Examining the Characteristics and Traits of Young Engineers' Moral Exemplars

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I am the middle child of African American Darius Carter and Filipina Geraldine Goyena Carter. As a child I loved space and planets, as I grew older I enjoyed making spaceships and machines out of lego. After highschool I decided to go to San Francisco State University where I am a 4th year studying Mechanical Engineering. I have been working with Dr. Stephanie Claussen in the Engineering Ethics Lab for 1 year where I have been working on a research paper studying the moral exemplars of engineering students.

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Using Moral Exemplars to Explore Engineering Students' Ethical Understanding

Introduction and Background

Engineers have the potential to contribute great benefits to society or enact great harm through their work. This is evident in media reports of large-scale engineering failures (e.g. [1]), public debates about emerging technologies [2], and the commonplace ethical dilemmas that engineers might confront in everyday practice [3]. As a result, engineering students' and professional engineers' perceptions and understanding of the ethical implications of their work is of great importance.

In this paper, we use the moral exemplars identified by engineering students as a tool to explore their ethical perceptions over their years of undergraduate studies and the subsequent transition to professional practice or graduate school. Moral exemplars have been used previously both to measure ethical understanding (e.g. [4]) and to support ethical development (e.g. [5]), and has led to a number of research findings. Han et al. [5] found that, when someone can identify a moral exemplar who they see as relatable and attainable, they are, in turn, more motivated to act ethically themselves. In another work, Walker and Hennig found that people frequently have differing conceptions of moral exemplarity, which the researchers organize broadly into three divergent categories: exemplars who are just, brave, or caring [4]. From this body of work focused on moral exemplars, exemplarist virtue theory emerged, which proposes that moral education should be structured around the admiration of a specific person or individual [6].

Related work has explored moral personality, a term used "to broadly refer to individuals' characteristics related to morality" [7, p. 1], [8]. The field of psychology has frequently organized personal traits into five categories, termed the Big 5 Personality Traits: extraversion, conscientiousness, openness to experiences, neuroticism and agreeableness, as defined in [9]. These traits have been used to study moral exemplars in the past, including moral exemplars in engineering [10]. Of the Big 5 traits, conscientiousness, openness and agreeableness are most frequently associated with moral individuals [11], [12]. Conscientiousness is the trait that describes someone's impulse control and ability to regulate their desires. Agreeableness involves positive interactions with people. Finally, openness to ideas allows for an individual to seek out creative solutions to helping others and the inclusion of groups that are often overlooked.

This study uses longitudinal interviews with engineering students and early-career engineers at three timepoints over seven years to characterize the moral exemplars selected by participants and, in turn, to use these moral exemplars as a tool for assessing the ethical perceptions of the interviewees. This study is part of a series of ongoing longitudinal projects focused on

engineering students' and early-career professionals' views of engineering ethics and social responsibility [13], [14].

Methods

This study is part of a longitudinal research project that began in 2015. The initial phase of the project focused on understanding how undergraduate engineering students perceive ethics and social responsibility, and how those perceptions change over their years of undergraduate studies [13]. In a second phase of the project, we have continued to track the longitudinal participants after they graduated and started their professional careers or graduate studies [14]. The project has included four repeated surveys (implemented when the students were in their first year of undergraduate studies, their third year, their fourth year, and then a few years after graduation) and three semi-structured interviews (in their first and fourth year of college and a few years after graduation). These survey respondents were recruited through emails and class visits. As described more in [15], our interviewees were recruited from this larger sample of initial survey respondents. Our interview data set consisted of three longitudinal interviews conducted between 2015 and 2022 with engineering students and alumni from three American universities. Both the survey and interview participants were offered participation incentives in the form of a gift card. All surveys and interview protocols were approved by the participating institutions' Institutional Review Boards.

In the study described in this paper, our data set consisted of 112 interviews that took place when students were in their first year of undergraduate studies (T1), 32 follow-up interviews in their fourth year (T2), and 19 interviews with participants after they had begun their career or graduate studies (T3). Of the 112 T1 interviewees, 66.6% indicated their gender was male, 31.4% indicated their gender was female, and 1% selected "other" as their gender. 68.5% identified as white, 10.2% identified as Asian or Asian American, 4.6% identified as Hispanic or Latino/a, and 16.7% identified as either mixed race or of another race. At the time of the T1 interviews, the participants were all undergraduate engineering students at one of three American universities: University B, a large, private, religiously-affiliated institution in the Mountain West; University C, a smaller, public, engineering-focused institution in the Mountain West; and University D, a large, public, research institution in the Eastern U.S. (Students from a fourth university, University A, were a part of our survey sample and T1 interview pool, but was not a part of the longitudinal interviews.)

Our analysis focused specifically on a portion of the interview where we asked interviewees to describe a person who they believed exemplified moral character, personal or professional integrity, and/or social responsibility. We asked them a series of follow-up questions to probe why they selected that person and how they would describe their moral character. (The full interview protocol can be found in [16].)

We began our analysis by reading through the relevant section of each interview, and identifying the following four codes: who the participant selected as their moral exemplar, the reason they gave for choosing that moral exemplar, their description of their moral exemplar, and their definition of moral and ethical character. (This latter code was used to give context to their moral exemplar response when necessary.) Next, we categorized the moral exemplars selected by the participant into one of the following categories: family member, friend, professional contact, educator, modern political figure, religious figure, historical figure, scientist or tech figure, extracurricular contact, pop culture icon, fictional figure, group of people, or other. Table 1 contains a definition and sample quote for each category. This list was developed iteratively: after familiarizing ourselves with the data, we created an initial list of inductive categories. Then, during the categorization step, we added, combined or removed categories as needed.

We allowed for a participant's moral exemplar to fit into multiple categories if we believed they qualified for more than one. For example, in one interview, the participant chose their family members as their moral exemplars which can be categorized as both family member and group: “A lot of people in my family just are good moral people who are just trying to do the right thing” (Cameron, T1). Occasionally, a participant identified two moral exemplars during the interview. In that case, we categorized both.

One member of our team did the initial categorization of the moral exemplars. Then, to minimize bias, a second researcher reviewed the categories and suggested changes when necessary. In addition to categorizing the moral exemplars, we also noted the gender of the moral exemplars as male, female, and other/unspecified based on the pronouns the participant used to describe their moral exemplar or the identity of the person named (e.g. if a participant identified their dad as their moral exemplar, it was classified as male, as was Barack Obama).

Finally, we categorized the traits the participant ascribed to their moral exemplar using the Big 5 Personality Traits [9]. Using the definitions of the five personality traits provided in [9], we identified which traits the participants ascribed to their moral exemplars. In addition, we also indicated whether the participant identified their moral exemplar as high or low with regards to that trait, using terms commonly adopted by personality researchers. We focused this analysis on the T2 and T3 interviews, as we observed a lack of depth and details in the response of the students during the T1 interviews, something that was also observed in other studies of this data [17].

Categories of moral exemplars

During the initial T1 interviews, participants were much more likely to identify someone they knew personally (such as a family member, friend, educator, or professional contact) as their moral exemplar (58.8% of moral exemplars identified) rather than someone they did not know

Table 1: Descriptions and sample quotes for the categories used to identify participants' moral exemplars.

Category	Definition	Quotes
Family Member	A person who is known through blood relation or through adoption. Example: Father	"I think my dad has really good character that I really admire in him" (Bobby, T1).
Modern Political Figure	Someone who is actively or recently worked in a position of government. Example: Joe Biden	"I guess like Ruth Bader Ginsburg, I just saw a movie about her so she's in my head" (Carly, T2).
Historical Figure	A person who is known through their importance in history. Example: Abraham Lincoln	"I think George Washington is a really good example because he had a goal in mind, and he lived his life" (Brenda, T1).
Tech Figure/ Scientist	A person who is known through their work in science or making large advancements in technology. Example: Neil deGrasse Tyson	"Someone that I feel as when go down the root of scientific advancement, how it benefits society in terms of like business: Elon Musk" (Christopher, T1).
Friend	A person who is known through a mutual bond of respect and affection.	"I guess there's a few, just like some of my really close friends are really, I guess, that way" (Brock, T1).
Professional Contact	A person who is known through working in the same field as the participant. Example: Boss or co-worker	"I usually see the president of ASU as being someone who is very ethical in his doings" (Andres, T1).
Pop Culture Icon	A person who is known for being in popular media and culture. Example: Jennifer Lawrence	"I'm gonna go with Fred Rogers, Mr. Rogers" (Bradley, T1).
Educator	A person who has taught or is actively teaching the participants. Example: Teacher	"The professor I work with is a really good guy and we do a lot of studies with at-risk youth and wilderness programs" (Byron, T1).
Fictional	A person created for a story but does not and has not existed in real life. Example: Goku	"When I think of like who a good king would be at Game of Thrones" (Penelope, T2).
Group	A group or categorization of people. Example: Engineers	"Probably just about any U.S. veteran" (Alex, T1).
Other	Anyone that does not fall under any of these categories or when a participant did not identify a moral exemplar.	"I would not like to [pick someone], mainly because I don't think there's a way to define what are good morals" (Poe, T1).
Religious Figure	A person who is known for having an important and well-known role in a religion. Example: Jesus Christ	"The biggest one of course would be Christ. Especially him, that's the biggest one that comes to mind" (Brittany, T1).
Extracurricular Contact	A person who is known through activities outside of work and school. Example: A sport teammate	"Okay, there's a man I met on my mission in City Y. He was the bishop, Bishop Patrick. He definitely was an example of moral character" (Benson, T1).

personally (such as a historical figure or pop culture icon, 39.4% of responses). As shown in Figure 1, participants were most likely to identify a family member as their moral exemplar (39.2% of moral exemplars). This was followed by historical figures (10.8% of moral exemplars) and friends (9.2% of moral exemplars). The gender of the chosen moral exemplars also shows interesting data. 66.1% of the moral exemplars identified were male while only 16.5% of moral

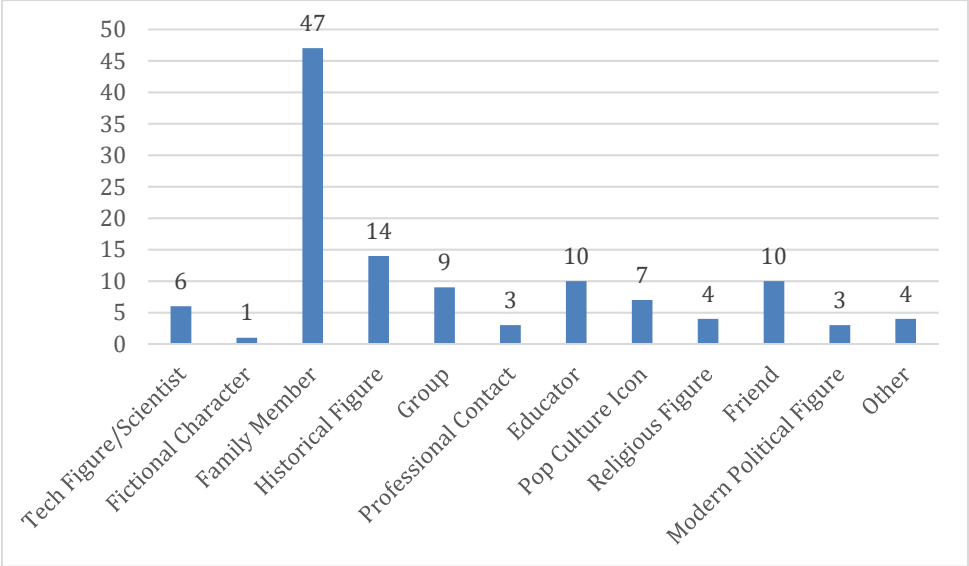

Figure 1: Summary of the categories of moral exemplars identified by participants during the T1 interviews.

exemplars are female (the remaining 17.4% of responses did not have a gender ascribed to them or referenced a group made up of multiple individuals, such as “members of the military”).

In the T2 data, moral exemplars close to the students remained high, making up 56.3% of chosen moral exemplars. The family member category decreased to 21.9% of moral exemplars, while the professional contact category grew to 21.9% of moral exemplars (very few participants cited a professional contact during the T1 interviews). Moral exemplars that were not known personally by the participant made up 40.6% of moral exemplars. The gender breakdown was even more skewed with the T2 data than it was at T1. 75% of the T2 moral exemplars were described as male and 15.6% were other or could not be determined. Female moral exemplars made up a mere 9.4% of the moral exemplars identified.

At T3, the participants were either early-career professionals or pursuing graduate students. At this time point, we had noticeably fewer longitudinal participants (n = 19) than at T1 (n = 108) or T2 (n = 32), so the data may swing more drastically due to the smaller sample size. In addition, the interview question related to moral exemplars changed slightly in T3, asking the participant to identify a moral exemplar who they knew personally. However, interesting findings still emerged from this data. The largest category remained family members, making up 23.8% of the responses (approximately the same percentage as T2) The share of participants who identified a friend rose to 19% and group rose to 14.3%. The most notable increase was in coworkers, especially when looking at the changes from T1 to T3.

We also explored the longitudinal changes in the moral exemplars selected by participants in T1 and T2 using a sankey diagram (found in Appendix A). One of the notable findings from

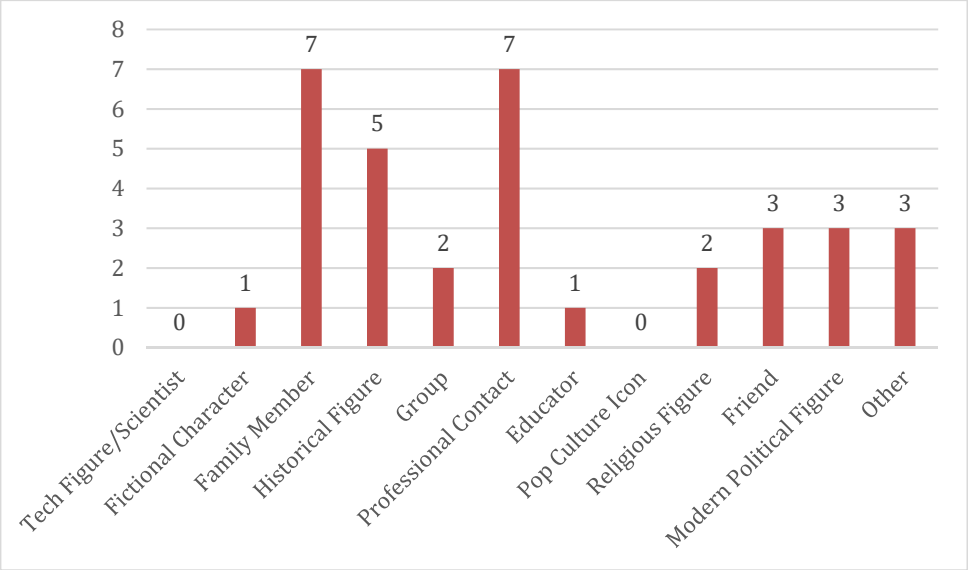

Figure 2: Summary of the categories of moral exemplars identified by participants during the T2 interviews.

representing the data this way is found in the family members category: half of the T2 participants who selected a family member as their moral exemplar in T1 again selected a moral exemplar in T2. In addition, we see in this diagram the emergence of the professional contact category in T2 that was not present at all in this sample of the T1 participants. There was no clear longitudinal pattern among the participants who selected a professional contact in T2 – they selected moral exemplars in many categories in T1.

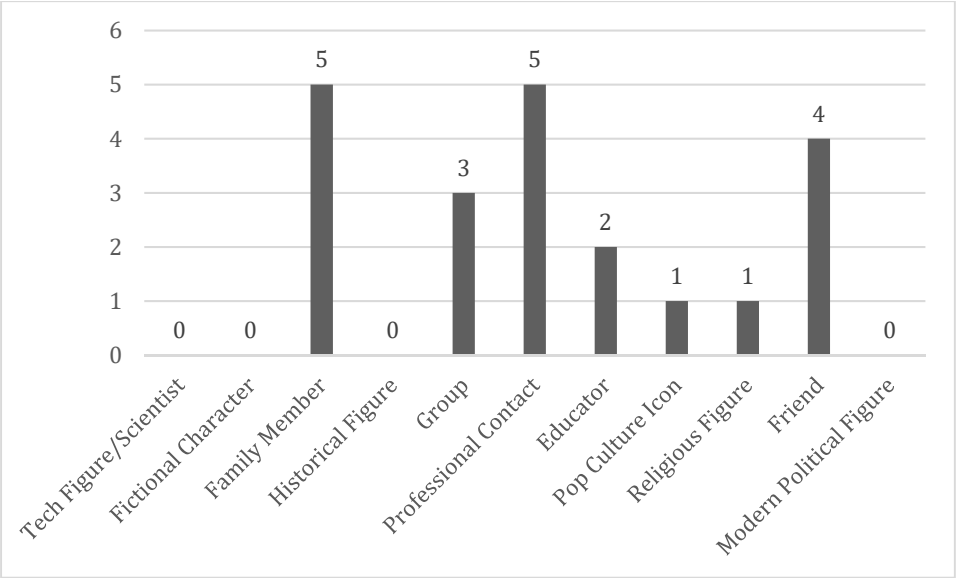

Figure 3: Summary of the categories of moral exemplars identified by participants during the T3 interviews.

Personality traits of moral exemplars

During the interviews, conscientiousness, agreeableness, and openness were the most frequently described traits of moral exemplars, as shown by the "Positive" bars in Figure 4. High conscientiousness was described in 84.4% of the T2 interviews and 78.9% of the T3 interviews. In T2, conscientiousness was not present in three interviews and low conscientiousness was described twice. As an example of high conscientiousness, Charlie described his coworker in the following way: "He does everything, uh, with his religion in mind, like not drinking, not doing drugs, not, um, going out there and spreading government secrets like [laughter] he is, um, yeah, about as reliable and, like, uncompromising too, in his morals" (T3).

High agreeableness was described in 78.1% of the T2 interviews and 84.2% of T3 interviews. 15.7% of the T2 and T3 moral exemplars either had low agreeableness or it was not described. For example, Chad described someone he worked with as having high levels of agreeableness: "So his senior design project is he's on a team of people that's helping install electricity in somewhere in Zimbabwe in a little village. Before anyone threw out ideas, he just like, no let's freaking ask him. [...]. We want to do just what they want. We can suggest other things but we're not going to do it unless we have permission to" (T2).

High openness was described in 53.1% of T2 and 47.4% T3 interviews. Additionally, low openness was only described in 15.8% of T3 interviews and 3.1% of T2. For example, Paula identified a friend as a moral exemplar with high openness: "She's just open to opportunities in the world. She's like, went-- studied abroad in China, no knowledge of Mandarin. Worked really hard to learn Mandarin so that she could talk with people and just learn about them. [...] There are people on that trip who had taken years of Mandarin, and she left knowing so much more

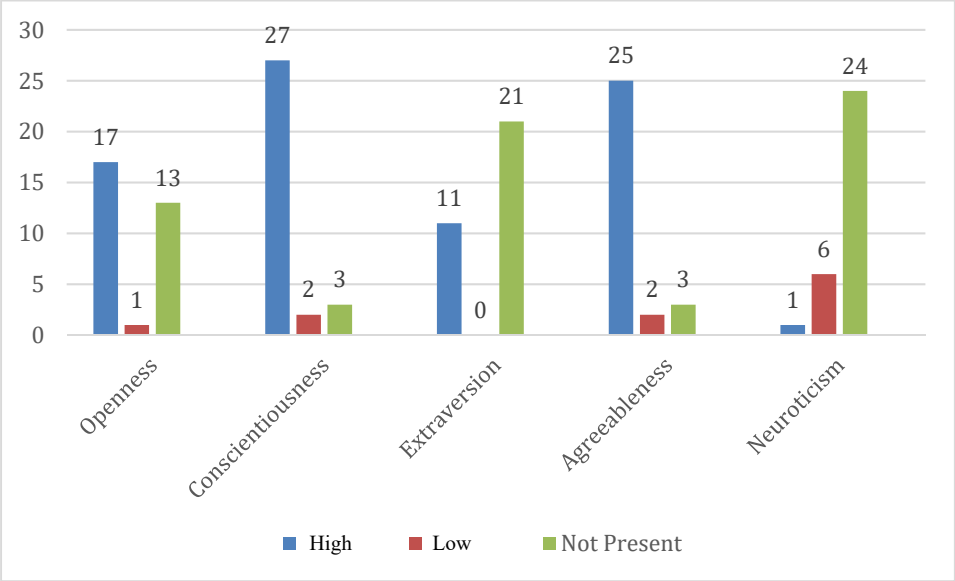

Figure 4: Frequency of the Big Five personality traits identified during the T2 interviews (n=32).

than they did. Because she talked to people she just like, tried things she just, you know, believes that there's good in the world, and then it will, it will come back, which is just an amazing thing" (T3).

In T3, 19 participants (out of the 20 total interviewees) answered the question regarding moral exemplars. As shown in Figure 5, high conscientiousness was described 15 times and not described in four interviews. High agreeableness was described in 16 interviews and not referenced in three interviews. High openness was described in 9 interviews, low openness was referenced in 3 interviews times and not described in 7 interviews. Extraversion and neuroticism were very infrequently referenced.

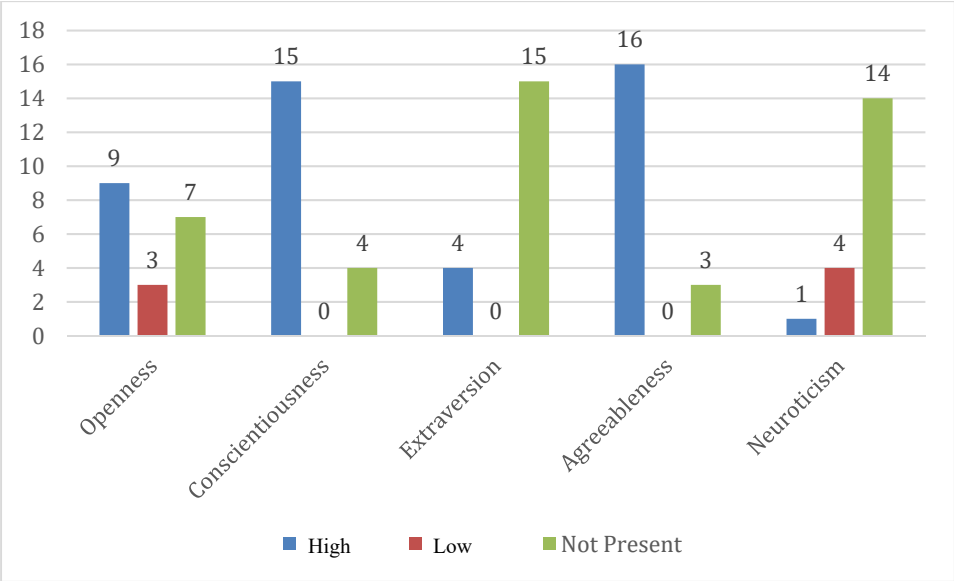

Figure 5: Frequency of the Big Five personality traits identified during the T3 interviews (n=19).

Relationship between gender of the participant and gender of the selected moral exemplar
As mentioned earlier in this section, we classified the gender of the moral exemplar as either male, female, or other/unspecified. We assumed the gender of the moral exemplar based on the pronouns the participant used to describe them or the identity of the moral exemplar specified (e.g. if a participant described their friend with she/her pronouns, it would be classified as female, as was Mother Teresa). The gender of the interview participants was determined from self-reported demographic data from surveys used in an earlier phase of the larger research project.

Overall, as reported above, we observed a lack of people choosing women as moral exemplars. Male moral exemplars were most commonly selected by participants, and participants were more likely to not specify the gender of their moral exemplar than to select a woman as a moral exemplar. At T1, male moral exemplars were selected at about two times the rate of female

moral exemplars; at T2 and T3, participants were even more likely to select a male moral exemplar, with a ratio of approximately 3:1.

We noticed that usually the gender of the participant did not act as a strong signifier for the categories of the moral exemplars they identified. For example, in T1, approximately equal proportions of men and women chose family members as their moral exemplars (39.5% of men and 44.7% of women). But, there were some cases where there was possibly a relationship between the gender of the participant and the category of moral exemplar selected. For example, in T2 22.7% of male participants choose a historical figure while no female participants choose historical figures. However, we acknowledge that we did not check for statistical significance of these results, and they are likely impacted by our small sample sizes, especially for female participants and T2 and T3 participants.

Men rarely chose women as their moral exemplar (in T1, 3.75% of the moral exemplars selected by men were women; in T2, it was 10% and in T3, it was 14.3%). Women chose women for their moral exemplar significantly more often (in T1, 83.3% of the moral exemplars selected by women were women; in T3, it was 80%). This possibly correlates to earlier research of the importance of the relatability of a moral exemplar [5]. The exception to this finding was among the T2 women participants, who rarely chose women as moral exemplars (8.3% of T2 women participants).

When looking at both the gender and category of the moral exemplars selected, the most common moral exemplar at T1 was a male family member (22.9% of all T1 moral exemplars identified). For both T2 and T3, the most common moral exemplar selected was a male professional contact (21.9% of all T2 moral exemplars and 19.05% of all T3 moral exemplars). The most common female moral exemplar in T1 was a family member (55.6% of all T1 female moral exemplars). Since there were so few female moral exemplars in T2 and T3, it was difficult to relate them to make any broad categorizations.

Discussion

There were three notable patterns we found in our data and then further investigated. There is an importance of the closeness of the moral exemplars as participants generally chose people they knew personally. Additionally, we found that participants mostly chose moral exemplars that matched their gender (women often identified a female moral exemplar, and men selected male moral exemplars). Finally, we investigated the traits that the moral exemplars and attempt to understand the focus on conscientiousness and agreeableness.

Closeness of moral exemplars

Many of the participants in our study identified moral exemplars who they had personal relationships with, such as a family member or friend. This finding emerges specifically from the

T1 and T2 data because the moral exemplar interview questions were open-ended in these two interviews. (In T3, we changed our interview protocol slightly and asked the interviewees to describe a moral exemplar who they knew personally, likely influencing them to identify someone they had a close personal relationship with.) In addition to frequently identifying someone they were personally close to, the moral exemplars identified were also often someone the participants interacted with frequently during their current stage of life. At T1, the participants were young college students, most of whom had only recently moved away from their families; unsurprisingly, many T1 participants cited a family member (39.8%). The percentage of participants who identified family members decreased in T2 and T3, though still remained high (21.9% and 26.3% in T2 and T3, respectively). At T3, after the participants entered the workforce, we saw an increase in the percentage who chose coworkers and professional contacts. This shift from citing family members to professional contacts could be due to the influence of close social contacts on one's moral perceptions. A prior paper from this project identified family and friends as common influences in engineering students' ethical development [16]; the results from our analysis looking specifically at moral exemplars serve to bolster this finding.

Though a majority of our participants identified moral exemplars who they know personally, there was a subset of our T1 and T2 participants who identified a famous person, pop culture icon, or historical figure as their moral exemplar. (Again, in T3, we specified that they identify someone they know personally; as a result, we are focusing on the two earlier interviews here.) With the growth of social media, it is easier than ever to be able to view the thoughts and personalities of many famous individuals. One example of this is Elon Musk, who was identified by three students as a moral exemplar in the T1 interviews. (Of all the famous individuals mentioned by T1 participants, Elon Musk ranked third as the most-frequently cited. Ahead of him were only George Washington and Abraham Lincoln, named by five and four participants, respectively.) In 2016, when the T1 interviews were being conducted, Musk had fostered a perception of himself as a philanthropist billionaire using money and technology to benefit society. These first-year engineers cited his visionary qualities and motivations as evidence of his status as a moral exemplar. However, in the time since 2018, perceptions of Musk have shifted in response to his very public statements and political positions. When considering public figures as moral exemplars, we see that these individuals may present a version of themselves to the public that is white-washed and more accepted than how they may act in their personal lives, potentially calling into question their position as moral exemplars.

Prior work has compared the impacts of moral exemplars who are known personally to a participant to those who are only known at a distance or through public images. Research has shown that when moral exemplars are viewed as relatable, they tend to have an increased effect on the moral development of the person identifying them. Peters et al. [18] found that role models that are similar to the participant have a positive effect and less similar role models have

a less positive or a negative effect on the participants. Furthermore, Han et al. have found that being exposed to stories of attainable moral exemplars led to an increase in voluntary service, in terms of both the number of participants who reported participating in voluntary service and the number of hours that they reported volunteering [5]. On the other hand, exposure to stories of unattainable moral exemplars caused very little change in both individual engagement and volunteer hours.

Role of institutional context

While we did not perform statistical analysis relating the demographics of our participants and the moral exemplars they identified, a few interesting, anecdotal observations did arise. One striking observation was that, of the six students who identified a tech figure or scientist as their moral exemplar in T1, five were from University C (and three of those five participants selected Elon Musk). Perhaps unsurprisingly, University C is an engineering-focused institution with a heavy cultural emphasis on techno-optimism. However, as a counterpoint to this observation, of the four participants who identified a religious figure as their moral exemplar in T1, only two were students at the religiously-affiliated university, University B, that was a part of this study.

Gender of the moral exemplars

In our data, an overwhelming majority of the moral exemplars identified were male. There are plenty of factors that may have caused this, but we believe the most likely explanation is that the majority of the participants in our study identified as male themselves. We observed that male participants were more likely to identify male moral exemplars and female participants were more likely to identify female moral exemplars. There are conflicting findings from prior work on the difference gender makes in one's view of morality, showing that the individual identities of our participants may offer only a partial explanation for this result [4], [19], [20]. Walker and Hennig [4] found that, regardless of their gender, the participants in their study described similar characteristics in the moral exemplars they identified, leading the researchers to conclude that gender does not influence one's perception of moral exemplars. Another study asked participants to rate the morality of people when shown their face, and found that the perceived gender of the face does not make a crucial difference [19]. However, Gilligan and Attanucci [20] did identify differences in how men and women view morality, finding that women participants tended to focus on caring traits while men focused on just traits.

Historically, engineering has been a male-dominated sphere, a gender disparity which lingers to this day. As a result, most of the notable and widely-known engineers and inventors are men. This bias may cause people to lean towards choosing male moral exemplars. Furthermore, moral exemplars are generally perceived to be people who are forward with their beliefs and willing to push their ideals; these traits may be perceived differently by society based on the gender of the person pushing such ideals. Two potential moral exemplars may have similar behaviors and

achievements, but due to gender, their actions may be viewed (and later, recalled, when prompted for a moral exemplar) in different lights.

Personality traits ascribed to moral exemplars

Prior research found that the most frequently-cited personality traits for moral exemplars were conscientiousness, agreeableness and openness [11]. Our work supported this finding: our participants frequently ascribed conscientiousness and agreeableness to the moral exemplars they identified. Openness was less commonly cited but more common than the other traits. Interestingly, we observed that there was a pattern to the traits identified by our participants based on the university they attended. For example, students who attended a faith-based university in our study were less likely to cite openness, as exemplified by Brody in T3: "I would say, in order to have ethical or moral character, you need to have some kind of foundational truth or belief that you harken back to. And then the character aspect of that really comes down to how consistent are you to adhering to that belief?" Similarly, Beverly, who attended the same university, said during her T2 interview, "That's, I mean, being a member of the church we've kind of been taught our whole lives that we make the decision before we come to that situation".

Conclusion

Engineering ethics is a complex and multifaceted topic; as a result, researchers have struggled to identify impactful ethical interventions [21] and ways to meaningfully assess changes in ethical understandings of students and engineers over time [17], [22]. In this study, we used one tool of measuring ethical perceptions, the identification of a moral exemplar, to explore the views of engineering students and early-career professionals and how those understandings change over time.

Our findings largely aligned with prior work. We found that students frequently cited moral exemplars who they knew personally. We saw a shift in who they identified, from frequently citing family members when they were first-year engineering students to more often identifying a professional contact by the time they were early-career engineers. We also saw that participants overwhelmingly identified a male moral exemplar (in the cases where they ascribed a gender to the individual or group that they named). Finally, our participants most frequently described conscientiousness and agreeableness as the traits of their moral exemplars, aligning with prior findings [9].

This study demonstrates the efficacy of using moral exemplars to illuminate participants' understandings of ethics and related concepts, and provides a demonstration of an additional measure available to engineering ethics researchers.

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Appendix A: Sankey diagram showing changes over time in the categories of the moral exemplars selected by participants in our longitudinal sample