction with transfer engineering students in a variety of forms (28%). Additional transition support was found through faculty (20%), workshops/events (16%), scholarships (12%), student resource centers (12%), and (tutors). In many of these cases, emphasis was placed on how the resources helped respondents with their coursework (28%). One student shared, “I feel fortunate to have joined the EMPOWER Program at UC San Diego, which has been a pivotal point in my transition. Through this program, I've developed a strong sense of belonging at UC San Diego. The program provides a supportive environment where I know I can always seek help when I have questions.” The EMPOWER Program was mentioned as a significant support for 8 of the 25 respondents (32%).

Discussion and Conclusion

The survey results in this exploratory study provide insight into how EMPOWER Program transfer engineering students engage with program and school activities and how these activities may influence the students’ motivation and sense of belonging. The high average values for the investigated sense of belonging and motivation factors (i.e., self-efficacy, self-determination, intrinsic motivation, career motivation, and goal motivation) across all respondents plotted in Figure 6 are encouraging. Career motivation levels were the highest of all categories. This is a positive observation, as one major goal of NSF’s S-STEM program is to lead students toward STEM careers. When comparing responses to these factors across participants and non-participants, as shown in Figures 1-5, it was originally hypothesized that participants would have higher reported scores than non-participants, likely correlated with their motivation to attend hosted activities and caused by expected activity outcomes. However, with no statistical difference between the two groups, this was not found to be true. Only minor trends suggest that participation in these activities, particularly professional development and social events, might be linked to slightly higher intrinsic motivation and a sense of belonging. One potential reason for this finding is the small sample size within non-participant subgroups, which may have limited the ability to detect meaningful differences. Additionally, self-selection bias in survey participation may have played a role. It is possible that among non-participants, those who were more motivated or already had a strong sense of belonging were more likely to respond to the survey, leading to an overrepresentation of highly motivated individuals in both groups. This

could have resulted in smaller observed differences between participants and non-participants than might exist in the broader population of the EMPOWER Program students. Furthermore, analysis of the open-ended free responses revealed that many transfer engineering students are resourceful and, if not through the structured program or school activities, are likely to find support through unstructured activities, for example, through their new or existing transfer student friends. It might be advantageous for student scholarship programs and institutions to identify and strengthen existing friend groups while also facilitating structured peer mentoring, learning communities, and alumni networking events. Encouraging community-building through student organizations and study groups can enhance transfer students' sense of belonging and academic integration, supporting them in, through, and out of a major transition.

Some limitations of this study are worth noting. Although the number of survey responses was high, many subgroups did not have a high enough number to draw generalizable conclusions. Larger numbers across groups may lead to seeing additional, meaningful trends. Furthermore, the data collected is not longitudinal, but rather cross-population at one point in time. Although this approach provides valuable insights into how scholarship programs can allocate resources effectively, transitions, along with students' perceptions of their situation, self, support, and strategies, change over time and can be influenced by program, school, or unstructured activities at different magnitudes and rates during the transition cycle. A longitudinal study would likely lead to an improved understanding of how students persist and how programs like the EMPOWER Program, described here, could optimally impact their students. Additionally, given that this survey was conducted at a single large public research university with well-established academic and non-academic support structures, findings may not be fully generalizable to all two-year college transfer students, particularly those at smaller institutions with fewer centralized resources. Expanding future research to include multiple institutions would provide a broader perspective on the varied experiences and needs of transfer engineering students.

Three primary conclusions from this study include:

- EMPOWER Program transfer engineering students reported highly positive scores (5+ out of 7 on a Likert Scale) for motivation (self-efficacy, self-determination, intrinsic motivation, career motivation, and goal motivation) and sense of belonging.

- No statistical difference was found between activity participants and non-participants when measuring the impact of those activities on aspects of motivation and sense of belonging.
- While transfer engineering students in the EMPOWER Program often describe their transition from community college into a 4-year university as turbulent or difficult (50% of respondents), they are also very resourceful, finding a variety of support, such as that from friends (32%) and faculty (20%).

Researcher Positionality Statement

As researchers, we acknowledge our positionality in this study and recognize how our backgrounds, experiences, and perspectives might influence the research process. Our team comprises three professors in electrical and computer engineering who do not have first-hand experience as transfer students but have extensive experience in student advising, mentorship, and institutional support programs for both transfer and non-transfer students. Our engagement with transfer students through mentoring and program development has provided insights into the challenges they face and the support programs that might help them during their transition.

We recognize that our perspectives influenced the survey design, data collection, and analysis. To strengthen the relevance and clarity of the survey, we incorporated insights from student responses to a similar survey conducted the previous year. By analyzing themes and patterns from prior responses, we refined survey items to better capture students' experiences with academic and social support systems. This approach allowed us to align the survey questions with student-identified challenges and concerns.

Furthermore, we acknowledge that the findings of this study are influenced by the distinct environment and institutional structure of a large public research university, and they may not directly apply to all engineering education contexts. Nevertheless, we hope that these insights encourage educators to design and implement programs that better support the success of transfer students in engineering programs.

As human participants in the research process, we also recognize the ethical responsibility involved in collecting and analyzing both quantitative and qualitative data from students. Beyond

compliance with IRB approval, we took deliberate steps to protect participant confidentiality, ensure voluntary participation, and accurately represent student experiences. Given that open-ended responses often contained personal reflections on academic struggles, transitions, and institutional barriers, we de-identified responses before engaging in the data analysis to maintain participant anonymity.

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Appendix A: Survey Questionnaire for Engineering Transfer Students in Transition

Student Background Related to Events/Support [Never Rarely - Very Frequently]

- How often do you use the Academic Support Services, such as Professor/TA/Tutor Office Hours, the Tutoring Center, or other Tutoring offers at UC San Diego?
- How often do you attend the social events held at the Jacobs School of Engineering?
- How often do you attend the professional development or technical events (seminars, workshops, etc.) held at the Jacobs School of Engineering?
- How often do you meet with a mentor at UC San Diego in an INFORMAL setting? The mentor can be a professor, an academic advisor, or an alumnus with whom you meet at least once a quarter.

Self-efficacy (Likert Scale 1-7) [Adapted from [17]]

- I will be able to achieve most of the goals that I have set for myself.
- When facing difficult tasks, I am certain that I will accomplish them.
- In general, I think that I can obtain outcomes that are important to me.
- I believe I can succeed at most any endeavor to which I set my mind.
- I will be able to successfully overcome many challenges.
- I am confident that I can perform effectively on many different tasks.
- Compared to other people, I can do most tasks very well.
- Even when things are tough, I can perform quite well.

Self-determination (Likert Scale 1-7) [Adapted from [16]]

- I put enough effort into learning engineering topics
- I use different strategies to learn engineering topics
- I spend a lot of time learning engineering topics
- I study hard to learn engineering topics
- I prepare well for the exams in engineering courses

Intrinsic Motivation (Likert Scale 1-7) [Adapted from [16]]

- The engineering topics I learn are relevant to my life
- Learning engineering topics is interesting
- I am curious about discoveries in engineering fields
- I enjoy learning engineering topics

Career Motivation (Likert Scale 1-7) [Adapted from [16]]

- Learning engineering topics will help me get a good job
- Understanding engineering topics will benefit me in my career
- My career will involve engineering

Goal Motivation (Likert Scale 1-7) [Adapted from [16]]

- I like to do better than other students on engineering course exams
- Getting a good grade on engineering course exams is important to me
- I think about the grades I will get in engineering courses
- Scoring high on engineering tests and laboratory work matters to me a lot

Sense of Belonging (Likert Scale 1-7)

- I feel accepted at the UC San Diego
- I feel comfortable at the UC San Diego
- I feel supported at the UC San Diego

EMPOWER Program Specific Questions

- Are you currently an EMPOWER Scholar (admitted to the EMPOWER program)?
- How often have you participated in the EMPOWER program activities?
- How, if at all, have the EMPOWER program components you engaged with contributed to your transition? Please provide an example.
- How, if at all, have they contributed to any feelings of being welcomed at the Jacobs School of Engineering? Please provide an example.