# Familial Influence on Engineering Student Sense of Belonging and Identity

**Abigail Stephan**
Clemson University, USA, atsteph@g.clemson.edu

**Candice Bolding**
Clemson University, USA

**Georgia McKown**
Clemson University, USA

**Abstract:** As social beings, humans are influenced by other individuals in the contexts in which they interact. From early childhood through young adulthood, the family is one of the most significant social contexts contributing to one's identity development and social capital as they relate to education and career goals. Students' intended career paths and decisions about college are impacted by familial and societal factors (Inchara, Gayathri, & Priya, 2019). Additionally, family members often act as a source of support and inspiration for college students when they are deciding on their major and future career (Meador, 2018). While current engineering education research has focused on the role that parental education attainment and profession play in engineering students' persistence, choice of major, and career pathways (Martin & Simmons, 2014), there has been little examination of how familial social capital influences students' sense of belonging and engineering identity. The purpose of the current study is to investigate the impact of familial influence, determined through parental education levels and professions, on undergraduate engineering students' sense of belonging in their engineering major, engineering identity, and academic performance. Results for this sample did not suggest that familial influence for undergraduate engineering students will significantly affect their sense of belonging and engineering identity. These findings and potential implications are discussed.

**Keywords:** Familial Influence, Engineering students, Sense of belonging, Sense of identity

## Introduction

As a critical context for development, the family system contributes to youth's identity development and social capital. Familial influence often feeds into youth's decisions about college and their future careers (Inchara, Cayathri, & Priya, 2019). Additionally, family members often act as a source of support and inspiration for college students when they are deciding on their major and future career (Meador, 2018). While current engineering education research has focused on the role that parental education attainment and profession play in engineering students' persistence, choice of major, and career pathways (Martin & Simmons, 2014), there has been little examination of how familial social capital influences students' sense of belonging and engineering identity. The purpose of the current study is to investigate the following questions:

1. What is the impact of familial influence on undergraduate engineering students' sense of belonging in their engineering major?
2. What is the impact of familial influence on undergraduate engineering students' engineering identity?

### Familial Influence

In the current study, familial influence acts as a predictor for engineering students' sense of belonging and engineering identity. As evidenced by systems theories, the family context is a significant arena for youth development cognitively, emotionally, and socially (Cox & Paley, 1997). The family system within which a youth is embedded sets the stage for their behaviors and beliefs around their future profession. Familial influence is related to the concept of social capital, which is comprised of one's social networks, the norms followed in these social networks, and the value placed on these networks and norms as one works to achieve their goals (Baron, Field, & Schuller, 2000). In this way, the family system acts as a critical social network and influences students' beliefs about acceptable behaviors and expectations (Martin, Simmons, & Miller, 2014).

Students' intended career paths and decisions about college are impacted by familial and societal factors (Inchara, Gayathri, & Priya, 2019). Family members often act as a source of support and inspiration for college



Stephan, A., Bolding,C., & McKown, G.(2019). Familial Influence on Engineering Student Sense of Belonging and Identity. In M. Shelley & V. Akerson (Eds.), *Proceedings of IConSES 2019-- International Conference on Social and Education Sciences* (pp. 93-97). Monument, CO, USA: ISTES Organization.

students when they are deciding on their major and future career (Meador, 2018). Parental and sibling guidance has been shown to influence undergraduate engineering students' choice of major and persistence at their chosen institution (Brisbane et al., 2019). One study found that choice of engineering major was influenced more significantly by a sibling or other relative being affiliated with engineering than by a parent (Godwin, Potvin, Hazari, 2014). While this literature demonstrates that there is a relationship between familial education background as an engineer and students' choice to major in engineering, past studies have called for additional work to go further by focusing on how familial influence predicts engineering identity and sense of belonging in engineering (Godbole, Miller, Bothwell, Montfort, & Davis, 2018).

### Sense of Belonging in Engineering

In the context of engineering, sense of belonging can best be defined as a feeling of inclusion and willingness to engage with one's peers, instructors, and materials in an engineering setting (Wilson et al., 2015). Within an engineering classroom, sense of belonging is comprised of academic belonging and social belonging (Schar et al., 2017). Therefore, sense of belonging has important implications for academic self-efficacy and motivation in the context of learning engineering content (Schar et al., 2017). Engineering students' sense of belonging can be inhibited by a number of factors including financial barriers, pressures related to course-load, self-efficacy in engineering content and technical knowledge, and comfort in university or college environment (Smith & Lucena, 2016). A lack of sense of belonging has been linked to attrition at the university level, while an abundance of sense of belonging is correlated to persistence within a university and major (Good, Rattan, & Dweck, 2012).

### Engineering Identity

Undergraduate engineering students must have a moderate to strong sense of engineering identity in order to persist through their major, earn a degree, and begin working in the field. Engineering identity can be described through its three vital components: interest in engineering topics, self-perception as capable of "doing" engineering, and empowerment by themselves and others to self-label as an engineer (Rohde et al., 2019). While one study found that peers and instructors have a more weighted influence on engineering identity for graduate students pursuing a professional degree in engineering, the family's impact remains a salient factor contributing to engineering identity (Choe & Borrego, 2019). However, because of the lack of exposure to advanced peers and engineering professionals upon entry to the university, the assumption can be made that the family context remains more impactful for undergraduate students, especially those at the outset of their careers as engineering majors.

## Methods

### Sample

Data for this project are from larger study funded through a National Science Foundation IUSE/Professional Formation of Engineers: Revolutionizing Engineering Departments (IUSE/PFE: RED) grant. The sample for this study included 343 sophomore, junior, and senior undergraduate student participants who were enrolled in a single engineering major. Participants' race/ethnicity and gender demographics are included in Table 1.

Table 1. Race/Ethnicity and Gender Demographics for Study Participants

| | Total Sample |
|---|---|
| *Race/ethnicity* | |
| *n* | 342 |
| % White | 85% |
| % Black or African American | 5% |
| % Asian | 3% |
| % One or more race | 6% |
| *Gender* | |
| *n* | 342 |
| % Male | 78% |
| % Female | 22% |

### Data Collection

**Protocol.** Data were collected in students' face-to-face lab section meetings using an online data collection platform (Qualtrics citation). Data were collected during the Spring 2019 academic semester over a time period of two weeks, and collection sessions were led by members of the research team using a single administration protocol.

**Measures.** The study included measures of familial influence as well as student sense of belonging and sense of engineering identity. Familial influence was measured through parent education and social capital. To measure parental education level, student participants indicated the highest level of education completed by their parent(s). Social capital was measured through a combined score of parental occupation type from each parent indicated by the participant (Engineering, Non-engineering STEM, or non-STEM). These two scores were combined to provide a single score for familial influence.

Student sense of belonging was measured through 24 survey items using a 7-point Likert-type scale (1=*not at all*, 7= *very much so*). The results of these items were then combined to provide a measure of an overall mean score of student sense of belonging. Engineering identity was measured through 14 survey items using a 7-point Likert-type scale (1=*strongly disagree, 7=strongly agree)*. The scores across items were combined to give an overall mean student engineering identity score for each participant.

### Data Analysis

Data were analyzed utilizing simple linear regressions. Tests were run to determine the relationship between familial influence and sense of belonging and familial influence and engineering identity. Prior to running analyses, participants' indications of parental occupation type were recoded using a simple coding method in Excel where parent 1 reported occupation was combined with parent 2 occupation (i.e. Parent 1 Engineering + Parent 2 Engineering = 1; Parent 1 Engineering + Parent 2 STEM = 2). While the majority of participants (339) listed two parent occupations, four students list single parent occupations. This recoding allowed for participants to have a single score for parental occupation type across one or both parents. Parental occupation type was then combined with parental education level to generate a single variable called familial influence.

## Results

An initial linear regression was calculated to predict engineering student sense of belonging based on familial influence, as measured by parent education and social capital. A non-significant regression was found ($F(1,260) = 0.805$, $p < .371$ with an $R^2$ of .003. Participants' predicted sense of belonging is equal to 4.569 + .012 (familial influence) when familial influence is measured by mean score of 1-7. Participants' sense of belonging in engineering was not significantly predicted by the familial influence variable.

An additional linear regression was calculated to predict engineering student identity based on familial influence, as measured by parent education and social capital. A non-significant regression was found ($F(1,258) = 0.568$, $p < .425$ with an $R^2$ of .002. Participants' predicted engineering student identity is equal to 5.527 + .017 (familial influence) when familial influence is measured by mean score of 1-7. Participants' engineering student identity was not significantly predicted by the familial influence variable.

## Discussion

Results of the two linear regressions suggest that familial influence as measured by parental education level and parental occupation type does not significantly predict participant sense of belonging in engineering or participant engineering identity in the identified sample. These non-significant test results offer insight into both features of the study as well as opportunities to improve the study to better capture the influence of families on student sense of belonging and engineering identity.

It is important to consider how well parental occupation acts as a proxy for familial influence. For example, it is possible that additional measurable predictors, such as parental encouragement and engagement, may be more aligned with the framework used to conceptualize familial influence. Though these predictors were not included

in the survey, questions related to parental encouragement and engagement should be included in future qualitative follow-up protocol. If student responses demonstrate that these have a meaningful influence on sense of belonging and engineering identity, related questions should be added in the next iteration of the survey.

The design of this study could be strengthened in two primary ways. First, the question on the instrument related to familial influence asked students to indicate the professional field of their parent(s)' work. This question may have led to confusion for students if 1) they were not aware of what constitutes a STEM profession, 2) their parent(s) switched fields by entering into or out of a STEM field throughout the student's life, or 3) their parent(s) worked at engineers, which technically also falls within the STEM category. This limitation can be avoided in the future by adding additional options for students to choose, creating a space for students to list their parents' professions, or following up with semi-structured interviews. An additional limitation exists in the fact that data for the current study was collected from one university. Therefore, these results are not generalizable to all undergraduate engineering students.

**Recommendations for Future Research**

The results of the current study would be strengthened with the addition of a qualitative component. Through interviews and focus groups, this component could explore how students' perceive familial influence impacting their sense of belonging and engineering identity. Interpretation of qualitative would bolster research on this topic by either substantiating claims made based on quantitative survey data or highlight areas where significant divergence occurs between quantitative and qualitative findings. Additionally, future research should consider how demographic differences in families influence students' sense of belonging in engineering and their engineering identity.

## Conclusion

The purpose of this paper was to analyze the impact of familial influence on undergraduate engineering students' sense of belonging and engineering identity. While findings from the current study suggest that there is not a significant relationship between familial influence and student sense of belonging and engineering identity, there is value in further exploring this space and continuing to conduct research related to familial influences for undergraduate engineering students.

## References

Baron, S., Field, J., & Schuller, T. (2000). *Social capital: critical perspectives*. New York, NY: Oxford University Press.

Brisbane, J.M., Gallagher, E., Hines, A.E., Murphy, J., Dunwoody, I.A., Patel, K., Gramopadhye, A.K. (2019). Familial influences affecting student pathways to engineering at two-year and four-year institutions. *Proceedings of the ASEE Annual Conference and Exposition*. Tampa, FL: American Society for Engineering Education.

Choe, N. H., & Borrego, M. (2019). Prediction of Engineering Identity in Engineering Graduate Students. *IEEE Transactions on Education*, *62*(3), 181–187.

Cox, M.J. & Paley, B. (1997). Families as systems. *Annual Review of Psychology*, *48*, 243-267.

Godbole, A., Miller, B., Bothwell, M. K., Montfort, D., & Davis, S.C. (2018). Engineering students' perceptions of belonging through the lens of social identity. *Proceedings of the ASEE Annual Conference & Exposition.* Salt Lake City, UT: American Society for Engineering Education.

Godwin, A., Potvin, G., & Hazari, Z. (2014). Do engineers beget engineers? Exploring connections between the engineering-related career choices of students and their families. *Proceedings of the ASEE Annual Conference and Exposition.* Indianapolis, IN: American Society for Engineering Education.

Good, C., Rattan, A., & Dweck, C. S. (2012). Why do women opt out? Sense of belonging and women's representation in mathematics. *Journal of Personality and Social Psychology*, *102*(4), 700.

Inchara, R., Gayathri, R., & Priya, V. V. (2019). Awareness on the choice of profession among school students - A survey. *Drug Invention Today*, *11*(4), 871–874.

Martin, J.P., Miller, M.K., & Simmons, D.R., (2014). Exploring the theoretical social capital "deficit" of first generation college students: Implications for engineering education. *International Journal of Engineering Education*, *3*(4), 822-836.

Martin, J.P., & Simmons, D.R. (2014). Family roles in engineering undergraduates academic and career choices: Does parental education attainment matter? *International Journal of Engineering Education*, *30*(1), 136-149.

Meador, A. (2018). Examining recruitment and retention factors for minority STEM majors through a stereotype threat lens. *School Science & Mathematics*, *118*(1/2), 61–69.

Rohde, J., Musselman, L., Benedict, B., Verdin, D., Godwin, A., Kirn, A., … Potvin, G. (2019). Design Experiences, Engineering Identity, and Belongingness in Early Career Electrical and Computer Engineering Students. *IEEE Transactions on Education*, *62*(3), 165–172.

Schar, M., Pink, S. L., Powers, K., Piedra, A., Torres, S. A., Kai Jun Chew, & Sheppard, S. (2017). Classroom Belonging and Student Performance in the Introductory Engineering Classroom. *Proceedings of the ASEE Annual Conference & Exposition*. Columbus, OH: American Society for Engineering Education.

Smith, J. M., & Lucena, J. C. (2016). Invisible innovators: How low-income, first-generation students use their funds of knowledge to belong in engineering. *Engineering Studies*, *8(*1), 1–26.

Wilson, D., Jones, D., Bocell, F., Crawford, J., Kim, M.J., Veilleux, N., Floyd-Smith, T., Bates, R., & Plett, M. (2015). Belonging and academic engagement among undergraduate STEM students: A multi-institutional study. *Research in Higher Education*, *56*(7), 750-776.