

Investigating Influences on First-year Engineering Students' Views of Ethics and Social Responsibility

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Abstract

According to current ABET accreditation requirements, engineering students need to become aware of the social contexts of engineering and develop ethical and professional responsibilities during their undergraduate training. Concerns also persist about the moral and ethical commitments of engineers once they enter the workplace, as underscored by a number of recent ethics scandals involving engineers and technology. The education of ethically adept engineers therefore remains a pertinent issue for the engineering education community. Yet there remains relatively little research on how students' prior experiences shape their ethical perspectives. Specifically, there is a lack of understanding of the role of pre-college and early college experiences and other influences in shaping first-year engineering students' views on ethics.

This paper reports select results from an NSF-funded project aiming to address some of these gaps in the literature. This longitudinal study was conducted across four universities and focused on the ethical development of undergraduate engineering students. Preliminary analysis of interviews from the first phase of this study identified a number of major themes in the data set, two of which are important to highlight here: 1) influences on students' ethical perspectives (e.g., academic curricular, extracurricular activities, family, etc.) and 2) learned outcomes, defined as insights, learning, or realizations related to ethics, morality, and values. Deeper investigation of the relationship between specific influences and students' insights related to ethics can provide a better understanding of first-year engineering students' baseline ethical development.

The goal of this paper is to characterize what specific ethical lessons are gained through various types of experiences, as well as to glean how this learning and growth occurs. Data for this study was drawn from 66 interview transcripts and consisted of sections coded simultaneously for influences and learned outcomes. The cross-coded data were analyzed using a thematic analysis approach. The types of influences impacting students' ethical learning, and exemplars of how students report their lived experiences and ethical realizations, are discussed through the lens of what they learned and the mechanisms through which they gained these understandings.

Our analysis suggests that several pre-college (e.g., extracurricular activities, service/volunteer roles and social experiences) and early college experiences (e.g., academic courses, part-time employment) play a critical role in shaping students' ethical perspectives. We more specifically present our findings organized around eight types of experiences and influences, which are in turn related to three categories of learned outcomes and three types of learning mechanisms. As we discuss in more detail below, the results of this study will likely be of interest to engineering educators, policymakers, and researchers with an interest in administering and studying high-impact ethics interventions for undergraduate engineering students. More specifically, our results underscore the importance of being more aware of how students' background perspectives and experiences likely play important roles in enabling or disabling their further ethical development.

Introduction

In recent decades, interest in engineers' professional ethics has grown in the United States [1,2], ABET accreditation criteria further mandate the importance of engineering ethics education, namely by requiring that engineering graduates "understand the impact of engineering technology solutions in global ... and societal context" and have an "understanding of professional and ethical responsibility" [3]. To better understand and enhance engineering students' exposure to and engagement with ethics, researchers have studied various content and pedagogies appropriate for college-level engineering ethics instruction [4].

However, there are few studies which analyze how the ethical perspectives of engineering students change over time. Also, little is known about students' ethical development before college and in relation to their early university experiences. A lack of baseline knowledge of students' diverse understandings of ethics can cause difficulties in developing content for academic experiences and identifying opportunities for ethical development within and beyond core coursework.

This paper reports select results from an NSF-funded project aiming to address some of these gaps in the literature. This larger research effort is driven by two main research questions:

- 1) What do engineering students perceive as responsible (and irresponsible) professional conduct, and what do they perceive as just (and unjust) professional work practices?
- 2) How do foundational measures and understandings of social and ethical responsibility change during a four-year engineering degree program, both in general and in relation to specific learning environments and experiences?

To address these questions, we are conducting a longitudinal mixed-methods study which includes both qualitative and quantitative analysis of data from undergraduate engineering students at four different universities. The project is organized around three main phases of data collection and analysis. During the first phase of the project (2015-16), researchers collected survey responses from engineering students (n=757) during their first year at university. This data was then used to recruit a targeted sample of survey respondents for interviews (n=112).

Jesiek, Zoltowski, Fuentes, Claussen, and Warnick [5] coded a subset of this same interview data (n=66) using an integrated inductive-deductive thematic analysis approach and developed a coding framework organized around three overarching categories: 1) influences on students' ethical perspectives; 2) learned outcomes, defined as insights, learning, or realizations related to ethics, morality, and values, and; 3) perspectives related to other specific themes and survey measures (e.g., definitions of ethical character, moral disengagement, ethical climate). The first and second of these three categories are the main focus of this paper. We more specifically present our findings organized around eight types of experiences and influences, which are in turn related to three categories of learned outcomes and three types of learning mechanisms. Before turning to a more detailed discussion of our study methods and results, we turn to a review of some related literature.

Background and Literature Review

To support ongoing efforts to understand and enhance engineering ethics education, there remains a critical need to better understand how students understand ethics, morality, and social responsibility when they enter college, including how their previous experiences may have shaped their views. With this knowledge, instruction can be designed and sequenced in a way to facilitate a deeper understanding of their obligations as engineers. While several studies have provided glimpses of student perspectives on ethics when they begin college, few have worked to connect students' pre-college experiences to their developing ethical reasoning skills.

However, some recent research has shown connections between students' co-curricular college experiences and the civic commitments they make [6]. This work is consistent with a more general body of work showing that multiple sources of influence can affect individuals' ethical beliefs [7,8]. Various instruments have also been developed and used to assess engineering students' moral reasoning such as the Defining Issues Test-2 [9], Engineering and Science Issues Test [10], and Reflective Judgment Model [11]. However, assessment using these instruments has traditionally occurred after students start college and thus do not provide information about their levels of ethical development in relation to previous experiences [12]. Other studies have examined how volunteering, community service, participation in student government, study abroad, and/or family have influenced students' decisions to continue in engineering [13],[14]. But again, these studies did not examine how those influences specifically shaped engineering students' ethical reasoning.

Work outside the field of engineering has also shed light on students' understanding of ethics and social responsibility. Perry's four-year longitudinal study of undergraduates noted a general progression from viewing the world in "unqualified polar terms of absolute right-wrong, good-bad" to "personal commitments in a world of contingent knowledge and relative values" [15] p.3). The work of Clarkeburn, Downie, Gray, and Matthew [16] corroborates what Perry found in his original study, namely that many students start college with some understanding of relativism but are somewhat distressed by it. They more specifically noted that first-year college students accepted "multiplicity and relativism in the application of values, though sometimes reluctantly" [16, p.446]. These researchers additionally propose that intellectual development and ethical development evolve in tandem as students progress from "a simplistic stance on the nature of knowledge as ... absolute to one which is more pluralistic and contextual" [16, p. 443]. Students similarly progress in their understanding of "basic conceptions of morality; what are the sources of moral answers, whether there are absolute moral answers, and how one is to commit oneself to different moral values" [16, p. 443]. Consequently, there is some general understanding that many undergraduates come to college with a simple, polarized view of the world, but little research has looked at how further ethical development may be enhanced (or impeded) by specific kinds of experiences. Studies have also looked at general effects of college experiences – ranging from institution type to particular extracurricular participation – on student moral development [17], but these have reported mixed effects.

Within engineering more specifically, Cech's pioneering research [18] suggests that many undergraduate engineering programs are often characterized by a "culture of disengagement," with engineering students becoming less oriented toward social and professional responsibilities as they progress toward graduation. Still other recent efforts suggest growing awareness for how

engineering students' pre-college experiences may impact their further ethical development. The Student Engineering Ethical Development (SEED) survey, for instance, was developed to "explore connections between the ethics education experiences of engineering undergraduates and their ethical development" [19, 20]. Finelli et al. [21] noted that research supports the idea that curricular and co-curricular activities affect students' ethical development in college. Most of their work focused on curricular and co-curricular experiences related to ethics education while in college, but their survey also asked students to report their participation in service activities during high school, as well as instances of positive and negative ethical behavior in high school. However, the survey did not ask about curricular or co-curricular activities beyond service in high school.

Earlier work from our own NSF-sponsored study [5] discussed here additionally showed that first-year engineering students had difficulty distinguishing between morality and ethics, though they did have some understanding of general rules and specific norms and traits, as well as an orientation toward other people (labeled "other-oriented"). Jesiek et al. further observe that some students described how pre-college experiences led them to develop "empathy, responsibility, good work habits, and honesty" [5, p. 19]. Empathy, particularly as it relates to perspective-taking, has been proposed as a core component of ethical professional behavior for engineers [22]. As these authors argue, perspective-taking is relevant to engineering students because they need to account for the multiple views and needs of the various stake-holders for engineering decision making [22].

Though the earlier work cited here provides some important foundational insights, there is still a need to better connect students' specific experiences during their pre-college and early college years to their ethical commitments and development throughout their undergraduate careers. This study aims to provide some new insights about how a variety of such experiences influenced engineering students' perspectives and understandings of ethics and social responsibility.

Methods

Project Background

As noted above, the first phase of data collection for the larger research project described herein involved conducting interviews with undergraduate engineering students (n=112). As we report in more detail elsewhere [5], efforts were made to stratify the sample such that the interviewee group had a composition that did not deviate too much from the broader survey population (e.g., in terms of demographic variables, school affiliation, engineering majors, etc.). But we also performed some targeted recruitment focused on other attributes and characteristics, e.g., participation in academic programs known for more or less formal coverage of engineering ethics, low or high scores on survey measures related to ethics and social responsibility, etc.

The researchers used a semi-structured interview protocol focused on four main areas: "(a) general definitions (including macro-ethics), (b) experiences that influence ethical perceptions past, present, and future (including justice), (c) ethical climate at the students' undergraduate institution, and (d) elaboration on the ethical scenarios and associated responses included in the survey" [5]. These interviews were conducted face-to-face by researchers at each participating

institution, transcribed by a third-party service, checked for accuracy by a member of the research team, and finally edited to remove all identifying information. This paper reports more specifically on a smaller subset (n=66) of the same first phase interviews. While these interviews were chosen at random, in previous work [5] we reported evidence showing that the first 29 of these same 66 subjects were roughly representative of the larger study population. We strongly suspect that all 66 interviews analyzed here follow this same trend.

Jesiek et al. [5] coded the interview data using an integrated inductive-deductive thematic analysis approach and developed a coding framework organized around three overarching categories: 1) influences on students' ethical perspectives; 2) learned outcomes, defined as insights, learning, or realizations related to ethics, morality, and values and; 3) perspectives related to other specific themes and survey measures (e.g., definitions of ethical character, moral disengagement, ethical climate). The first and second of these three categories are investigated further in this paper. During the semi-structured interviews, students had many opportunities to self-identify experiences and influences that shaped their perceptions of ethics, morality, and related concepts. These were coded by type of influence as summarized in Table 1. It is also worth noting that it was possible for some influences to be double-coded, e.g., a service learning experience would by definition be classified as both Academic and Service/Volunteer.

Table 1
Influences that shaped perceptions of ethics and morality as coded in interviews

Influence Code	Description
Academic	Formal, school-related learning experiences
Extracurricular	Voluntary involved in a formal organization or club, or active involvement in a hobby or other special interest
Family	Any reference to family members in conjunction with any question prompt or activity
International	Any experience abroad or domestic experience involving international students/contacts
Professional/work	Paid work or formal involvement in a professional setting, including jobs, internships, research, etc.
Religion	Any reference to religious affiliation, program, church organization or sponsorship
Service/Volunteer	Any volunteer or service-oriented activity non-paid*
Social/Friends	Informal, non-family social interactions

The study reported in this paper investigates how various experiences students have before they enter college and in the early years of college impact their understandings and perceptions of ethics and social responsibility. In this paper, further qualitative analysis at the intersection of specific types of influences (Table 1) and explicit evidence of student learning provides a more

nuanced view of ethical perceptions and development among first-year engineering students. In this study, we delve into each influence to report on similarities and differences in what students learned, as well as the specific mechanisms through which their ethical perceptions were shaped. The main research questions for this paper are:

- RQ1) What specific learned outcomes (i.e. insights/values) related to ethics and morality do engineering students learn from different types of experiences before and during their first year of college?
- RQ2) Through what mechanisms did engineering students gain these specific learned outcomes?

Qualitative Analysis Methodology

To answer the research questions for this study (RQ1 and RQ2), we focused on analyzing the interview transcript data cross-coded (i.e., co-occurring) under influences (Table 1) and learned outcomes. To further analyze this data, the transcripts were grouped by influence and distributed among five members of the research group from two of the participating institutions. We used a qualitative inductive thematic analysis approach to code the data in two phases. During the first phase, each of the five research members worked individually to analyze their assigned parts of the transcripts (representing one or more influence codes) inductively to develop new sets of codes specific to their data. The research team then met several times to discuss the preliminary findings across the group and discussed directions for developing consistent themes across the entire selection of transcripts. During these meetings, it was also decided that the group would consistently share and review each other's work to enhance the trustworthiness of the coding work and ensure alignment of our individual analysis process. The research group once again dispersed to work on developing themes for their assigned influence codes based on the earlier group discussions. After the researchers had iteratively identified themes and drafted findings for their assigned influences, the team once again met to review each other's work. In the second phase of the analysis, group meetings were used to discuss the common themes and threads identified within and across the transcripts, identify differences across the influences, and ensure consistency of language and interpretation across the themes and descriptions. Findings from phase two of the analysis are presented in the next section, which offers an initial mapping of what students' learned related to ethics and morality, as well as associated learning mechanisms.

Findings

An overview of identified outcomes (i.e., what students learned related to ethics and morality) and mechanisms through which they gained a particular insight or value are presented below for each influence. We then highlight cross-cutting themes across all the influence codes with an emphasis on prevalent learned outcomes and the primary mechanisms through which students gained certain kinds of insights and values.

Summary of Learned Outcomes and Mechanisms

Overarching themes across the influences are shown in Table 2. The first part of the table includes the types of learned outcomes that students associated with the various influences and related experiences. We grouped the learned outcomes into three main subcategories: learned traits, the importance of other-oriented traits/behaviors, and ethical decision-making. Learned traits included the importance of honesty and integrity, practicing good work habits, being responsible to and accountable for oneself, and other norms/traits such as selflessness, lessons (e.g., do a good turn daily), and navigating moral/ethical situations by staying true to one's "conscience." Importance of other-oriented traits was the second major learned outcome that students often talked about in reference to their influences and related experiences. Other-oriented traits include sub-themes such as considering others' perspectives, compassion, empathy, influence on society, communication, teamwork, and treatment of others. Third and finally, participants also mentioned factors related to making ethical decisions, such as evaluating and prioritizing multiple goals in a given situation, and recognizing that long-term benefits may outweigh immediate inconveniences. They also described the emotional impact of ethical decisions on themselves and others and how emotions influenced their action or behavior.

The second part of the table outlines mechanisms through which students gained their ethical insights. We grouped these mechanisms into three main categories: active social learning, observational social learning, and cultural elements. The first category, active social learning, relates to all learning that occurred through active involvement in a situation. These situations included first-hand experiences that stem from participating in specific tasks or activities and academic/non-academic classroom experiences. The second category, observational social learning, included outcomes learned from an observed experience that broadened students' perspectives and opened their eyes to new realities. Experiences included learning directly and indirectly from observing others' actions and through peer discussions as well as exposure to situations that encouraged students to reflect on ethical considerations in a particular context.

The third prominent learning mechanism included cultural elements. Students often talked about learning values within particular environments and through cultural groups, including core values of organizations and personal values. Core values of an organization included both implicit (e.g., emphasis on "doing the right thing") and explicit (e.g., formal talk or presentation about ethical responsibility, Scout Oath/Law, Reserve Officers' Training Corps (ROTC) value of putting common good of others, team mission above oneself, etc.) features. For some students, participation in that group or organization carried with it the expectation of attending to group ethical and moral norms. Others described an innate shift in their moral or ethical perspectives as they came under the influence of organizations with a particular moral or ethical orientation. Students also referenced personal values that drove interest in participating in a particular activity, or participation in an activity developed and affirmed a previously held ethical or moral value. Others described how aspects of environment or culture in their upbringing impacted their ethical and moral learning.

The sections that follow offer more in-depth insights about the findings, organized by type of influence and with an emphasis on the associated content and mechanisms of ethics learning.

Table 2

Summary of learned outcomes and mechanisms across influence themes

	Academic	Professional Work	Service/Volunteer	Extracurricular	International	Family	Social/Friends	Religion
Learned outcomes (What students learned)								
Learned Traits	Honesty/ Integrity	X	X	X	X	X	X	X
	Hard work	X	X	X		X	X	
	Responsibility	X	X	X	X	X		
	Other norms/traits		X		X	X		
Importance of other-oriented traits/behaviors	Considering others' perspectives	X		X	X			X
	Influence on society	X	X	X	X	X		
	Compassion			X	X	X		X
	Empathy	X		X	X	X		X
	Teamwork	X	X		X			
	Communication	X	X		X			
	Treatment of others	X		X	X		X	X
Ethical decision-making	Consider unintended consequences	X		X	X	X		
	Positive benefits and/or delayed gratification			X	X			
	Connection between emotions and ethical decision-making			X	X		X	
	Handling multiple goals	X			X			
Mechanisms (How students learned)								

Active social learning	Personal experiences	X	X	X	X	X	X	X	X
	Courses (lessons)	X		X					X
Observational social learning	Learning from others	X	X			X	X	X	X
	Observing ethical situations	X	X	X	X	X	X	X	X
Cultural Elements		X	X		X	X	X		X

Academic

Examples of lessons learned from academic sources ran the gamut from emphasizing specific actions and imperatives to concentrating on more abstract virtues and ideals. The list of such lessons included many concrete ideals: honesty, not cheating or plagiarizing; proper citation and crediting of ideas; the need for confidentiality; the possible existence (and need to eliminate) sexual harassment in the workplace; and accident avoidance. More general ideals that revolved around other people included: considering others' perspectives; the importance of applying empathy in understanding; the potential in each human being for good and evil; the necessity of holding paramount the health, safety, and welfare of the public; and recognizing responsibilities to employer(s), coworkers, communities, and society writ large. Regarding ethical-decision-making, participants mentioned the importance of sustainability in decision-making; considering the prospect of unintended consequences; properly weighting cost and benefit analyses; making a commitment to principles and beliefs; having an understanding of specific ethical theories; the potential role that culture can play in shaping ethical norms; and the role of codes of ethics in the engineering profession.

As listed above, there was a litany of lessons that students learned from experiences and influences coded as academic. The lessons broadly fall into learned behaviors, virtues, and ethical decision-making, as summarized in Table 2. Some of the more frequently referenced lessons were related to academic integrity (e.g., plagiarism, citations, and cheating) and were not necessarily specific to engineering per se, such as the following remark: "a lot of teachers at my high school kind of harped on the idea of ethical work and not using others' work as your own." Additionally, there were no consistent patterns between what a student learned in relation to *where* (e.g., group setting, class setting, specific class) and *how* the student learned that lesson. For example, some students learned about the imperative not to cheat from watching their friends receive punishment for cheating, while others reported learning this same imperative from lectures from a professor in class.

Professional/Work

Prior professional/work experiences seem to have strong and multifaceted influences on the ethical perspectives of students. Most students who reported having any prior professional work experience referred how the experience(s) influenced learned values and traits such as honesty,

hard work, and compassion. Owing to the social nature of work, subjects often talked about how work experiences helped them learn to be a good “team player.” Some of the subjects even referred to how the work experiences inculcated a greater sense of responsibility in them. That is, participating in professional or other work activities by default puts them in positions of responsibility, which in turn teaches them to be more ethical, and specifically to be honest, responsible, and ready to own up to one’s mistakes. Aside from just participating in the work activity, some of the subjects also talked about the role of work culture and the environment in shaping their ethical and moral learning. For instance, some subjects were vocal about crediting their learning to observing their co-workers or supervisors demonstrating compassion or other admirable traits. In other cases, some also explicitly referred to aspects of a company’s culture as having a great influence on their ethical and moral learning.

Service/Volunteer

When reflecting on what they learned from serving or volunteering, many students noted that they learned to take the perspectives of others, with three of them independently noting that this kind of work was “eye-opening” for them. They often observed that their time volunteering allowed them to view people and the world around them differently than they had before. A student noted that his experience serving others helped him to realize that “I really have to understand people and not just force my own ideas or opinions on them, but to look from their perspective and try and understand why they think and do the things the way they do.” Taking another person’s perspective also helped students to become more aware of their own biases, the need to set those biases aside, and the importance of understanding others’ values. Serving others awakened a sense of responsibility toward others, with a few students discussing how they can use their education to make people’s lives better. Volunteer work also helped students see the good in the world around them and others. Additionally, volunteering made students more aware of the need to treat others with compassion. Students most frequently stated that their actual participation in some kind of volunteer or service work was how they learned these outcomes. Fewer students mentioned that they learned by just observing others, and only two students mentioned related formal coursework as the means for them to attain these learning outcomes.

Extracurricular

Through active participation in extracurricular activities, students identified ethical connections in both formal and informal leadership experiences in Boy and Girl Scouts, team sports, student government, and other organization, club, and related activities. Students acknowledged the importance of responsibility associated with leadership, including maintaining open communication in a team/group, “being a team player,” upholding high standards for personal conduct, and addressing unethical behavior (e.g., cheating, poor work ethic, dishonesty). Those with multiple years of experience in an organization noted how responsibilities might expand over time, starting with learning as a participant, then to teaching and sharing information, and then to being an example and taking responsibility for others. Students described the importance of personal, professional, group, and “big picture” goals to encourage ethical behavior, and also noted how involvement in activities/organizations with a common purpose could be an opportunity for like-minded others with similar values to work and grow together. Standards and lessons were learned and/or reinforced in organization and competition rules, expectations, and

values, such as the Boy Scout Oath/Law, slogans like “do a good turn daily,” and ideas such as “[putting] the common good above ourselves.”

Abiding by organizational cultural norms, many students also reported stepping out of their comfort zone and gaining a broader view of their world beyond their “bubble” of friends/family, normal day-to-day experiences, and personal needs or desires. Many students additionally identified an increased knowledge of local, national, or global issues; varied perspectives individuals hold; and the interconnectedness of individual and group efforts and societal problems. In light of increased self and other-awareness, extracurricular experiences provided opportunities to evaluate ethical implications (e.g., positive and negative consequences, unforeseen side effects, scope and level of impact) of their actions, shared knowledge, decision-making, or project designs, both on others as well as themselves. Some students further distinguished that power and influence do not only lie in what is said and how it is said, but also in a person’s behaviors and “simple acts.” Students’ recognition that there can be more than one “right” answer or multiple paths to a common goal encouraged behaviors such as seeking out and incorporating diverse perspectives in decisions and withholding judgment and personal biases – potentially leading to improved solutions. One student additionally recounted how playing single player video games (and especially those shaped by a player’s moral and ethical choices) allowed him to “cool off” and evaluate his actions. He could then reflect on how others in society may perceive his actions and consider how to stay true to one’s conscience and what was “right” even if it means not “winning” this time around.

International

Some interviewees became aware of cultural differences in other countries and explained how these learning experiences shaped their ethical perspectives. For example, a student mentioned she learned “morals are, in many cases, societal” when she was living in another country. Also, some students referred to varying levels of resources in different countries. For instance, one student who visited a low-resource environment said they could “appreciate more of what is given to us and what we have,” as well as to the importance of using “stuff from more sustainable and better-paid work environments” given that many products were made using “really cheap labor” which provides less for the workers than they deserve. Similarly, being in developing countries provided students with opportunities to interact with a wide range of different people in different situations, including people from disadvantaged backgrounds. Two respondents mentioned that as a result of those experiences, she realized that “not everybody has that capability and possibility” and made her move toward “empathizing with others.”

Outcomes of international experiences also include identifying ethical standards to follow. Observing bad examples such as government corruption and the consequences of that corruption, as well as individual’s decisions (e.g., evading taxes) provided the students with specific behaviors to reflect on and potentially avoid. Also, as a unique point of international influence observed in our dataset, a student reported that she gained an appreciation for environmental sustainability while participating in a study abroad program. Students also learned they could use their knowledge to help others throughout their international experiences, especially through activities such as participating in Engineering Without Borders and creating a tutorial video about how to filter water and distribute it for developing countries. The most prominent learning

mechanisms of international experiences were active participation in related activities (e.g., Engineers Without Borders, creating a tutorial video) and observation (e.g., seeing many things).

Family

Regarding family influences, students often reflected on the various values and traits they had learned from their parents. For instance, many students talked about being “taught to be honest.” Along similar lines, others talked about their parents teaching them “to be independent” or to “work hard,” among other traits. While students were quick to credit the role of their parents in teaching them what they perceived as “good habits” or values/traits, most of them often failed to characterize how they learned to be ethical or moral. However, there were a few subjects who talked about the role of family members as exemplifying ethical and moral character and how that translated into their own ethical and moral learning. Such learning was often characterized by observation, reinforcement, and cultural influence. The environment and culture in which the students’ upbringing takes place also seem for many to have an impact on their ethical and moral learning. For instance, students talked about the various aspects of their environment such as parents’ upbringing style, parents’ religious inclinations, and parents’ marital status as key influencers in shaping their ethical perspectives. Some students also talked about ethical and moral learned outcomes that have come from seeing a family member go through a negative experience. While one student talked about seeing betrayals in family business shaping his ethical perspective, another talked about her uncle facing discrimination for being gay, and still another student talked about how his dad struggled to stand up for his rights. In citing these particular stories, students often seem to learn how *not* to act or be.

Social/Friends

The most common outcome learned from friends or social situations was that cheating is wrong. Students often noted that the temptation to cheat with their friends was a decision they often faced, but generally stated that they chose not to cheat because it is wrong. One student mentioned how in high school, his friends wanted to copy off his homework. This situation helped him to realize “what was best for me was that I do my own work and that I be proud of it, and what was best for them was that they also have the opportunity to learn for themselves instead of just copying down the answer.” Another common theme was that making good choices, such as not cheating, may not pay off immediately. Students discussed times they had to do the right thing which alienated their friends, but most maintained that doing so was the correct decision even with such negative consequences. Students who learned from social/friend experiences most frequently reported that they learned by observing their friends’ choices and noting the consequences. Less frequently they reported learning from their own experiences.

Religion

Religious influences were also evident in our dataset, including mentions of ethical standards which students can reflect on when determining their behavior, considering the larger purpose of their life and actions, and referring to specific preferred norms/traits. Some interviewees referred to considering the purpose of God as a driving force of their life as a principle learned at church and that shaped their ethical perspectives. Others mentioned specific norms such as honesty and

integrity. Emphasizing other-oriented traits was something else that students experienced through religion. For instance, one interviewee said he learned about trying to do his best for other people – as opposed to thinking mainly or wholly about himself – by considering God’s love for others. In reflecting on the examples from the Bible, another student said religion helps one to see “the value of every person.” Another student additionally observed that “humans are basically good,” but that their environment influences their decisions. Similarly, another said that everyone is “trying to do what’s right” although he or she may not always do what is right. Those presumptions influenced the students’ point of view on moral behaviors by making them realize that they also could do what was good even though they were not perfect.

Another prevalent theme was students’ learning about thoughts and experiences that were different from their own. Some interviewees mentioned that they observed “different mentalities” (ways of thinking) among different people and the struggles of others (e.g., poverty) by participating in religious activities such as mission and charity events. Noticing those differences helped them to broaden their horizons and made them consider how to behave.

Additionally, the specific mechanisms of student learning related to religious experiences include lessons about standards to follow and an in-depth understanding of concepts related to specific norms (e.g., wisdom in scriptures): observation; practice; and influence of cultural/environmental elements. Students uniquely referred to practice in religion as an “ethically molding experience,” and also described how religious activities help them “remember” the lessons that they learned in the church.

Discussion and Conclusion

Overall, our findings align with a preliminary analysis of learned outcomes in a subset of these interviews outlined in Jesiek et al. [5] while highlighting both commonalities and nuances within and across influences, including how multiple factors and sources influence students’ perceptions of ethics. The findings from these student interviews illustrate several notable ideas.

First, there is the self-evident takeaway that students learn lessons related to ethics from nearly every facet of their lives. Our work supports the seemingly trivial yet important observation that multiple factors and sources influence students’ perceptions of ethics [7,8]. In a certain light, this is a hopeful observation because it suggests that inconsistency (or inadequacy) of engineering ethics in the typical undergraduate engineering curriculum [23] could be addressed through intentional linking of prior ethical experiences to engineering contexts. For example, with a few exceptions, most comments related to empathy for others or a changed perspective in engineering within extracurricular influences were realized in an engineering-focused extracurricular activity (e.g., Engineers Without Borders, Engineering Projects in Community Service) during students’ first year of college. However, students encountered other influences on their ability to empathize with others, such as through service/volunteer roles, international experiences, and religion. What students reported could be a result of the questions asked in the interview or a lack of connection between ethical insights learned outside of an engineering context and engineering related outcomes. Regardless, there is an opportunity to make more explicit connections to scenarios students may have faced prior to and during their first-year university experiences and how ethical learning translates to different contexts and experiences.

A second notable idea from the findings is the array of modalities by which students learned lessons about ethics. These mechanisms ranged from the active to the passive. This is a useful observation for researchers interested in better understanding how students specifically learn about ethics and morality, and for instructors who might creatively reimagine ethics education through the use of diverse pedagogical approaches. In fact, ethics instruction might be enhanced when multiple modalities are used (e.g., formal lessons coupled with real-world experiences).

Yet one caveat worth noting here is the degree to which students veritably learned any of these lessons. In the present work, when students reported in interviews that they learned something in a particular way (or from a particular source) it was taken at face value as accurate. The present analysis sidestepped the question of what it means for a student to learn any of these lessons if it was not accompanied by an instance of how they applied that lesson. For example, if a student said that they learned the importance of academic integrity from lectures in their engineering classes, then it was assumed that students truly learned that lesson. They did not necessarily have to provide an instance of when they avoided an academic integrity violation. Moreover, if that same student later committed an academic integrity violation, what would that say about whether the student learned about the importance of academic integrity? In short, readers should simply note that the themes noted herein are self-reported and may diverge from actual behaviors.

In summary, this paper highlights the varied ways in which students gain ethical understanding prior to and during their first year of college. Future work includes further analysis of all 112 interviews from the first phase of the broader NSF-funded project and to provide further insights into the relevance of current themes and findings. Additionally, analysis from these initial interviews will be compared with follow-up interviews to be conducted with as many of the original student subjects as possible during their final year of study. Analyzing these two sets of interviews could provide a holistic framework for understanding how students' prior experiences influence their ethical and moral development as they progress in their college education.

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