

## **Impact of Misperception on Selecting an Engineering College Major: An Empirical Analysis**

**Mostafa Batouli, Rebekah Burke, Jeffery Plumblee, and Jeff Davis**

*The Citadel, Charleston, SC*

### **Abstract**

This paper explores the students' motivations for choosing between civil and construction engineering and identifies key misperceptions about the construction engineering programs. Based on the theoretical construct of self-determination theory, we divided students' motivations for major selection into a variety of intrinsic (e.g. interest in subject area) and extrinsic (e.g. prospect of a high paying job) factors. Using a mixed method approach including focus groups and questionnaires, we collected data from freshmen and sophomore students with declared majors of construction and civil engineering. Data was analyzed to identify the critical misperceptions that caused false positive (i.e. selecting a construction major based on inaccurate perception) and false negative (i.e. not selecting the construction major due to misperception of the major) errors. The findings of this study enable academic advisers in engineering programs to help students make more informed decisions about choosing their college major by focusing on the critical misperceptions that may result in the incorrect initial engineering discipline selection.

### **Keywords**

Major Selection, Misperception, Construction Engineering.

### **Introduction**

Choice of major affects academic and career success of students, and influences sustainability of degree programs and the rate of student attrition in higher education institutions. Misperception of the subject area and career paths associated with different programs is a root cause of inappropriate major selection by college students<sup>1</sup>. The misperception is most likely to happen when students decide between seemingly similar engineering majors. This is particularly true when students are deciding between construction engineering (ConE) and civil engineering (CE) majors. ConE and CE are similar majors because they are both professional fields focused on constructing the built environment. However, there are also important differences between the two majors that are often overlooked by students. ConE and its academic cousins Construction Engineering and Management (CEM), and Construction Management (CM) are combination of engineering, technology, construction techniques and management with different quotas of engineering, management and business content in their curricula. Graduates of these programs are typically placed in jobs related to engineering and management of construction processes. On the other hand, CE programs prepare students for careers in design of buildings and infrastructure facilities<sup>2</sup>.

Previous studies have pointed to occupation outlook<sup>3</sup>, students' math skills<sup>4</sup>, social identity<sup>5</sup> and gender<sup>6</sup>, racial composition of academic programs and workplace<sup>7</sup>, and values and costs of education<sup>8</sup> as factors influencing students' decision to pursue ConE or CE major. Other studies

have attempted to enhance student recruitment and retention at ConE programs by promoting construction major to high school students, and improving academic relevance of construction programs<sup>6,9-10</sup>. However, few studies have investigated the impacts of misperception of subject area and career paths associated with construction and civil engineering majors on students' selection of ConE programs.

The objectives of the research presented in this paper are twofold: First, to identify and evaluate the factors that motivate students to pursue an undergraduate degree in construction engineering; and second, to determine key misperceptions of construction and civil engineering that may cause ill-informed selection of one major over the other. The paper is unfolded as follows: the background of the research and the research objectives were presented in introduction. The research methods will be presented in the next section followed by results and conclusions.

## **Research Method**

The research processes used in this study included four components as shown in Figure 1. For determination of research objectives and processes related literature was reviewed and focus-group discussions were conducted. The outcomes of literature review and focus group discussions were used to create a survey including questions related to students' motivations for pursuing ConE major as well as the students' perception of ConE as a college major and a career. Data collected about students' motivations for major selection was classified through the lens of self-determination theory. Statistical analysis was conducted on data related to students' perception of ConE. Ultimately, the effects of extrinsic and intrinsic motivations on recruitment, retention, and success of students in ConE programs were discussed and major misperceptions of ConE were identified. The following subsections describe components of the research method.

### *Research Determination*

The questions investigated in the present study arose from a practical need of the author's for advising students to select between civil engineering and the newly developed construction engineering program at authors' institution. To facilitate informed decision making of students, the authors reviewed existing literature on best practices for selecting an engineering college major. In the review of the literature, the authors were particularly interested in specific information about ConE and CE programs. Summary of the literature reviewed by the authors is presented in the introduction section of this paper. Significantly, the authors realized that few studies exist on students' motivations to choose ConE/CE programs and their perceptions of the two engineering majors. Consequently, the research team decided to take on an initiative to

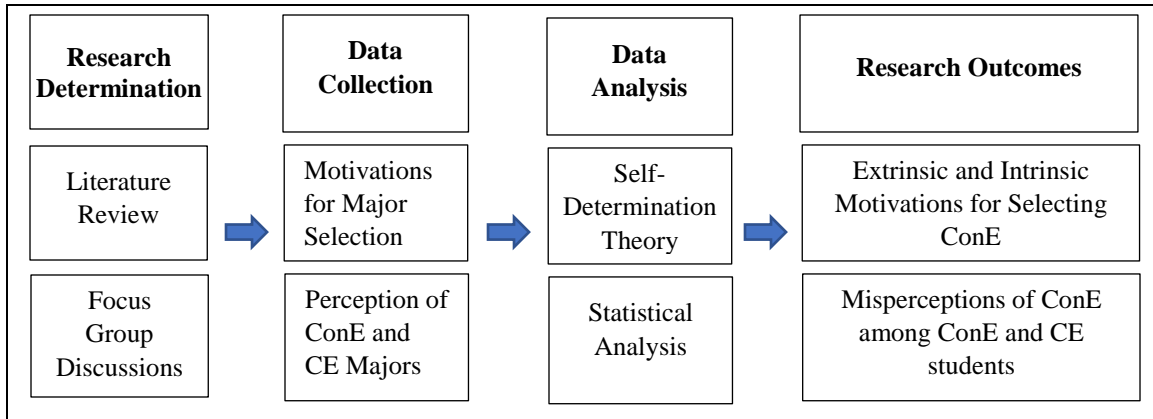


Figure 1: Components of the research method

investigate students' motivations for and perceptions of the ConE program. As a first step, one focus group of first-year and one focus group of third-year students, consisting of 15 and 10 ConE students, respectively, were selected. Each focus group met for a 50-minutes group open-ended discussion regarding students' motivations for selecting their major, and how they differentiate between civil and construction engineering. The participants were encouraged to share their thoughts and feelings freely. The moderator asked follow-up questions to clarify the participants' points of view without directing them to a desired response. For example, when a participant stated: "I'm selecting my major due to interest in the subject area", the moderator asked: "what aspect of ConE are you most interested in?" The moderator also encouraged other participants to share their thoughts about the same question. During this process, the researcher took notes of the vital points of the discussion as they relate to the research objective. The literature review and focus group discussions helped the research team to clarify the research objective and develop a roadmap for conduct of the research.

#### *Data Collection*

A survey consisting of three sections were developed to collect data about students' motivations for selecting ConE/CE majors and their perceptions of the two majors. The three sections of the survey are as follows: the first section collected demographic and personal information of the respondents. Second section asked respondents to identify their main reasons for selecting their major. The last section provided respondents with several statements about ConE and CE and asked them to identify (on a 5-point Likert scale) to what degree they agree with each statement. A summary of the components of the survey is presented in Table 1.

#### *Data Analysis*

Data collected about motivations of students for major selection was analyzed using theoretical concept of self-determination theory. According to the theory of self-determination, human motivations could be divided into intrinsic and extrinsic motivations (Deci & Ryan, 1985, 2000). Intrinsic motivations are the ones that are inherently joyful for a person while extrinsic motivations root in external rewards and/or punishment. Furthermore, extrinsic motivations could be either externally or internally regulated. When an external motivation arises from punishment for violating an external regulation, it is called an external extrinsic motivation. On

the other hand, internal extrinsic motivations are associated with self-endorsement of an external goals (Deci & Ryan, 1985).

Table 1: Summary of the survey sections

<b>Survey Section</b>			
	<b>Demographic and Personal Information</b>	<b>Motivations for Major Selection</b>	<b>Perception of ConE</b>
<b>Example of questions asked/ data collected</b>	<ul style="list-style-type: none"> <li>➤ Gender</li> <li>➤ Ethnicity</li> <li>➤ Declared Major</li> <li>➤ Status in the Department of CEE (Freshman, Sophomore, etc.)</li> <li>➤ GPA</li> <li>➤ SAT Score</li> <li>➤ Work Experience</li> </ul>	<ul style="list-style-type: none"> <li>➤ Interest in subject area</li> <li>➤ Intellectual curiosity</li> <li>➤ fulfilling career</li> <li>➤ graduate school</li> <li>➤ Prestige</li> <li>➤ high paying job</li> <li>➤ International opportunities</li> <li>➤ Time for other activities</li> <li>➤ Study abroad</li> <li>➤ Parental Desires</li> <li>➤ Easy requirements</li> <li>➤ Scholarship/assistantship</li> </ul>	<ul style="list-style-type: none"> <li>➤ Definition</li> <li>➤ Skills needed for ConE</li> <li>➤ Type of Construction jobs</li> <li>➤ Payment for Construction Jobs</li> <li>➤ Requirements of ConE major</li> <li>➤ Hostility to female and minorities</li> <li>➤ prestigious degree</li> <li>➤ Family and peer encourage ConE</li> </ul>

Soria and Stebleton (2013) used the theory of self-determination to study students’ motivations for major selection. According to their findings, “external extrinsic motivations for selecting a major tend to be negatively associated with students’ satisfaction and sense of belonging. Intrinsic motivations and internal extrinsic motivations tend to be positively related to students’ satisfaction and sense of belonging”. We used the findings of their phenomenal study to assess how students’ motivations for selecting ConE affects their satisfaction and sense of belonging to the program.

Data related to students’ perception of ConE were analyzed using common descriptive statistical analysis. A total of 95 questionnaire surveys were completed. The respondents included 72 civil engineering and 23 construction engineering students, composed of 89 male and 6 female students, with about 85% of respondents being white. The respondents were 65% freshmen and 35% junior. The outcomes of this research will be presented in next section.

### **Research Method**

The results are presented in two separate sub-section. The first sub-section is focused on students’ motivations for selecting ConE major. The second sub-section presents results on students’ perception of ConE.

Table 2: Frequency and categorization of priority motivations for choosing ConE and CE majors

Factor	Motivation Type	ConE Students		CE Students	
		n	%	n	%
Interest in Subject Area	Intrinsic	16	76%	32	35%
Intellectual Curiosity	Intrinsic	0	0%	5	5%
Fulfilling Career	Internal Extrinsic	3	14%	22	24%
Grad School	Internal Extrinsic	0	0%	1	1%
Prestige	External Extrinsic	1	5%	5	5%
High Paying Job	Internal Extrinsic	1	5%	18	20%
International Opportunities	Internal Extrinsic	0	0%	3	3%
Time for Other Activities	Internal Extrinsic	0	0%	2	2%
Study Abroad	Internal Extrinsic	0	0%	1	1%
Parental Desire	External Extrinsic	0	0%	1	1%
Easy Requirements	External Extrinsic	0	0%	0	0%
Scholarship /Assistantship	External Extrinsic	0	0%	1	1%
Total		21	100%	91	100%

### *Motivations*

The students' priority motivations for selecting ConE and CE majors are summarized in Table 2. In general, both ConE and CE students have more intrinsic and internal extrinsic reasons for pursuing their major and less external extrinsic reasons. Clear majority of ConE students (76%) selected their major due to "interest in subject area". CE students had more diverse reasons for selecting their major. However, "interest in subject area" is still the most widely selected reason for CE students with 35% of students selecting it as their priority motivation to pursue CE. In general, as shown in Table 1, students have less intrinsic motivations to join CE compared to ConE, but they have more extrinsic reasons to do so.

### *Perceptions*

Analysis of the survey yielded the following important results regarding students' perception of ConE:

1. 53% of students (48% of ConE students and 56% of Civil Students) do not distinguish between civil and construction engineering.
2. In general, students do not think the construction is hostile to female or minority students.
3. About 16% of all male students and 0% of all female students think the construction is hostile to female.
4. Only 7% of white students think the construction is hostile to minorities. But 20% of minority students think ConE is hostile to them.
5. 8% of Civil students disagree or strongly disagree that ConE requires design skills. No ConE students disagree with this.
6. 4% of Civil students disagree that ConE requires math skills. No ConE students disagree with this.
7. 3% of Civil students disagree or strongly disagree that ConE requires critical thinking skill. No ConE students disagree with this.
8. 6% civil and 4% of ConE students disagree or strongly disagree that ConE requires strong people skill.
9. 4% civil and 4% of ConE students disagree or strongly disagree that ConE primarily work on the jobsite.
10. 22% civil and 9% of ConE students agree or strongly agree that ConE has easier requirements compared to other engineering majors.
11. 17% civil and 9% of ConE students agree or strongly agree that ConE is hostile to female.
12. About 6% of Civil students disagree or strongly disagree that ConE leads to high paying job. No ConE students disagree with this.

## Conclusions

This study was a preliminary step in assessing students' motivations for and perceptions of ConE programs. While further research with larger sample sizes are required to validate the findings of this research, the following important conclusions could be made based on the results of this study: Students select ConE mainly due to intrinsic and internal extrinsic motivations. This finding explains that more effort is needed to attract students to construction majors; however, after they join ConE programs they will be less at risk of changing major or leaving the college without getting a degree. This result is consistent with the findings of (Bringham Jr.et al., 2012). The main issue with recruiting students to ConE and CE programs is that majority of students cannot properly distinguish between the two majors. The fact that 16% of total students think ConE is hostile to female students, but no female ConE student shares the same view, implies that those female students who think construction is hostile to women, do not join ConE programs. Hence, changing the work environment and the perception of construction jobs is required to attract more female students to construction majors. On the other hand, minorities tend to believe ConE is hostile to them, yet, that does not prevent them to join ConE programs. A possible explanation for this observation, is that minorities may believe other majors are equally or more hostile to them. Finally, it was observed that students who select CE, when compared to those in ConE program, are more prone to have misperceptions about the requirements and skills required for ConE graduates. Informing these students about the actual requirements of ConE may increase the quota of students in CE programs who will transfer to ConE.

## References

- 1 Porter, S. R., & P. D. Umbach, “College major choice: An analysis of person–environment fit”, *Research in higher education*, 2006, 47(4), 429-449.
- 2 Abudayyeh, O., J. Russell, D. Johnston, and J. Rowings. “Construction engineering and management undergraduate education”, *Journal of construction engineering and management*, 2000, 126(3), 169-175
- 3 Burt, R., and A. K. Tinker, “Comparing Construction Managers and Civil Engineers Based on the Occupational Outlook Handbook”, 53rd ASC Annual International Conference Proceedings, 2017, 163-169.
- 4 Musu-Gillette, L. E., A. Wigfield, J. R. Harring, and J. S Eccles, “Trajectories of change in students’ self-concepts of ability and values in math and college major choice”, *Educational Research and Evaluation*, 2015, 21(4), 343-370.
- 5 Kim, A. Y., G. M. Sinatra, and V. Seyranian, “Developing a STEM Identity Among Young Women: A Social Identity Perspective”, *Review of Educational Research*, 2018, 88(4), 589–625.
- 6 Menches, C. L., and D. M. Abraham, “Women in construction—tapping the untapped resource to meet future demands”, *Journal of construction engineering and management*, 2007, 133(9), 701-707.
- 7 Bottia, M. C., R. A. Mickelson, J. Giersch, E. Stearns, and S. Moller, “The role of high school racial composition and opportunities to learn in students' STEM college participation”, *Journal of Research in Science Teaching*, 2018, 55(3), 446-476.
- 8 Perez, T., J. G. Cromley, and A. Kaplan, “The role of identity development, values, and costs in college STEM retention”, *Journal of educational psychology*, 2014, 106(1), 315.
- 9 Gaedicke, C., F. Shahbodaghlou, and D. Guiney, “Promoting Construction in K-12 STEM Education Through an Innovative University-based Summer Camp”, 52nd ASC Annual International Conference Proceedings, 2016.
- 10 Pisarik, C., and T. Whelchel, “Academic Relevance: College Students' Perspective”, *International Journal of Teaching and Learning in Higher Education*, 2018, 30(1), 26-35.

## Mostafa Batouli, PhD, MPA

Mostafa Batouli is an Assistant Professor of Construction Engineering at the department of Civil and Environmental Engineering at The Citadel. Dr. Batouli received his PhD in Civil and Environmental Engineering from Florida International University. He also holds Master of Public Administration and Graduate Certificate in Homeland Security and Emergency Management from FIU, Master of Science in Civil Engineering/Construction Engineering and Management from IAU, and Bachelor of Science in Civil Engineering/Surveying from University of Tehran. Dr. Batouli’s research interests include system-of-systems analysis of sustainability and resilience in civil infrastructure, as well as broad area of engineering education.

## Rebekah D. Burke, Ph.D., P.E.

Dr. Burke is an Assistant Professor of Construction Engineering at The Citadel. Dr. Burke received her Doctoral degree from Arizona State University. She was previously the Director of Sustainable Design for Clark Nexsen, Architecture & Engineering, where she also began her career as a structural engineer. She was a founding board member, and the first chair elect of the Hampton Roads Green Building Council.

## Jeffery M. Plumblee, PhD, MBA, PMP

Dr. Jeffery Plumblee is an Assistant Professor in the Department of Engineering Leadership and Program Management at The Citadel. Plumblee’s research interests focus on building a more

resilient society. Plumblee has a passion for providing opportunities for students to work within and develop projects for resource constrained settings (primarily humanitarian technology and delivery), and he enjoys understanding how these activities uniquely develop students.

**William J. Davis, Ph.D., P.E.**

William J. Davis is a Professor of Civil & Environmental Engineering at The Citadel in Charleston, SC. His academic experience is focused on transportation infrastructure planning and design, infrastructure resilience, traffic operations, highway safety, and geographic information systems. His research interests include constructing spatial databases for better management of transportation infrastructure, improving transportation design, operation, safety and construction, understanding long-term effects of urban development patterns, and advancing active living within the built environment. He teaches courses in interchange design, engineering management, transportation engineering, highway design, geographic information systems, and land surveying. He has served in numerous leadership positions in TRB, ASCE and ITE.