Board 71: A Website to Host Educational Modules on Global Engineering Ethics and Conduct Research in Cross-Cultural Moral Psychology: A Work in Progress

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**Abstract**
To ensure more long-term ethical behaviors within engineering, a website is being developed to host educational modules on global engineering ethics and conduct research on cross-cultural moral psychology. The modules are all-inclusive, with a cross-cultural and international focus, requiring less preparation on the part of instructors and are easier for different types of students to use than existing online resources. Education and research using the site can occur at the same time, each strengthening the other in the process. Rather than simply ethical understanding or the ability to reason ethically, research on moral psychology can ensure more ethical behaviors, better understanding what people know and think about ethics and the causes of (un)ethical behaviors. This research is cross-cultural, since culture has been shown to affect behaviors and thoughts related to ethics, and the educational and working environments of engineering are more cross-cultural and international than ever before.

**Introduction**
This paper describes the motivations for and nature of a website being developed to host educational modules on engineering ethics, as well as to collect information regarding cross-cultural moral psychology.

These motivations include improving access to and the quality of ethics education, while at the same time conducting research based on information collected through the site, to trace the results of ethics education and increase the likelihood of long-term ethical behaviors. The goal is not simply to bring together existing resources but (1) to develop inclusive online educational modules for an engineering ethics course. This would require less preparation on the part of instructors and, for that reason, the modules would be easier for instructors to assign and students to use; (2) to track student performance on the modules, at the same time collecting information about background knowledge of and views about ethics.

The nature of the site is modelled on a combination of one hosted by Cornell University, with materials and exercises about plagiarism[1], as well as ones maintained by the University of Virginia[2], [3], Harvard University[4], and the MIT[5], [6], to collect information related to moral psychology and applied ethics. Although the site described here takes inspiration from these, it will be distinctive, since it will be used for educational and research purposes at the same time, rather than only one, and used cross culturally.

This paper is divided into four parts: Part one considers current circumstances that necessitate greater access to engineering ethics education, and how the website described here would help to do so. Section two outlines online resources currently available, as well as potential shortcomings in the effective use of these resources, and how the modules included on the site could improve the quality of engineering ethics education. Part three explains the nature and use of the modules themselves. Section four describes why and how the website will be used to conduct research on cross-cultural moral psychology, materials included on the site, and the theoretical and research paradigms to which these belong.
Improving access to engineering ethics education
This first section explains why access to engineering ethics education should be improved, and how the website described here will help to do so.

Colleges and universities have expanded and increased their offerings in science, technology, engineering, and mathematics (STEM) fields, especially in the developing world. For example, China now graduates more STEM majors than any other country.[7], [8] As a result, institutions are under pressure to cover larger amounts of information in engineering curricula, such that courses related to the humanities, social sciences, and broader contexts in which engineering occurs are increasingly peripheral. Information related to these broader contexts is central to ethical engineering, but engineering faculty have reported feeling uncomfortable teaching ethics-related materials in their own courses, in part because of their own lack of knowledge.[9]

The existence of web-based educational modules in engineering ethics, with full lessons and exercises, would allow for greater, easier access to engineering ethics education. This would be especially true in developing countries, where ethics do not yet figure prominently in engineering curricula, and which lack the educational infrastructure to meet this demand.[10] Additionally, web-based content enjoy the potential of “going viral,” being shared and viewed by exponentially greater numbers of people through social media and other forms of online communication. For instance, the Moral Machines project, hosted by the MIT media lab, has collected responses from more than 16 million people worldwide.[6] A similar approach can and should be used to increase knowledge of and access to engineering ethics education.

Improving engineering ethics education and research
This second part of the paper briefly reviews previous efforts and online resources to improve access to engineering ethics education, potential problems associated with the effective use of these resources, and the ways the modules and website described here would address these problems, improving education and research about engineering ethics more broadly.

Various massive open online courses (MOOC’s) in engineering and technology ethics have been developed.[11]–[13] The Online Ethics Center (OEC) hosts educational materials and resources on science, engineering, and technology ethics,[14], and the Markkula Center for Applied Ethics at Santa Clara University[15] does the same. Additionally, most professional societies devote pages of their websites to materials on ethics, such as the National Society for Professional Engineers.[16] These are valuable resources, which provide a service to and should be used by educators, students, and practitioners alike. However, three factors inhibit their effective use.

First, research has found students mostly likely to enroll in online education programs have difficulties effectively using the resources these programs provide.[17], [18] Second, materials currently hosted online are primarily beneficial to educators rather than students, since they could be difficult to navigate unless one knows what one is looking for (Fig. 1), and most materials consist in lesson plans, case studies, and videos for use in instructor-led courses (Fig. 2). Third, their use requires substantial preparation time and effort on the part of instructors (Fig. 3). By contrast, the web modules described here are all inclusive: They can be used anytime, anywhere by students, without preparation on the part of instructors.
Fig. 1 Navigating resources at the OEC [14]

Fig. 2 A lesson plan for big data at OEC [19]

This class plan gives a selection of exercises out of which an instructor may build a class session around issues concerning the development of big data resources in genetics and genomics such as the materials being compiled by 23 and Me. The materials are suitable for upper division undergraduate courses in bioethics or the life and environmental sciences.

Learning Objectives

Students will be able to:

- Evaluate ethical arguments for and against the pursuit of “direct-to-consumer genetics”
- Think critically about the role of informed consent within the context of genetic/genomic research
- Describe how individuals, including scientists, can act on social responsibilities concerning genetic privacy and ownership of genetic data

1. Before Class Assignment

Assigned Readings:


Seife, Charles. “23andMe is terrifying, but not for the reasons the FDA thinks: the genetic-testing company’s real goal is to hoard your personal data.” Scientific American 27 (2013). https://www.scientificamerican.com/article/23andme-is-terrifying-but-not-for-the-reasons-the-fda-believes/
Also, work with the website aims at cultivating more ethical behaviors. Education in engineering and technology ethics has tended to emphasize ethical understanding and reasoning as educational outcomes.[21], [22] This emphasis assumes these capacities are sufficient to produce ethical behaviors. However, if this were true, then professional ethicists would behave more ethically than other philosophers and people in general, but studies have failed to find evidence to support this assumption.[23] To explain and address this, various psycho-social models of moral judgments and behaviors have been proposed, supported by studies about the ways emotions, situations, and biases contribute to (un)ethical behaviors.[24]–[27] These insights have been brought to bear on applied and professional ethics, in business and law, but only minimally in engineering or technology.[28], [29]¹

To ensure more ethical behaviors by engineers and with regard to technology, insights from empirical moral psychology are absolutely essential. Continuously collecting and analyzing information about what students know and think about engineering ethics, related moral intuitions, and technical concepts, can be used to tailor curricula to background knowledge and current perspectives, with the ultimate goal of increasing ethical behaviors. Additionally, information from different types of groups can be collected, addressing concerns about the representativeness of samples used in psychological studies, which are overwhelmingly comprised by participants who are Western and educated, from industrialized, rich, and democratic countries (WEIRD). Subjects with this profile are outliers on a variety of psychological dimensions, including “visual perception, fairness, cooperation, spatial reasoning, categorization and inferential induction, moral reasoning, reasoning styles, self-concepts and related motivations, and the heritability of IQ” [30, p. 61], making conclusions drawn from these samples suspect.

¹ To some extent, the effects of social phenomena on decision-making have always figured prominently in engineering ethics, for example, “groupthink.”
Further, the site described here has been designed with the goals of conducting qualitative as well as quantitative research, with the ability to use free-response rather than exclusively fixed-response question types. This is especially important in cross-cultural research, where participants might employ thought styles and response patterns different from those anticipated by researchers.[31] Finally, in the process of collecting information, participants can receive education, allowing both educators and researchers to monitor the effects of different types of interventions. That makes this site different from the ones used by psychology labs mentioned above.

**The contents of web-based educational modules on global engineering ethics**

Based on these motivations, the following section describes the nature of the educational modules and website itself, beginning with the materials and exercises, and moving on to describe how responses could be analyzed, and how doing so could affect behavioral outcomes.

The educational modules are based on partially abridged materials from *Global Engineering Ethics*, used with permission from the authors and publisher. As the title indicates, this text approaches engineering ethics from a “global perspective,” reconceptualizing engineering ethics in terms of the increasingly cross-cultural and international environments of contemporary engineering. Materials for the book were developed while teaching engineering ethics courses to national and international students at institutions in the US, Japan, Taiwan, and mainland China.

The modules are divided into two parts: Part one includes explanatory and theoretical materials, with readings about engineering, the role responsibilities of engineers, professionalism, business, culture, autonomy, and rights (Fig. 4). Part two includes case studies, with readings about events, policies, and trends relevant to materials in part one – for example, automation and the Uberlingen midair collision; energy policy, the environment, and international relations in China; and the sharing economy, Uber, and public safety in India (Fig. 5).
Fig. 4 Overview of part one – abridged materials

The contemporary context of engineering and engineering ethics

Engineering has traditionally been localized to specific countries and cultural contexts. Therefore, ethics for engineering could legitimately be based on the cultures of particular societies, and instructors could assume general familiarity with these among students. This is no longer the case.

Engineering is more cross-cultural and international than ever before, for example, the coming to dominance of multinational corporations, location of plants by national corporations in other countries, increasing international mobility of engineers, and establishment of international supplier and customer systems.

Therefore, ethics for engineers should be reconceived at a fundamental level, using the global environment of engineering as a starting point; for example, putting aside the particular national assumptions about the practice of engineering and theoretical foundations of ethics arising from specific cultures. Only assumptions that can be justified on the basis of engineering itself and universal human characteristics should be used as a starting point. The following are the most significant of these assumptions:

1. Engineering is not value neutral, and the activities of engineers should not leave the world less well-off than it was before. A cursory definition of “engineering” could be the following: transformation of the world, using scientific principles and mathematics, in order to achieve some desired practical end.
2. The ability to use reason is a relatively universal human characteristic.
3. Human beings exhibit a tendency to seek out their own gain, although not exclusively so, and the dominant manifestation of this tendency in the contemporary world is the adoption of capitalist markets and associated behaviors.
4. Different cultures have different value systems, and these can conflict at a fundamental level.
5. A non-religious/secular approach to ethics is the most appropriate for a global perspective on engineering ethics.

Give an example of a behavior you consider prototypically unethical.

Please input your answer in the box

Fig. 5 Overview of part two – case studies

Case Studies

Case Study 1. The Überlingen midair collision: Systems conflicts and global contexts

Case Study 2. Development and its broader contexts: Coal mining and energy, and the West-East Pipeline in China
Questions appear throughout part one and at the end of the case-studies in part two. These questions serve two related ends: first, causing participants to reflect on their own knowledge and experience, fostering critical thinking skills in relation to and better retention of contents; second, for research purposes, to better understand what users know and think about concepts and contents related to ethics, technology, and society (Fig. 5 and Fig. 6).

**Fig. 5** Free-response questions about ethics

- **Please input your answer in the box**

1. Engineering is not value neutral, and the activities of engineers should not leave the world less well-off than it was before. A cursory definition of “engineering” could be the following: transformation of the world, using scientific principles and mathematics, in order to achieve some desired practical end.

2. The ability to use reason is a relatively universal human characteristic.

3. Human beings exhibit a tendency to seek out their own gain, although not exclusively so, and the dominant manifestation of this tendency in the contemporary world is the adoption of capitalist markets and associated behaviors.

4. Different cultures have different value systems, and these can conflict at a fundamental level.

5. A non-religious/ secular approach to ethics is the most appropriate for a global perspective on engineering ethics.

- **Please input your answer in the box**

Give an example of a behavior you consider prototypically unethical.

- **Please input your answer in the box**

Explain what makes this behavior unethical.
Fig. 6 Free-response questions about culture

Given cultural diversity, it is important to recognize the limited scope of ethics in engineering here. Matters of courtesy or custom will not be considered within the scope of ethics. Additionally, ethics is concerned with potential effects on others. A number of ethical traditions stress character development or the spiritual state of persons, although such concerns are largely left aside here.

Give an example of culture:

Please input your answer in the box

Explain what makes this an example of culture:

Please input your answer in the box

submit

Questions appearing at the end of the case studies concern each of the ten steps of the case-study procedure outlined in chapter two of *Global Engineering Ethics* (Fig. 7 and Fig. 8).

Fig. 7 Step one of the case-study procedure

**Case study step 1**

List as many ethical issues as possible – remember, ethical issues concern what individuals/organizations should or should not have done/might or might not have done, and are posed in the form of a question.

Should the pilots of 757 have confirmed their new altitude to Nielsen?

Should the second air traffic controller have taken a break, leaving Peter Nielsen on his own?
Fig. 8 Step two of the case-study procedure

**Case study step 2**

Choose the most important one – or reformulate a new issue that encapsulates multiple issues from step one – providing a brief (one- to two-sentence) explanation for why this issue is the most important.

**Most important ethical issue:**

Should pilots receive the same training in all countries?

**Justification:**

This issue encapsulates the greatest number of subsidiary issues, involving not only technologies but the relations between individuals and organizations. Additionally, had both sets of pilots received the same training and acted accordingly, then the disaster might have been averted.

Versus multiple-choice, fixed-response questions – generally used in web-based educational exercises – here participants are forced to more thoroughly reflect. Additionally, participants practice the skills of articulating their own beliefs in an organized fashion.

To review these responses, the site will use natural language processing algorithms that can word cloud responses, providing images of the conceptual schema participants use to think about ethics, technology, and related concepts. Sentimental analysis allows administers to discern the emotional valence of these schema, indicative of emotional states and potential motivations occurring in relation to them. These analyses will be guided by theoretical paradigms within moral psychology and experimental philosophy, described in the final part of this paper.
These results can be shared and discussed with participants, exposing them to what their peers think and positions they might not otherwise have considered. Doing so allows for the possibility of dispelling “pluralistic ignorance,” either not knowing what others do or think should be done, or mistaking what others do or think should be done.[32] This strategy has been successful in combatting excessive alcohol consumption on university campuses, as well as affecting other types of social change.[33]–[35] Exposing and dispelling pluralistic ignorance could reduce unethical behaviors in professional environments.

Research on cross-cultural moral psychology
The final part of this paper outlines the kinds of moral psychological research that could be conducted with the website, surveys and questions included on the website to do so, and the theoretical paradigms to which these belong.

To better understand moral judgments and intuitions, and why people engage in (un)ethical behaviors, the site will also host a section with questionnaires and thought experiments. On registering for the site, participants are told their responses will be stored and analyzed for research. The research is described – benefits, drawbacks, and confidentiality – asking participants for consent that their responses be stored and analyzed (Fig. 10). After agreeing, site visitors can enter information concerning, for instance, gender, ethnicity, socioeconomic status (SES), education levels, nationality, and political and religious orientations. Since information of this type has been shown to affect thought style[36], [37], personal and cultural values[31], and perceptions of ethics[38]–[43] and technology[44], these can be treated as input variables in correlational, cross-sectional and longitudinal studies, identifying interesting trends.

At present, participants are unable to access educational, survey, and thought experiment materials without registering and submitting demographic information, although this will be changed in the future.

Fig. 10 Study information/consent to participate

CONSENT TO PARTICIPATE IN A RESEARCH STUDY/HAVE ANSWERS COLLECTED AND ANALYZED

Principal Investigator:

Confidentiality: Please answer as honestly and thoroughly as possible. No specific answers or identifying information will be disclosed publicly.

Purpose: To better understand the nature of and views about morality and topics related to applied ethics.

Procedures: If you consent to participate, you can read a variety of materials and answer questions about them.

Potential Risks or Discomforts: There should not be any risks or discomforts. You will be asked to honestly and thoughtfully answer questions about yourself, knowledge, and views.

Potential Benefits: Better understand topics related to applied ethics, your own views of morality, as well as those of others

Questions, Comments, or Concerns: If you have any questions, comments, or concerns about the research, you can contact

☐ I consent to participate in this study.

☐ I consent to receive information regarding this work.

Next
Materials can easily be altered, allowing for the creation of different experimental conditions, for example, administering dilemmas in different languages\[45\]–\[47\] or including images of watching eyes\[48\]–\[50\], as these have been shown to affect decision-making. In addition to questions embedded in the modules, initially the site will include trolley-car and other types of ethical dilemmas used in previous studies\[51\], \[52\], as well as the Moral Foundations Questionnaire (MFQ). These materials belong to “pluralist” theories of moral psychology, where the contents of moral judgments are conceived as multi-faceted, not about only any one thing.\[53\] Pluralist paradigms are especially relevant to engineering ethics, since this field tends to highlight conflicting interests and principles as ethical issues – for instance, a duty to public safety and health versus an obligation to an employer. The interested reader can consult the appendix for a fuller description of exercises and instruments that will be used on the website to study cross-cultural moral psychology, as well as descriptions of the theoretical paradigms to which these belong.

Conclusion
The website described here has been set up, and some modules and surveys have been placed online, although the project is still in its infancy. The website will be operational by May 2019, at which point it will be piloted in three sections of a course on engineering ethics, using the site and modules for educational and research purposes. Based on these results, the site and modules will be further refined, and used again for two sections of a course on engineering ethics during the fall 2019 semester. All results from the summer and fall semesters will be presented next year.

With time and refinement, the site could become a powerful tool for educators in engineering and researchers in the social sciences. The site could also be used – or similar ones could be established – for other branches of applied ethics, since these fields face similar challenges. The authors of this paper are actively seeking out institutional and industry collaborators to further develop and use the site. Any and all inquiries are encouraged.

References


Appendix

The following further describes theoretical paradigms used to study cross-cultural moral psychology empirically, and the exercises and instruments included on the website to which these belong.

Trolley-car dilemmas, a dual-processing model of ethical decision-making, and social and evolutionary accounts of norms

Greene and colleagues have proposed a dual-process model of moral decision-making, where utilitarian and deontological judgments result from different cognitive processes, operative in different circumstances and subserved by distinct regions of the brain.[25] This model is supported by evidence from studies using trolley-car and related ethical dilemmas, which bring consequentialist and rule-based judgments into conflict, measuring response times and using fMRI
scans to better understand, for example, which types of judgments are more intuitive and why they come into conflict.[51], [54], [55] This framework has been used within medical ethics, where medical administrators were found to make more utilitarian judgements than either doctors or the rest of the population, likely because of training and work.[52]

However, given the incredibly social nature of the human species, it is unlikely that ethical judgments and/or (un)ethical behaviors result from cognitive processes involving individuals alone. Rather, these judgments and behaviors are likely affected by social factors. Such an account has been proposed by Biccheri and colleagues, pulling from but modifying the theory of planned behavior by Ajzen and colleagues.[33] According to Biccheri’s social-expectations account of norms, behaviors result from different types of motivations and information. She differentiates “customs,” rules of behavior intrinsically motivated by personal preferences, from “descriptive” and “social” norms, behavioral rules extrinsically motivated by knowledge of what others are doing/will do, and what others expect one to do, respectively.

Challenging this account with insights from theories of gene-culture coevolution[56]–[58], Kelly and Davis have outlined a cognitive evolutionary theory of norms, which they refer to as the “minimal account.”[59] This account gives central importance to punitive measures in the enforcement and stabilization of norms and cooperative behaviors, as well as their intrinsically motivating nature, neither of which are essential to Biccheri’s account. To test these theories, additional questions could be posed after trolley-car dilemmas, for instance, asking what others are likely to do or think.

The MFO, scope, and structure of the normative domain
The dual-processing model, and social and evolutionary accounts of norms concern the nature of moral judgments and norms – what people consider right and wrong in given situations, and how and why they make these judgments. They do not address the “scope” or “structure” of the normative domain – the kinds of behaviors people think fall within the purview of right and wrong as such, and how these behaviors and judgments are related. However, judgments regarding the scope of normativity and its structure are likely related to the nature of moral judgments and norms. Moral Foundations Theory (MFT) can be used to address this relation.

MFT is a social intuitionist model of ethical decision-making, conceived by Haidt and colleagues.[24] It highlights the non-rational, social dimensions of normative thought. According to MFT, moral judgments result from “intuitions” closer in nature to feelings than rational thoughts. Rational thought plays only a secondary role, justifying judgments to oneself and others once they have been made. Intuitions result from different “moral foundations,” which have been likened to mental “modules,” suites of fast acting, informationally isolated cognitive mechanisms, which have evolved to deal with different kinds of ancestral challenges and respond to specific contents.[60] This is the intuitionist component of MFT.

Evidence has been given for the existence of five moral foundations, dealing with care, fairness, loyalty, authority, and sanctity.[3] The first two have been called “individuating” foundations, primarily concerned with protecting individuals, and the latter three have been called the “binding” foundations, primarily concerned with maintaining the integrity groups. Given their evolutionary origins, these foundations would be universal, although culture affects the relative priority given
to and contents associated with the different foundations. Those who identify as socially liberal, for example, have been found to emphasize the individuating foundations, judging a concern for the wellbeing (care) and equal treatment (fairness) of others as paramount in assessments of right and wrong, whereas those who identify as socially conservative emphasize all five.[61] This is the social component of MFT.

Questions about concepts and extended conceptual analysis
The reflection questions in the educational modules, and case-study procedure, concern the meaning and use of concepts, and encourage counterfactual thinking. For these reasons, participant responses can be used in “extended conceptual analysis.”

Conceptual analysis has been used by philosophers to clarify the meanings and uses of concepts. This has generally occurred through a “method of cases,” wherein actual or imagined scenarios are considered, to decide whether a concept would or would not apply, in some cases breaking down a concept into its component parts and/or outlining necessary and sufficient conditions of its application, consulting one’s intuitions in the process, to confirm, reject, or modify the analysis.[62] Since the intuitions of philosophers might not be especially representative and/or truth tracking[63],[64], empirically-minded experimental philosophers have extended this work to broader populations.[65]

In a series of now classic studies, Joshua Knobe used this method to study the notion of intention.[66] Intention has generally been conceived by philosophers as involving foresight and volition, where one’s actions would be intentional if and only if they involve anticipation of an outcome and a desire to bring about that outcome. However, this account has been undermined by asymmetrical responses to scenarios where agents act with foresight but without volition, showing that the ways people conceive of intention and apply it are different from and, perhaps, more complicated than might initially appear. Similar work has been carried out regarding other philosophical concepts, and differences have been found related to gender and culture.[62], [65]