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Does Public Welfare Responsibility Training in Engineering Education Shape Engineering Professionals' Reasoning about Ethical Issues?

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Abstract

Postindustrial societies are characterized by complex technological objects and systems. The publics therein are increasingly reliant on engineers to take public welfare into account when designing and maintaining these objects and systems and raise awareness when public welfare is threatened. The training engineers receive in their engineering undergraduate education is thus expected to foster their sense of responsibility to public welfare, but such training may be absent or insufficient. In this paper, we draw on a survey of 120 employed engineers in the US to assess the extent to which they received formal public responsibility training in their undergraduate education and to assess the relationships between this training and their response to one of four randomly assigned ethical dilemmas. We find that engineers who reported receiving training in public welfare responsibilities as undergraduate students felt better prepared to address public welfare issues than those who had not received such training. Individuals with training in public welfare responsibilities were less likely to identify the ethical dilemma as irrelevant to their work, indicate that such dilemmas happen all the time, be uncomfortable reporting the issue, and believe that their colleagues might respect them less if they report. These findings have implications for improving engineering ethics education and ethical conduct trainings within engineering practice more broadly.

Introduction

Most people in postindustrial societies live their lives alongside, within, and through immensely complex technological objects and systems that they lack the knowledge to fully control or alter [1-3]. As a result, laypersons are increasingly reliant on the engineers who design and maintain these objects and systems to account for public safety, health, and security in their work.

Recognizing this need, many engineering programs and engineering educators have instituted training that extends beyond rudimentary ethics education to include education about engineers' public welfare responsibilities (i.e., their professional responsibilities to account for the social consequences of the technologies they help develop and maintain). But does such training have an enduring impact on how engineering professionals think about the ethical dilemmas they may encounter in the workforce, long after they leave the engineering classroom?

Using a unique survey of 120 employed engineers in the United States, this study compares the responses to ethical dilemmas by engineering professionals who received training as undergraduate students in engineers' public welfare responsibilities to the responses by engineers who did not receive such training. Survey respondents were presented with a hypothetical incident in which their supervisor falsified data on the design of a mobile phone camera, and they were asked a series of questions about their reactions to this incident. To ensure that the

responses were not dependent on the specific context of the data falsification incident, respondents were randomly assigned to one of four scenarios: falsification of data on the toxicity of the camera's materials, on the inability of the camera to recognize a full range of skin tones, on the camera's lack of compliance with requirements of the Americans with Disabilities Act, and on an incident of sexual harassment within the design team.

Across the four iterations of this ethical dilemma, engineers who received undergraduate training in public welfare responsibilities were less likely than those who had not received such training to view the ethical dilemma as irrelevant to their work and to believe that such dilemmas are common in organizations. Furthermore, those who had received public responsibility training in school were less likely to feel uncomfortable about reporting the incident and less likely to believe that their colleagues would respect them less if they reported the incident.

These findings highlight the enduring effects of training engineering students on their public welfare responsibilities for how engineering professionals think about and plan to respond to ethical dilemmas of engineering design.

Background

Engineers' Responsibilities to Public Welfare

The engineering profession holds social and sometimes legal monopolies on entire areas of knowledge production and the design, development, and maintenance of ubiquitous sociotechnical systems. As a result, the profession holds accompanying responsibilities for upholding the health and safety of the public it serves [4, 5]. These responsibilities are most clearly articulated in engineering codes of ethics [6]. For example, IEEE's Code of Ethics reads:

> We, the members of the IEEE, in recognition of the importance of our technologies in affecting the quality of life throughout the world, and in accepting a personal obligation to our profession, its members and the communities we serve, do hereby commit ourselves to the highest ethical and professional conduct and agree…..to hold paramount the safety, health, and welfare of the public, to strive to comply with ethical design and sustainable development practices, to protect the privacy of others, and to disclose promptly factors that might endanger the public or the environment;...to improve the understanding by individuals and society of the capabilities and societal implications of conventional and emerging technologies, including intelligent systems; [and]...to support colleagues and co-workers in following this code of ethics, to strive to ensure the code is upheld, and to not retaliate against individuals reporting a violation. https://www.ieee.org/about/corporate/governance/p7-8.html

These codes of ethics demand that engineering professionals seriously consider how the technological objects and systems they design and maintain impact the public [7, 8]. Engineering

codes of ethics also specify that engineering professionals have a responsibility to raise the alarm to employers, clients, public leaders, and/or the media when they encounter ethical dilemmas that put the safety, health, and/or welfare of the public in jeopardy.

Existing research reveals that engineers encounter such ethical dilemmas with some regularity. In a recent study that interviewed engineering professionals, Adams [9] found that nearly three-quarters (72.5%) of engineers had personally witnessed or were involved with an ethical dilemma during their career. A separate survey-based study of professional engineers found that 18% reported frequently encountering ethical or moral dilemmas at work, and 7% of respondents indicated that encountering an ethical dilemma was the primary reason they had left a previous job [10].

Engineers encountering these dilemmas often reported experiencing pressure from their employers to behave unethically, typically stemming from organizations' prioritization of productivity and shareholder profit [9]. Berenbach and Broy inventoried different categories of ethical dilemmas engineers may face in the workplace including: unrealistic timelines and expectations from supervisors; pressure to release a product prematurely when it still contains defects or lacks necessary functions; overstatements of a product's capabilities to clients or investors; and pressure to prioritize work over personal commitments [11].

Adams' 2020 study also suggested that nearly one in four professional engineers find it difficult to balance professional ethics with employer demands [9]. Organizations many shoehorn employees into their goals and values explicitly through stated rules, or implicitly, through social approval and promotions [12]. Institutional cultures that incentivize compliance and discourage criticism often prevent workers from resisting or whistleblowing on a company's unethical practices [13].

While pressure to make unethical decisions can occur in all engineering fields, some moral dilemmas are particularly common in specific subdisciplines. For example, Schuelke-Leech and colleagues [13] described particular controversies relating to self-driving vehicles and other autonomous systems. In such contexts, there is insufficient ethical guidance for engineers who are designing machines that augment or even replace human cognition that may be required to make decisions with life-or-death consequences [13].

Beliefs about engineers' public welfare responsibilities are not static. Over the past century, public opinion has shifted to value duty to society over loyalty to employers. This shift is reflected in the engineering profession; in the past, many professional engineering societies' codes of ethics listed protection of employers' and clients' interests as an engineers' paramount obligation, whereas most modern codes of ethics prioritize the welfare of the public [14]. In turn, there has been a recent uptick in engineers' willingness to resist unethical practices in the workplace and to act as whistleblowers in their organizations [14]. Many engineers also take

moral stances by openly prodding organizations to adopt more ethical practices as a condition of accepting employment or shunning jobs and companies that do not align with their values [15].

Yet even with this growing concern regarding engineers' public welfare responsibilities, research indicates that most engineers are unfamiliar with the legal duties and protections associated with whistleblowing, and most feel unprepared to act if necessary [14, 16]. Additionally, many engineers feel that resistance is too risky in the majority of situations because of threats of retaliation and other negative impacts on an individual's self-esteem, career, and private life [9, 13, 16]. Support systems for professional engineers who seek to intervene when they encounter ethical dilemmas can vary sociodemographically; for example, professional support systems are more frequently accessed by white heterosexual men, while women, people of color, and LGBTQ identifying individuals generally rely more on personal support systems [17].

Professional Responsibility Training in Engineering Education

Institutionally, undergraduate engineering education bears the responsibility for shaping future engineers' awareness of, and commitment to, their public welfare duties [18, 19]. Engineering colleges and programs in the US have integrated ethics instruction into both curricular and co-curricular experiences to promote ethical development among undergraduate engineers. The approaches used in the formal curricula are diverse [20-22], with engineering undergraduates receiving classroom ethics instruction in multiple settings (e.g., introductory engineering courses, senior and capstone design courses, out-of-class-workshops, and non-engineering courses) and through various pedagogies (e.g., lectures, case studies, guest speakers, role-playing activities, online modules, small group discussions, and in-class games). The co-curricular experiences that can introduce engineering undergraduates to ethics through co-curricular experiences are similarly diverse, including service learning, undergraduate research opportunities, military and volunteer work, and engineering clubs and organizations [23-25].

Although there is evidence that both curricular and co-curricular experiences may impact students' ethical development, it is unclear whether these approaches adequately prepare students for the social and ethical realities they face in professional practice [24-30]. Additionally, it is also unclear whether the intended impact of undergraduate ethics training persists in the years post-graduation. Research suggests that many engineers report that their engineering education did not prepare them to navigate ethical dilemmas in the workplace and feel they lack formal guidance on how to handle these situations [31].

This paper examines the prevalence of professional responsibility training among a survey sample of 120 employed engineers, and it explores the relationship between this training and engineers' reactions to hypothetical ethical dilemmas.

Hypotheses

Overall, we expect that engineers who received undergraduate training about the public welfare responsibilities of engineers will be more likely than those who did not receive such training to see ethical concerns that arise in the context of design as within the purview of their job duties and to be more likely to feel comfortable reporting such concerns.

Consistent with the research reviewed earlier, we expect that many engineers in our sample will have encountered ethical dilemmas in their workplaces at some point. We choose to assess their reactions to hypothetical ethical dilemmas (rather than their recollections of past events) to hold constant both the incident in question and the decision-making timeframe. Our survey presents each respondent with a hypothetical ethical dilemma about the design of a camera based on real-world instances of design flaws and then asks questions about how they would respond. This approach enables us to avoid difficulties in causal ordering between respondents' meaning-making about past ethical dilemmas and their recollection of their undergraduate training.

As described in greater detail in the methods section, respondents were randomly assigned to one of four versions of an ethical dilemma that they hypothetically encounter while working on a team designing a mobile phone camera. These versions include the toxicity of the camera materials, the inability of the camera to recognize a full range of skin tones, the lack of compliance of the camera with Americans with Disabilities Act (ADA) requirements, and an instance of sexual harassment on the design team. These dilemmas are described in Table 1 below. We varied the specific dilemma that respondents were exposed to in order to ensure that the broad connections we investigate between public welfare responsibility training and respondents' reactions to these ethical dilemmas were not contingent on the specific ethical issue in question.

Respondents were asked a series of questions to ascertain their reaction to the ethical dilemma. To assess the extent to which they consider responding to the dilemma as outside the purview of their engineering job, respondents were asked whether they believe the issue is irrelevant to their technical work. To capture their potential for downplaying the incident as a normal part of business operations, they were asked whether they believe this kind of issue is a common occurrence within organizations. Finally, respondents were asked about their level of comfort in reporting the incident.

We hypothesize the following relationships between undergraduate training in public welfare responsibilities and engineers' reactions to the ethical dilemmas:

> Hypothesis 1: engineers who received formal training as undergraduates in engineers' ethical and public welfare responsibilities and in understanding the social consequences of technology will be *less likely* than engineers who did not receive such training to view

ethical dilemmas as irrelevant to their work and *less likely* to believe that such dilemmas are common in organizations.

Hypothesis 2: engineers who received formal training as undergraduates in engineers' ethical and public welfare responsibilities and in understanding the social consequences of technology will be *less likely* than engineers who did not receive such training to see reporting the incident as outside their comfort zone and *less likely* to believe that their colleagues will respect them less if they reported.

Data and Methods

Data

Our analysis uses survey data of 120 engineers employed in the US collected through a piece rate virtual work platform called Mechanical Turk (MTurk). MTurk survey samples are roughly reflective of the US population along a variety of demographic and attitudinal dimensions and produce samples that are within 9% on average of corresponding values in the US population on factors ranging from income to marital status [32]. Although MTurk is not representative of US populations, it is frequently used to examine relationships between central constructs within such populations (here–the relationships between prior public welfare training and assessments of ethical responsibilities) [33].

We advertised the study as a "survey of engineers working in the United States" and restricted the survey only to MTurk participants who were employed as engineers in the US and who had a bachelor's degree or higher. The survey used the same survey question as the National Science Foundation's surveys of STEM professionals to categorize engineering jobs. To improve data quality, we included several attention filters and removed incidents (as indicated by nonsensical responses to the open-ended questions and speed checks) where surveys appeared to have been completed by bots. Participants who completed the survey were paid $18 through the MTurk work platform. Participation in the survey was voluntary and confidential and was approved through our institution's IRB (HUM## 00205051).

The survey asked engineers a variety of questions about their educational background, current engineering job, and whether they had received training on public welfare-related issues in the context of their undergraduate education. At the end of the survey, respondents were randomly assigned to one of the four versions of the ethical dilemma (see Table 1).

Operationalization

Public Welfare Responsibility Training Measures

Respondents were presented with several topics related to ethics and public welfare and asked whether they had received education on these during their "formal training in undergraduate

education (e.g., lectures, class assignments)." Specifically, the survey stated: "Over the course of their engineering training, engineers learn about the roles and responsibilities of professional engineers from a variety of places. Below is a list of factors of professional responsibility you may have learned about, and a set of places where you may have received training in these factors. For each factor, please indicate whether you received training in any of the places listed in the column below."

We use as our focal *independent measures* whether respondents reported that they have formal training in undergraduate education in the following:

- "Ethical responsibilities" (1=yes, 0=no),
- "Being mindful of responsibilities to public welfare" (1=yes, 0=no), and
- "Understanding societal consequences of engineering design" (1=yes, 0=no).

Because this is a sample of employed engineers who had been out of college for years or even decades, we asked only whether they received any sort of training on these matters, rather than asking them to recall any further details about this training.

Ethical Dilemmas and Reactions

The goal of our paper is to understand the connections between past training related to ethical and public welfare responsibilities and engineers' likelihood of expressing concern about ethical dilemmas in design. In order to reduce the possibility that the relationship between public welfare training and reactions to ethical dilemmas is tied to the idiosyncrasies of the dilemma presented, we randomly assigned respondents to one of four versions of the ethical dilemma. We designed these ethical dilemmas to mirror actual events of contextual and design content-related ethical issues that received widespread attention in recent years. Each variation of the ethical dilemma asked the respondent to "imagine the following scenario" where they encountered an issue while working on a team that was designing a mobile phone camera. The specific wording for each variation is provided in Table 1.

After reading the scenario, respondents were asked a series of questions about their thoughts on the dilemma. We pool responses across these four conditions in each model below, but include controls for which condition respondents were exposed to. Supplemental analyses examine variation in reactions by specific dilemma (see Appendix Table 1).

Our focal *dependent variables* assessed respondents' reactions to the ethical dilemma they were presented with by asking them to indicate their agreement with a series of statements in response to the scenario they read:

- "This issue is irrelevant to my work in the division" (1=strongly disagree [SD] to 5= strongly agree [SA]),
- "This happens all the time in organizations" (1=SD to 5=SA),
- "Reporting this issues would be outside my comfort zone"(1=SD to 5=SA), " and
- "My colleagues might respect me less if I reported" (1=SD to 5=SA)

Table 1: Versions of the Ethical Dilemma

	Imagine the following scenario. You are working as an engineer at a large mobile phone company. Your division is working on a new phone camera that would make facial recognition a more reliable method to unlock one's phone. Your boss is responsible for reporting about various technical and personnel aspects of your division to senior management, including ...
Toxicity Version	…materials used in the new camera. You find out that your boss is falsifying data on the toxicity of the materials used in the camera to make the division look better. You are the only one who knows this information.
Skin Tone Version	… the technical aspects of the new camera. You find out that your boss is falsifying data on whether the scanner works equally well on people with light and dark skin tones to make the division look better. You are the only one who knows this information.
American's with Disabilities Act ADA Version	… the technical aspects of the new camera. You find out that your boss is falsifying data about the camera's compliance with ADA (Americans with Disabilities Act) requirements to make the division look better. You are the only one who knows this information
Harassment Version	… human resource matters. You find out that your boss is falsifying data on the frequency of sexual harassment reports in your division to make the division look better. You are the only one who knows this information.

Controls

Each model controls for respondents' highest degree (1=less than high school to 8=PhD), years since their highest degree, and whether they were born outside the US (1=yes, 0=no). To avoid issues with multicollinearity with years since highest degree, we do not include a control for age in the models. As an indicator of racial and gender privilege, we also include indicators for whether they identify as white (1=yes, 0=no) and as men (1=yes, 0=no). To protect confidentiality of respondents in this modest size sample, we do not disaggregate these race and gender categories further. Each model includes indicators for which version of the ethical dilemma the respondent was presented with (the toxicity condition is the comparison category).

Analytic Strategy

Table 2 presents the means and standard errors on the dependent and independent measures for the engineers in the sample. Table 3 summarizes the coefficient estimates, significance levels, and standard errors produced by individual regression models predicting each reaction to the

ethical dilemma (rows) with whether respondents received formal training in their undergraduate education in each public welfare responsibility topic (columns). Ordinary least squares (OLS) regression models include controls for degree level, years since highest degree, whether they were born outside the US, gender, race, and ethical dilemma version.

In supplemental analyses, we ran OLS regression models predicting each reaction to the ethical dilemmas with indicators for which dilemma respondents saw (along with controls). Appendix Table 1 summarizes the coefficients in these models for each of the empirical conditions, with the toxicity version as the comparison category.

Table 2: Means and Standard Errors for Demographic Measures, Public Welfare Training, and Reactions to Ethical Dilemmas

	Mean	***Std. Err.***
Participant demographics		
Highest degree (1=less than high school to 8=PhD)	5.463	*0.058*
Years since highest degree	9.256	*0.705*
Born outside the US (1=yes, 0=no)	0.066	*0.023*
Man (1=yes, 0=no)	0.653	*0.043*
White (1=yes, 0=no)	0.793	*0.037*
Formal training in undergraduate education in:		
Ethical responsibilities (1=yes, 0=no)	0.322	*0.043*
Being mindful of responsibilities to public welfare (1=yes, 0=no)	0.190	*0.036*
Understanding societal consequences of engineering design (1=yes, 0=no)	0.289	*0.041*
Reactions to ethical dilemma (all on 1=Strongly Disagree to 5=Strongly Agree scale)		
This issue is irrelevant to my work in the division	2.893	*0.125*
This happens all the time in organizations	3.339	*0.115*
Reporting this issue would be outside my comfort zone)	3.537	*0.103*
My colleagues might respect me less if I reported	3.223	*0.103*

Results

Table 2 presents descriptive statistics (means and standard errors) for the sample of 120 employed engineers. The average level of education is a bachelor's degree, and there was about nine years on average since respondents had received their highest degree. Approximately 7% of the sample was born outside the US, 65% identified as men (slightly lower than the national average), and 79% identified as White.

While just under a third of respondents (32%) stated that they had received training in engineers' ethical responsibilities in their undergraduate education, less than 20% said they were taught to be mindful about engineers' responsibilities to public welfare, and only 29% reported that they were taught about the societal consequences of engineering design.

On average, engineers in the sample were more likely to disagree than to agree that the ethical issue they were presented with was irrelevant to their work in the division, and more likely to agree than disagree that this sort of incident happens all the time in organizations. The sample was more likely to agree than disagree that reporting the issue would be outside their comfort zone and that their colleagues would respect them less if they reported the issue (see means in Table 3).

Multivariate Results

The next set of analyses examines the relationships between having received formal training in public welfare responsibility as undergraduates and engineers' responses to the ethical dilemmas. Here, models include controls for the demographic variables listed in Table 2 and indicators for which version of the dilemma respondents were randomly assigned.

Table 3 summarizes the focal unstandardized coefficients, standard errors, and significance levels from the 12 OLS regression models predicting each reaction to the ethical dilemma (rows) with each topic of public welfare responsibility training (columns). Because of the small sample size, we report two-tailed marginal significance tests ($p<.10$) as well as those below a *p* value of .05.

Across the ethical dilemmas, respondents who had received training in engineers' *ethical responsibilities* as undergraduates were significantly less likely to believe that the ethical dilemma was irrelevant to their work and marginally less likely to believe that this sort of issue happens all the time in organizations.

Similarly, respondents who had received training as undergraduates in *being mindful of responsibilities to public welfare* were significantly less likely than those who did not receive such training to believe that the ethical dilemma was irrelevant to their work, and marginally less likely to believe that this sort of issue happens all the time. Those who received public welfare responsibility training were also marginally less likely to indicate that reporting the issue would be outside their comfort zone or that their colleagues would respect them less if they reported.

Finally, engineers who received training in the *importance of understanding the societal consequences of engineering design* were significantly less likely to believe that the ethical dilemma is irrelevant to their work and that such issues happen all the time, and marginally less likely to agree that reporting the issue would be outside their comfort zone.

In sum, even with this modest sample (N=120), these results reveal relationships between the training engineers received in their undergraduate education and their likelihood of considering ethical dilemmas to be relevant to their work, downplaying such dilemmas as standard organizational occurrences, and seeing responding to them as within their comfort zone, and even being more likely to disagree that their colleagues would respect them less for reporting the

issue. These patterns hold even when accounting for the number of years since highest degree, whether they were born in the US, and other demographic controls.

Table 3: Focal Coefficients and Standard Errors from 12 OLS Regression Models Predicting Reactions to Ethical Dilemmas with Public Welfare Training in Undergraduate Engineering Education, and Controls

	Received training in ethical responsibilities	Received training in being mindful of responsibilities to public welfare	Received training in understanding the societal consequences of engineering design
This issue is irrelevant to my work in the division	**-.999***** (p<.001) SE=.252	**-.857**** (p=.008) SE=.318	**-.761**** (p=.006) SE=.271
This happens all the time in organizations	**-.423+** (p=.077) SE=.237	**-.529+** (p=.069) SE=.288	**-.549*** (p=.026) SE=.244
Reporting this issue would be outside my comfort zone	**-.143** (p=.489) SE=.205	**-.470+** (p=.059) SE=.246	**-.371+** (p=.081) SE=.211
My colleagues might respect me less if I reported	**-.026** (p=.907) SE=.220	**-.497+** (p=.062) SE=.263	**-.135** (p=.556) SE=.228

Note: ***p<.001, **p<.01, *p<.05, +p<.10, two-tailed tests. OLS regression models included controls for gender, race, highest degree, and years since highest degree.

Supplemental Analysis

In supplemental analyses, we examined whether there is variability in engineers' responses to the ethical dilemma depending on the specific version of the dilemma respondents saw. We ran OLS regression models predicting the focal dependent variables with controls for each dilemma version. Here, the toxicity condition, the least politicized condition, was the comparison category.

As illustrated in Appendix Table 1, there was no significant variation in likelihood of expressing concern about the dilemma between the toxicity and the skin tone versions. In contrast, respondents who saw the ADA version were significantly more likely than those who saw the toxicity version to agree that reporting the incident would be outside their comfort zone and to agree that their colleagues might respect them less if they reported. Those who saw the ADA version were also marginally more likely than those who saw the toxicity version to believe that this sort of incident happens all the time in organizations.

Similarly, those where saw the sexual harassment version of the ethical dilemma were significantly more likely than those in who saw the toxicity version to report that this issue was irrelevant to their work, to say that reporting is outside their comfort zone, and to believe that their colleagues would respect them less if they reported this issue.

Although outside the scope of our analysis, these findings suggest the need for future investigation into whether having public welfare training in engineering education expands the *types* of ethical dilemmas engineers may see as part of their responsibilities, as well as their investments in responding to ethical dilemmas in general.

Limitations

Although these analyses have a number of benefits, they also have several limitations of note. First, the sample size is modest and non-representative. As such, we are unable to determine whether the prevalence of training or responses to ethical dilemmas is reflective of US engineers in general. Additionally, we focus on a specific context of engineering dilemmas—the design of an engineering camera. Future research should attend to ethical dilemma reactions situated in other engineering-related contexts (e.g., project scoping with clients) and with more representative samples to see if similar relationships between training and ethical dilemma reactions emerge.

Discussion

It is widely understood that engineering undergraduate education is responsible for preparing its graduates to address the public welfare responsibilities they will face as engineers. Our results show that such training is directly related to recognizing ethical dilemmas, seeing them as relevant, and being comfortable with reporting them. However, our results also reveal the lack of public welfare responsibility training that most engineers received as undergraduates. Though this may be disheartening, these results point to one straightforward solution --- the integration of more training into the engineering undergraduate curriculum. This can be accomplished, for example, by incorporating ethics instruction throughout the formal curriculum using varied pedagogical approaches [24, 26] or by leveraging students' participation in out-of-class activities to help students connect ethics trainings to engineering practice [23, 25]. Introducing engineering ethics in these ways can increase students' sensitivity to ethical dilemmas and improve both their ethical judgement and their ethical willpower [34], thereby better preparing them to uphold their public welfare responsibilities.

These findings have implications for institutions beyond higher education. Although some respondents did recognize a given ethical issue as relevant to their work, they still may have expressed discomfort in reporting that concern, perhaps due to fears of workplace repercussions. Their worries suggest that improvements in education, though necessary, are likely not sufficient to bring about the desired level of accountability for protection of public welfare. Rather, improvements to undergraduate ethics curriculum should be accompanied by improvements in the accessibility and reliability of avenues for reporting ethical concerns within engineering societies, technology organizations, and engineering workplaces, as well as greater social support for engineers who do come forward.

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Appendix Table 1: Focal Coefficients and Standard Errors from OLS Regression Models predicting the Responses to the Ethical Dilemma with the Specific Version Respondents were Shown.

	Skin Tone Condition vs. Toxicity Condition	ADA Condition vs. Toxicity Condition	Sexual Harassment Condition vs Toxicity Condition
This issue is irrelevant to my work in the division	.193 SE=.358	.550 SE=.356	.841* SE=.375
This happens all the time in organizations	.389 SE=.319	.559+ SE=.317	.513 SE=.334
Reporting this issue would be outside my comfort zone	.317 SE=.273	.636* SE=.272	.971** SE=.286
My colleagues might respect me less if I reported	.450 SE=.292	.652* SE=.290	.853** SE=.306

Note: ***p<.001, **p<.01, *p<.05, +p<.10, two-tailed tests. OLS regression models included controls for gender, race, highest degree, and years since highest degree. Models indicate significant variation between seeing the toxicity condition vs. either the skin tone version, the ADA version, or the sexual harassment version in the likelihood that respondents would express agreement with the statements listed in the leftmost column.