ASEE AMERICAN SOCIETY FOR ENGINEERING EDUCATION

Paper ID #36064

Examining the Relations between Moral Intuitions and Values among First-Year Engineering Students: Implications for Culturally Responsive Ethics Education

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Work-in-Progress - Examining the Relations between Moral Intuitions and Values among First-Year Engineering Students: Implications for Culturally Responsive Ethics Education

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Introduction

Historically, engineering ethics has tended to be "normative", simply telling people how they should think about or behave in engineering. Recently, engineering education researchers have begun conducting empirical work, examining how people actually think about and behaving in engineering, and what can be done to foster more ethical outcomes. Recent work in moral and cultural psychology has called into question the extent to which ethical judgments are based primarily on ethical reasoning[1,2]. Engineering educators feel concerned about the discrepancy between the gap between students' ethics learning (mainly focusing on ethical reasoning) in engineering programs and their actual ethical commitments and actions[3]. And although the relation between ethical reasoning and behaviors exists, this relation is only a weak one and its nature remains unclear[4,5]. Ethical judgments are also the result of intuitions, emotions, and held values[1]. The authors argue, thusly, that more empirical research is needed using this perspective, especially when exploring first-year students' ethical intuitions. Better understanding of how engineering students conceive ethics allows educators to tailor first-year engineering curricula, ensuring ethical behaviors specific to engineering and meaningful impact on ethical engineering practice and sensitivity to an increasingly globalized work environment.

This work-in-progress research study takes a quantitative and qualitative approach to examine the relationship between moral intuitions, measured using the Moral Foundations Questionnaire (MFQ), and student-held values about what is important in the engineering profession. Specifically, 287 first-year engineering students were surveyed at a public university in the northeast United States as part of a cross-institutional, international, National Science Foundation (NSF) funded research initiative to create more culturally responsive ethics education. Descriptive and correlational analyses are employed to examine meaningful connections between moral intuitions and values, with the goal of discerning the effects of culture, norms, and education on ethics.

Methods

Participants

Participants were undergraduate engineering students enrolled in the course *ENGR 0011: Intro to Engineering Analysis,* at the University of Pittsburgh - a US, public, educational institution

founded in 1787 and located in Pittsburgh, PA. Students were surveyed during the Fall 2021 semester, with the students attended the class in-person and also completed the survey in-person. While topics such as professional and academic integrity are taught, engineering ethics (including ethical theories, decision-making strategies, etc.) are not a focus. A brief description of the course is as follows:

"This course will provide an introduction to Excel and an introduction to design and entrepreneurship. In addition, we will address teamwork and professional integrity, both important aspects of engineering. This is a team-based, hands-on course, in which most of our class time will be spent working in teams to solve problems and participate in discussions, using what we learn in the course."

Out of the 659 students in the first-year engineering program, 287 students fully completed the survey and were included as study participants. Background characteristics such as age, gender, and political leaning were also gathered – 78% were 18 years old, 65% identified as 'male', and 55% characterized themselves as at least somewhat politically liberal (with 30% characterizing themselves as neither liberal or conservative). The portion of the survey of interest for this study was administered for extra credit and the research was deemed exempt from IRB approval (STUDY21080170).

Instrumentation

The **Moral Foundations Questionnaire (MFQ)** is associated with Moral Foundations Theory and presents participants with two sets of statements. For the first set of statements, participants decide how important each would be when deciding whether something is right or wrong, the relevance subscale. For the second set of statements, participants indicate their levels of agreement, the judgement subscale[6]. Each statement corresponds to one of five different "moral foundations" – ways of conceiving matters of right and wrong, concerned with different kinds of behaviors and contents (see Table 1).

Table 1. MFQ Moral Foundations

Care-Harm	Authority-Subversion
Fairness-Cheating	Sanctity - Denigration
Loyalty-Betrayal	

Care and fairness are called the "individuating" foundations, since they are associated with virtues aimed at protecting individuals, whereas loyalty, authority, and sanctity are called the "binding" foundations, since they are associated with virtues aimed at binding individuals into and, therefore, protecting groups[2]. Higher mean scores on items corresponding to each of the foundations indicate the relative preference given to these foundations and their associated intuitions.

The **open-ended question** of interest for this study asked students to list three values they think are the most important for defining a good engineer. The students were not provided a framework or a common set of terminology for "values". The purpose of the question is to explore first-year

students' initial perspectives of values and how it relates to their moral intuitions prior to any formal college-level ethics education.

Data and Analytic Plan

The data from this study will be in two formats: quantitative data on the subscales and foundation scores of the MFQ and text-data corresponding to the open-ended question "list three values you think are the most important for defining a good engineer".

Descriptive Analysis

Figure 1 summarizes the MFQ subscales and foundation scores for all of the student participants.

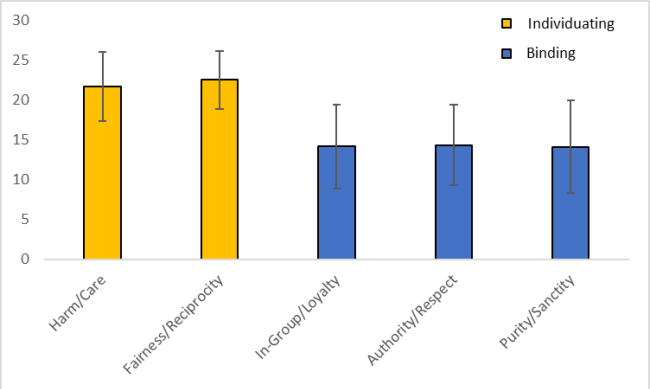

Figure 1. MFQ Subscale and Foundation Averages (error bars represent standard deviation)

These results demonstrate higher average scores in the harm/care and fairness/reciprocity subscales, which make up the individuating foundation (M = 22.11, SD = 4.03) as compared to the other subscales, which make up the binding foundation (M = 14.21, SD = 5.40). When comparing these scores against a cohort of Chinese engineering students at a US-Chinese educational institute in Shanghai[7], US students scored higher on average in the harm/care and fairness/responsibility subscales (the individuating foundation), and scored lower on the other subscales (the binding foundation). This suggests first-year engineering students prefer virtues aimed at protecting individuals whereas Chinese students prefer virtues at protecting groups. Research supports this conclusion, with conservative political leaning and those from Eastern cultures tending to care about all the foundations, whereas liberal political leaning and those from Western cultures prioritizing the individuating foundations[6,8,9,10,11].

Correlations between MFQ variables were calculated (Table 2) and as expected, variables associated with the individuating foundations (harm and fairness) and binding foundations (loyalty, authority, and sanctity) were highly correlated, more-so in the binding foundations.

Table 2. Correlation matrix of MFQ variables

	Harm/Care	Fairness/Reciprocity	In-Group/Loyalty	Authority/Respect
Fairness/Reciprocity	0.54			
In-Group/Loyalty	0.11	0.03		
Authority/Respect	0.04	-0.03	0.70	
Purity/Sanctity	0.24	0.07	0.60	0.61

When comparing these correlations with a similar engineering student population in China[7], a few interesting differences emerge. Chinese engineering students displayed much higher correlations between harm and sanctity, and fairness and loyalty (0.43 and 0.41, respectively). The average correlations between the binding foundations for this US sample is generally higher (0.64) than what was found in Chinese engineering students (0.56). Finally, the correlation between fairness and the binding foundations is almost non-existent for US engineering students, while it is quite positive for Chinese engineering students (0.41,0.23, and 0.32, respectively for the binding foundations). These results support previous research that suggests those from Eastern cultures care about all of the moral foundations (with a preference for protecting groups), where those from Western cultures prioritize the individuating foundations, with very little relation to the binding foundation.

When looking through the responses to the question "List three values you think are the most important for defining a good engineer", some interesting trends emerge. The three most common values are **honesty**, **integrity**, and **responsibility** (see Figure 2).

Figure 2. Word Cloud of Responses

Some preliminary results from asking the same question to Chinese engineering students yielded similar results, with **honesty**, **professional**, and **creativity** being the words used most. Further research needs to be conducted across a larger pool of Chinese students to see if these findings remain.

Summary and Next Steps

This work-in-progress offers some initial empirical results on the understanding of how engineering students conceive ethics through the lens of moral foundation theory. Descriptive analyses were carried out and comparisons to a commensurate Chinese engineering student sample and previous work was made. The next steps of this study include a more thorough analysis of the US student sample as well as formulating a plan to connect moral intuitions with student-held values (correlational analysis). Future work will also expand the sample of students to two US institutions, one European institution, and three Chinese institutions to further generalize and build on the research in cross-cultural settings.

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