

EAGER: Passed Down Strains and Belonging: How Traditional and Chosen Family Support Networks Shape the Experiences of Socioeconomically Disadvantaged Engineering Students

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Education ('22) and M.S. in Aeronautics and Astronautics ('21) at Purdue University, and two B.S. in Mechanical Engineering and Secondary Mathematics Education at the University of Nevada, Reno ('17). Atop their education, Justin is a previous NSF Graduate Research Fellow and has won over a dozen awards for research, service, and activism related to marginalized communities, including the 2020 ASEE ERM Division Best Diversity Paper for their work on test anxiety. As a previous homeless and food-insecure student, Justin is eager to challenge and change engineering education to be a pathway for socioeconomic mobility and broader systemic improvement rather than an additional barrier.

EAGER: S-STEM: Passed Down Strains and Belonging: How Traditional and Chosen Family Support Networks Shape the Experiences of Socioeconomically Disadvantaged Engineering Students

Abstract

This National Science Foundation (NSF)-funded S-STEM EAGER project uses narrative methods to understand how stress in traditional and chosen family support networks affects the sense of belonging of socioeconomically disadvantaged students (SDS) in engineering. This study is based on in-depth interviews with 15 SDS and examines how supporters' experiences influence SDS over time. Each SDS identified members of their traditional family—such as parents or siblings—and chosen family—such as mentors, advisors, or faculty—who supported their academic and personal lives. Interviews with these supporters are currently in progress. The research team is combining data from both SDS and supporters to create narratives that show different types of support strain, how this strain is transmitted to SDS, and how these strains affect SDS' academic and emotional experiences. Early findings show clear differences between supporter groups. Traditional family members often face long-term financial, emotional, and work-related stress, which limits the support they can give. SDS often take on this stress themselves, leading to feelings of guilt, worry, or hesitation to ask for help. In contrast, chosen family supporters often help SDS by using their knowledge of the education system to reduce institutional and administrative challenges. Across both groups, empathy and respectful, human interactions play an essential role in helping SDS feel that they belong in engineering.

Introduction

Socioeconomically disadvantaged students (SDS) often feel they do not belong in their engineering programs. Sense of belonging is a determining factor in whether SDS will be academically successful and pursue a career in engineering. Belonging is the feeling of being supported, comfortable, and accepted as a member of an academic or disciplinary community, including engineering [1], [2]. Research has shown that belonging is significant to student achievement, especially in STEM. Students who have a strong sense of belonging are more likely to persist, while those who feel they do not belong may disengage or leave [3], [4].

SDS report feeling a lesser sense of belonging due to a lack of class identity, cultural differences, and the inability to utilize resources available to them through their institutions [5]. Programs like the National Science Foundation's (NSF) Scholarships in Science, Technology, Engineering, and Mathematics (S-STEM) program provide support to SDS through a combination of financial assistance and structured academic and social support [5]. Academic and social support provided through the program includes mentoring by faculty members, peer cohorts, and bridge programs that are tailored to the institution. Studies show that institutional agent support, mentoring relationships, and community-building programs are effective in enhancing an individual's sense of belonging and reducing feelings of isolation [3], [6], [7] [8] [9]. Most research, however, focuses on campus-based programs and student-facing support services, while little consideration is given to the broader social environments in which students seek and use support [7] [10].

As we have discovered, engineering SDS do not simply get support from schools; many also get it from traditional families and "chosen" families. Traditional families are defined by biological connections (e.g., parents, siblings) and may provide emotional, financial, and practical support to students [11]. Unfortunately, there is no guarantee of that type of support, as traditional family members themselves may experience significant stressors, such as job instability, long hours at work, caring for others, and poor health [12], [13], [14]. To make up for missing resources, many

engineering students develop "chosen families," which consist of an individual's peer group, mentor, educator, friends, and others they trust to offer advice, advocate for them, and provide access to the ways in which the institution works [7], [11], [15], [16] [17]. While individuals within chosen families may possess greater access to social and institutional capital than many members of SDS' traditional families, the extent to which this capital can be mobilized to support SDS is shaped and constrained by broader structural and intersectional inequalities faced [14].

While there is a consensus among researchers that both family and other support networks have an important impact on student success, there are very few research studies that examine how the stresses experienced by those who provide support to SDS are "passed on" to the SDS and affect their sense of belonging to the engineering community. Without understanding regarding how stress from support providers is passed on to SDS, support programs may focus on visible outcomes and miss the deeper social and emotional factors that affect SDS persistence and success. This NSF-funded project (Award #2438112) examines how the strains placed upon SDS' traditional or chosen family units are "passed down" to SDS and affect their sense of belonging within engineering. This study will fill the existing void by providing insight into the unexplored relationship between family-based strain and SDS success in engineering as well as developing a foundation for supporting SDS in a more comprehensive manner.

Project Overview

Our project examines how strain in the support networks of SDS influences their sense of belonging within engineering. We explore the broader social environments in which SDS are included, particularly traditional and chosen family systems that operate primarily outside the institution's boundaries. This project develops an initial empirical and conceptual understanding of how stressors experienced by support providers of SDS, like family members, mentors, peers, professors, and other trusted individuals, are transmitted to SDS and shape their academic, emotional, and disciplinary experiences in engineering. With SDS in engineering as the center, this study examines how a sense of belonging in engineering is developed within institutional spaces and through broader SDS support networks. In particular, the research explores the role of family support, which includes both traditional and chosen families in fostering SDS' persistence and belonging. Each family member supports SDS differently, as a traditional family member can offer emotional encouragement and material support, while a chosen family member can support by providing emotional reassurance or by strengthening their sense of belonging. At the same time, these family members also experience structural strains, including financial, emotional, and time constraints, which can be passed on to an SDS and shape their educational experiences. By centering the intersection of SDS' educational and social worlds, this project aims to lay the groundwork for a new line of research that reconsiders how belonging is cultivated, constrained, or undermined beyond the university context.

Purpose & Research Questions

The purpose of this study is to examine how strain experienced within both traditional and chosen families of SDS in engineering is transmitted and influences SDS sense of belonging. By focusing on family-based strains, relational responsibilities, and access to social and institutional resources, this project seeks to develop a foundational understanding of how external stressors intersect with structural inequalities to influence belonging, persistence, and success among SDS. We seek to answer the following research questions (RQs):

Overall RQ: In what ways do the passed-down strains of SDS' families impact SDS' engineering belonging?

- RQ1: What strains do the families of SDS in engineering face tangential to supporting SDS?
- RQ2: In what ways are the strains of the support person passed on to SDS?
- RQ3: How do these strains impact the engineering belonging to SDS?

Current State of the Project

Data Collection - We have completed 15 in-depth narrative interviews with S-STEM students nationwide. SDS' interviews followed open narrative protocol and lasted about 90-120 minutes. Once interviewed, each of the participating SDS selected up to ten individuals from their traditional or chosen families who "have helped support their academic and personal pursuits." The researchers are currently conducting the second level of interviews with these support individuals, including participants' parents, siblings, mentors, and others.

Data Processing - All completed SDS interviews have been transcribed, and qualitative coding is nearing completion. The researchers use an iterative qualitative analysis process to identify, label, and code across narratives that align with the study's RQs. We continue to interview with SDS' supporters. The team uses a narrative approach to build a detailed story for each SDS. To improve accuracy and depth, the team uses member-checking by allowing SDS to review and comment on their stories. The team has developed a clear coding scheme to label parts of each narrative by key themes and related research questions, such as supporter strain, how that strain transfers to SDS, and how that transfer affects SDS' sense of belonging.

Preliminary Findings

These early observations are based on preliminary SDS and supporter interview data.

SDS Interviews - SDS frequently identified the role of both academic and instructional support in making them believe they are capable of, and confident in, an engineering space. Many SDS discussed ways they utilized university resources, including tutoring centers, computer labs, libraries, and engineering learning centers. The availability of these resources assisted SDS in completing their coursework and reduced uncertainty. SDS also identified positive interactions with faculty, advisors, and mentors, providing SDS assistance with resume writing, interviewing, course selection, and career choices. These interactions allowed SDS to better understand the workings of academic systems and created an environment where they felt supported rather than isolated. SDS recognized that academic support services legitimized seeking help and created a culture that allowed them to ask many questions repeatedly without fear of being judged.

At the same time, many SDS also described ongoing financial stress that shaped their daily lives and academic decisions. SDS said that growing up in low-income households influenced their attitudes toward money long before going to college. Financial concerns continued throughout their engineering program and often increased over time. SDS mentioned stressors related to tuition, debt, housing costs, and transportation. Some SDS described adjusting course loads, extending time to graduation, or prioritizing work over academic opportunities due to financial pressure. SDSs did not view these issues as temporary challenges, but rather as long-term issues that affect their ability to concentrate on their studies, their overall emotional well-being, and feelings of security and belonging. Some SDS reported unstable household environments prior to attending college, while others described earlier ones. Some SDS' families were forced to move

repeatedly and were separated from each other due to economic difficulties, evictions, or for other reasons. As a result, SDS had to expend an immense amount of time, and physical and emotional energy dealing with their uncertain living situations. Housing and food insecurity negatively impacted some SDS' participation in social and academic activities.

Furthermore, several of the SDS shared with us how their family environments impacted their behaviors and choices as SDS in college. SDS reported they were concerned about increasing the burden to their families, and therefore, many SDS either painstakingly minimized their personal issues or refused to ask for assistance. *This finding indicated that while family stress is likely independent of the SDS academic experience, it affects how SDS make decisions when facing difficulties in college and influences whether SDS feel they belong in an engineering program.*

Traditional Family - Early data suggest that most SDS family members are burdened by long-term, yet significant, issues that impact SDS' college experiences. Most of these issues occur unintentionally, usually due to the financial burdens experienced by parents and other close relatives due to low-paying jobs, job conditions, and unaddressed personal trauma. Examples include single mothers in poor economic conditions working multiple jobs while receiving unemployment benefits, or a family selling its home to use the funds to cover the cost of tuition to send the SDS to college. The economic and emotional limitations endured to help families' children succeed create a barrier to how much emotional support the family can give.

Notably, SDS are subjected to their parents' stress in a variety of ways. For example, parents working long hours to pay for household expenses have limited time to assist with homework and are therefore unable to provide the support that encourages SDS to do well academically. In extreme situations, this type of parental stress can create an unstable home environment (ongoing family stress, housing insecurity, and financial-related family conflict). Many SDS also assume a great deal of personal responsibility to "avoid" contributing to perceived family stress. For example, some SDS downplay their own difficulties in college; others are reluctant to seek assistance from their parents out of fear of being an additional "burden." *The behaviors SDS exhibit demonstrate that they perceive their family members' stress and alter their behavior in response.* While SDS greatly values their families' support and sacrifices, SDS also bear the emotional burdens of watching their loved ones. The preliminary data indicate that the financial and emotional burdens of SDS' families have not remained separate from their experiences in college but instead contribute to how SDS think, influence how SDS approach challenges, and determine if SDS will seek support or address such challenges independently.

Chosen Family Support - Unlike traditional family members, chosen family have different roles within the lives of SDS. These supporters include mentors, professors, advisors, coaches, and members of the SDS community. These supporters face different challenges, and they contribute to SDS' experiences in unique ways. Early findings show that supporters often assist SDS by providing guidance on how the post-secondary education system operates. For example, we found that a faculty member assisted an SDS in finding an affordable place to live during the summer, while another faculty member contacted a professor on behalf of an SDS to resolve an issue with their classes. These supporters use their insider knowledge to help SDS navigate the bureaucratic aspects of the post-secondary education system. Chosen family members are usually unaware of the influence they wield. A few SDS stated that simply receiving recommendations or guidance

from a mentor can greatly affect both their self-confidence and decisions. Some examples include a mentor suggesting that a SDS remain in a difficult class or that they engage in a research project. To the mentors, these comments would be considered minor suggestions; however, to the SDS, such suggestions significantly impact their life.

In contrast to parents, most professors and mentors face different kinds of challenges, particularly managing time and navigating institutional systems. Interviews with SDS show that supporters of “chosen families” provide essential services to traditional families, especially for SDS, who are also often unable to access them. While many parents wish to support their children through the college system, they often lack knowledge of how it operates and primarily offer emotional support. Chosen family supporters serve as positive role models and steady guides in the educational system. SDS frequently refer to specific mentors or program directors as “family on campus.” Chosen family members create safe spaces and offer guidance that helps SDS feel less alone at the university. Early findings show that this guidance and advocacy support SDS’ progress and can offset some disadvantages SDS face.

Empathy and Belonging - Empathy within both traditional and chosen family support networks plays a vital role in fostering SDS’ sense of belonging. SDS reported feeling more confident about pursuing an engineering career when a parent or professor demonstrated understanding of what they were going through and treated them as a person. Empathy within the family is very important and can be seen when parents recognize the pressures of being in college, even amid the challenges the family may be facing. On the mentor side, empathy shows through approachability and openness. SDS often value mentors who see them as whole people, not just grades. They say this makes them feel respected and understood. Initial results support the concept that both human and empathic actions from mentors can make SDS feel like they are part of an inclusive group. When supporters treat SDS with respect and validate how they feel valued and accepted within the engineering community.

Future Work

This project is in its early stages. In the coming months, we will complete family interviews to collect more in-depth information on family members' perspectives and family-related support. Collecting multiple perspectives from participants and their family members will help develop a more detailed picture of how family connections and experiences shape feelings of belonging to or exclusion from engineering. This data will be utilized to create what we are calling “ecosystem narratives” that integrate both SDS and family accounts to show how a combination of support, strain, and belonging is interdependent among SDS’ support systems. There are a variety of potential qualitative approaches that could be used in the future, including embedded case studies. Embedded case studies allow for more in-depth exploration of specific complex experiences by embedding individual personal stories into the context of family, culture, and society. By using embedded case studies, researchers can gain greater insight into how various family relationships influence participants' daily lives [18].

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