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Understanding International Perspectives in Science and Engineering Ethics

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Abstract

In 2014 an interdisciplinary team of researchers from the University of Delaware began a 5-year project with the Online Ethics Center (OEC) to gather international perspectives on science and engineering ethics, broadly construed.[1] We seek instructional and scholarly materials from international institutions and individual foreign scholars and teachers. This paper describes the rationale and outlines the theoretical foundation of this project. The central issue to be addressed here is: if there is indeed a benefit to the "internationalization" of science and engineering ethics, how can that benefit be understood from the more general standpoint of the purposes of science and engineering ethics *per se*?

It is now widely understood that contemporary science and engineering are increasingly international and collaborative. These complex practices are subject to difficulties introduced by differences in languages, cultures, social norms, education, religion, political systems, laws, resource and infrastructure availability, and other factors. Despite these variations, there is an important common factor in the production of scientific and engineering knowledge: it is not just descriptive, explanatory, and predictive, but also normative. This means that there are explicit and implicit rules and guidelines, regulations, and norms of practice and sanction regarding how one *ought to* behave as a scientist or engineer. This normative part concerns how to do research, but also how to orient one's research to a world that expects to benefit from it.

Given this character of science and engineering as in part normative, a better appreciation of these norms worldwide will be necessary to understand actual practices, as well as to motivate critical appraisals of practice. I explain the rationale for collecting those views, and making them widely available for further study.

In the final part of the paper I discuss a "contractarian" theory of the good of publicizing differences in norms. This approach, which is inspired by the political philosophy of John Rawls, can be seen as an alternative to a "conventionalist" understanding of science and engineering ethics.

Introduction

Ethical issues associated with the integrity of science and engineering include the falsification of experimental results, fabrication of data, conflicts of interest in industry-funded research, plagiarism, and improper attribution of authorship for collaborators, to name just a few. All of these factors threaten the secure accumulation of knowledge. Additionally, revelations of misconduct can lead to the perception of a lack of professional integrity and a corresponding erosion of public support and trust in science and engineering. These threats could be mitigated by recognition and enforcement of ethical norms and expectations for research conduct. However it is difficult to develop useful ethical guidelines that are applicable across different academic and industry areas, as well as in different cultural contexts. For instance, conventions differ on the criteria for authorship and fair use of the published work of others. One ethicist has even gone so far as to claim that the field of research ethics is itself incoherent.[2] Compounding these challenges is the fact that science and engineering research often involves competition, so individuals and groups have an incentive to seek advantage by violating ethical norms of research and thus to free ride on the general compliance with these norms by competitors. As the economist Kenneth Arrow notes, *"an ethical code is useful only if it is widely accepted. Its implications for specific behavior must be moderately clear, and above all it must be clearly perceived that the acceptance of these ethical obligations by everybody does involve mutual gain."* [3] While the benefits to science and society of better programs of ethics instruction and inculcation seem obvious, it is far from obvious how this ought to be achieved.

While popular media outlets sometimes report research ethics scandals, critical ethical inquiry into science and engineering is usually limited to university study in the various areas of applied ethics. Topics such as pollution and the use of non-renewable resources in science and engineering, STEM in the defense industry, the proper use of taxpayer dollars to fund controversial research, and the role of information technology in threats to individual privacy are included in curricula in environmental ethics, computer ethics, and bioethics. But these issues are not merely academic. Scientists and engineers must eventually face them when asked to justify the use of taxpayer monies to fund their research, to secure future investment funding, and in some instances to respond to complaints from interest groups or politicians. In recent years, funded research *and* ethics instruction have faced scrutiny from members of the U.S. Congress.

The work described here can be considered as an extension of efforts begun in the U.S. to improve online access to ethics resources in science and engineering. An important milestone in those efforts was the 2007 America COMPETES Act (ACA). In implementing the ACA, the National Science Foundation (NSF) acknowledged a need for the involvement of educators in science, technology, engineering, and mathematics (STEM) fields, as well as the involvement of ethicists, other humanists, universities and research organizations and the funding agencies themselves. In the wake of the ACA, the NSF funded three online ethics sites to assist individuals and institutions in meeting the mandate of the ACA: the Ethics in Science and Engineering National Clearinghouse at UMass Amherst, the Online Ethics Center at the National Academy of Engineering, and the National Professional and Research Ethics Portal, which evolved into Ethics CORE (Collaborative Online Resource Environment) and incorporates materials from the UMass project. Together, these online sites have contributed greatly to the resources available in research ethics and the responsible conduct of research (RCR) in science and engineering. The offerings include case studies, syllabi and other curricular aids, ethical and professional codes, original research on and news about research ethics, exercises, videos, and best practices. Past and ongoing efforts have not, however, focused on resources from outside of the U.S. This is the focus of the team of philosophers, social and natural scientists, and engineers that I lead at the University of Delaware.

We began our efforts by first recognizing the difficulties inherent in the subject matter, irrespective of global context. There are two basic challenges for understanding and improving the ethics of science and engineering. The first is the wide range of practices over which ethics is to be considered. Science and engineering include inquiries into the living and the dead, at many different scales, by academics, public sector employees, and industry researchers alike. How they *ought* to behave when they are practicing their respective crafts is often thought to be relative to each craft. The second challenge concerns variation *within* each practice, due to differences in mores that are manifest in laboratories, universities, journals, professional meetings, organizations, and academy-industry collaborations. Both challenges are made more difficult by what we might call the "anthropological" realities of *global* research, namely, the cultural, national, and linguistic diversity of researchers that complicates the matter of their collective ethics in many cases of collaboration. There is ample evidence that different normative traditions of research and practice have now begun to collide.[4] [5] [6] [7] Yet the benefits of doing international and collaborative science and engineering are such that no reasonable participant in these practices would want to retreat to an era in which collaboration was limited to colleagues in close proximity, and of the same nationality.

An analogy with the advantages of the Internet might be helpful here. There was a time when information exchange was slow, cumbersome and costly, and now it is fast, easy, and cheap. It is true enough that a networked world has also brought us spam, computer viruses, and the Distributed Denial-of-Service attack. But there is no going back—or at least there is no way back that does not involve tremendous loss. Similarly, national, cultural and linguistic diversity might complicate international science and engineering, but it is also part of its strength. So our main question can be restated: how can we better use the international character of science and engineering to understand and improve its ethics?

Overcoming the two challenges mentioned above, in light of the "anthropological" difficulty brought about by the scope of these practices, presents opportunities to develop a new, critical enterprise in an area of applied ethics. Instead of bemoaning the normative complexity introduced by global science and engineering, ethicists can use the diversity of norms to lead richer discussions of the ethics of science and engineering on the whole. This "windfall" of difference and contrast is something that is cherished in the ethics classroom. The best discussions of ethical issues almost always occur when students (respectfully) disagree. The ethics of science and engineering can also benefit from some disagreement—under the assumption that this is part of a process that is headed towards the convergence and acceptance of norms of research and practice, and not the opposite, towards divergence and chaos.

An anthropology of science and engineering ethics

As indicated above, contemporary science and engineering as a whole might be given an anthropological treatment, so that it could be studied as a collaborative set of complex behaviors, undertaken by individuals and institutions that vary by language, culture, social norms, education, religion, political systems, laws, media institutions, resource sufficiency, infrastructure, available technology, and national goals or agendas of the research enterprise. Cutting across all of these variations is a dominant but often overlooked factor in the production of scientific and engineering knowledge: it is thoroughly normative, with explicit and implicit rules and guidelines, regulations, and "folkways" of practice and punishment regarding what it is to do science and engineering. Our focus as part of the OEC project is on these normative factors, as they are manifest outside of the U.S., according to the contributions of foreign practitioners of science and engineering, including those who do science and engineering research, but also those who study, teach, and critique the practices. The prior projects funded by the NSF have focused on domestic resources in the same topical areas: responsible conduct of research, research ethics, the ethics of individual sciences and engineering fields, as well as the social responsibility of science and engineering. The scope of the expanded OEC, and hence of our international supplement to it, now covers areas such as sustainability, privacy and security, law and public policy, risk, and other normatively influenced topics. Clearly, this is a very large endeavor.

A distinction may help to organize what is being sought in such a collection of resources. Normative factors in science and engineering can be understood in narrow or broad scope. Narrowly, "ethical and responsible conduct of research" might focus just on the *processes* of research and practice themselves—e.g., how data ought to be gathered, represented in publication, or "managed" during and after publication; how inclusion and order of authorship is determined; what constitutes proper attribution (or failure thereof) concerning ideas and other intellectual contributions; and how scientific misconduct ought to be investigated.

Institutions and practices to regulate these narrow process issues have been or are being created in most developed nations with high levels of research,[8] in part in response to the perception that scientific fraud is a growing and international phenomenon that must be addressed. (The question whether scientific fraud is actually growing is quickly beset by a puzzle: since when?) There have been considerable international activities to address the narrow process issues of science and engineering; four meetings of the World Conference on Research Integrity have taken place since 2007 (Lisbon, Singapore, Montreal, and Rio de Janeiro). In 2011 the InterAcademy Council, through the InterAcademy Partnership (IAP) and its Committee of Research Integrity, began an international stakeholder project to forge "an international consensus on responsible conduct in the global research enterprise" and one year later issued their first report.[9] The IAP has now published a guidebook for responsible conduct of research, with a focus on global perspectives. [10] The narrow process factors of science and engineering ethics are increasingly under scrutiny.

Normative factors can also be understood more broadly to include a critical evaluation of the *products* of science and engineering research such as new knowledge, new technologies, or even negative outcomes such as inequities, inefficiencies, or social injustices that result from (or at least are not addressed by) such research.[11] The products of research may offer new opportunities to respond to global challenges such as climate change or world hunger, but they may also present new challenges of their own, such as bioterrorism, political instability, or the erosion of individual privacy. To date, these broad "product" issues have been less widely studied from an international and comparative perspective.

In considering both the (narrow) processes and (broad) products of science and engineering, the study of their normative factors can be undertaken as a descriptive inquiry in which norms, guidelines, and conventions are set out and clarified. As a description, the contributions of our international supplement to the OEC are designed to help populate the anthropology of science and engineering mentioned earlier.

But our goals go beyond description. Our larger aspiration is that the collection and publication of such materials can aid in a critical enterprise—one through which conventions and norms are deliberately and continually subject to challenge and refinement. In both cases—as description and as critical enterprise—the international supplement is intended to support pedagogic goals of breadth, balance, and the consideration of foreign perspectives in developing courses, syllabi, and instructional materials.

In thinking about ethics, many non-specialists will select from a variety of collections (physical and online libraries, available textbooks and other printed media), or may take the less-formal but still time-honored approach: ask a mentor or colleague. An online or physical collection—or any personal conversation, for that matter—runs the risk of inadvertent bias in favor of the ethical views of a particular community (linguistic or geographical), discipline, or nation. There is also the possibility of bias in developed world vs. developing world conceptions of science and engineering. After all, the most highly-cited research, as well as most of the textbooks, come from nations with highly-developed research infrastructures. The U.S. is the prime example. There is also the fact of cheap and fast access to those views that have been made available online. Contrast, here, the dearth of online resources from developing countries where Internet access and infrastructure is limited.

In terms of university pedagogy, it would be nice to think that considerations of difference and contrast in ethics will be useful. Moreover, it seems desirable to impart not just knowledge about science and engineering ethics, but also a kind of wisdom that that will serve students in the international, cross-disciplinary, and cross-cultural contexts through which their careers may take them. Since conventions differ markedly, it seems important to teach students how to reason critically through quandaries and disputes that are both value based and constitutive of behavioral norms. While the benefits to society of better programs of ethics instruction and inculcation seem obvious, it is far from obvious whether formal instruction can do all the work. Having good, critical online resources available for anyone to use should support the cause of formal ethics education.

Though it might be tempting to think that we can establish ethical standards governing research merely by adopting and enforcing conventional standards of conduct, these standards cannot be justified without examining the proper aims of research. Consider, for instance, that if one aim of research is to increase the number of publications, instead of the quality and depth of scientific knowledge, some level of plagiarism might well be justified. So the convention against plagiarism does not stand alone; it requires us to ask what we want out of science. Though conventions have their place in fostering collaboration, they require examination and testing. Students, faculty, and practitioners of science and engineering make up a diverse audience, and they will increasingly need to grapple with hypothetical cases, abstract principles, and engage in ethical reasoning. Reporting conventions, alone, cannot do it all.

The best print resources to help this audience will become rapidly outdated as we are in a quickly changing and global world of research. Print media are also costly to translate and to distribute widely. Finally, they include too few—and primarily Anglophone—viewpoints. Hence print resources in science and engineering ethics are likely to be of limited use and to run the risk of inadvertent bias towards the views of those who have easiest access to them.

To summarize, our basic challenges for understanding and improving the ethics of science and engineering are also our best assets. Variations in norms over cultural, national, and linguistic communities can the foundation of a new, critical ethics enterprise. This diversity provides opportunities for more fruitful discussion of the ethics of science and engineering on the whole.

A contractarian theory of science and engineering ethics

There is a deeper motivation behind the collection of international resources in science and engineering ethics that I would like now to sketch. To the extent that collecting resources in applied ethics requires a theory, I want to argue for one here that rejects a descriptivist or conventionalist understanding of science and engineering ethics. On conventionalist views, when a practitioner of science or engineering conforms to an ethical practice (such as refraining from plagiarizing), he or she does so because that is just "the way people behave" in the relevant context. If the convention were otherwise, the practitioner would just as easily conform to the contrary convention.

On the theory offered here, comparing and contrasting of international norms of science and engineering has a contractarian basis—one that follows, by analogy, the conception of the hypothetical social contract of "justice as fairness" made famous in the 20th century by the philosopher John Rawls. [12] On the contractarian view, there is a strong "publicity" requirement for airing of differences of opinion about norms of conduct within any practice that hopes to become more just. The same can be said of science and engineering: the opportunity to negotiate better norms of practice first requires a publicizing of differences. After, by means of a process that Rawls called "reflective equilibrium," practitioners are able to converge on an improved understanding of a norm. And, importantly, they will have done so through an exercise of "public reason" and therefore should be more inclined to endorse the outcome as one they would have adopted under ideal conditions. The goal, then, of internationalizing science and engineering ethics is both an eventual convergence of norms, and also a deeper internalization of them through reasoned consensus.

The development of an ethics by way of "reflective equilibrium" is intended to emphasize the public nature of agreements over principles of shared governance, the rational ability to find compromise between abstract principles (codes of ethics) and considered judgments about established practices, and ultimately the fairness of the results that we jointly consider to be reflective equilibria. For Rawls, the procedure was intended ultimately to justify our distribution of rights, liberties, opportunities, and other primary social goods. For scientists and engineers, reflective equilibrium can serve as a procedure to adjust their considered judgments about the rules and principles of research and practice to other, somewhat different views. As the bioethicist David Resnik has noted, the procedure of reflective equilibrium can serve to justify ethical rules and principles, allow for the resolution of conflicts between them, and avoid the kind of moral relativism that is often associated with outcomes validated merely by group deliberations.[13]

The idea of generating helpful contrasts with international ethics resources follows the pedagogy of problem-based learning, studies of which have suggested that it serves as an effective way to achieve cognitive as well as motivational effects.[14] In addition, the process of coming to consensus through discussion and debate should reinforce the fairness of the resulting norms of science and engineering. It is our hope that the collection of international science and engineering ethics perspectives will be a down payment on those goals.

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