Design and Assessment of the Social Responsibilities of Researchers' Graduate Training Program at the University of Notre Dame

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Why Social Responsibilities?

"Ethics" is, by now, recognized as a necessary and important part of the training of both undergraduate and graduate engineering students. But the word can mean different things in different contexts. While as received from philosophy the term is profoundly broad, covering everything from making good decisions to living the good life, when it enters the engineering education context considerations beyond immediate pragmatic concerns tend to fall away. Engineering ethics education at both the undergraduate and graduate levels tends to focus almost exclusively on distinctive professional responsibilities – that is to say, ethical issues that are commonly presented by the immediate practice of the work typical of each. For undergraduates, this is professional ethics in an industrial or consulting context.[1] For graduate students, whose training is preparation for a career in research, this is typically research ethics, implicitly in an academic context.[2] Thus, both construe the responsibilities of the engineer relatively narrowly. In particular, the concerns of each taper dramatically as the borders of the immediate work site are crossed.

While some focus is of course necessary and appropriate, the present narrowness has arguably become unhealthily myopic, particularly given the influential roles science and technology now play in modern life.[3] This can be seen by considering ethics training as following from the anticipated scope of responsibilities. Certainly, engineers and researchers, like anyone else, bear primary responsibility for the diligent and competent conduct of their own immediate work. The training typically provided speaks to this, as it should. Yet that work – whatever it may be – is undertaken for a reason and occurs in a complex social context. No matter how impeccably it is conducted, the product of that work – be it a new drug, a new building or a new theory – will have a cascade of impacts on society; many salutary, some less so – but all following from the work of scientists and engineers. Given this, some responsibility is clearly borne for these impacts, too. It is then apparent that ethics training that omits consideration of the social and ethical effects of science and technology on broader society is problematically incomplete.[4]

As the NAE has helpfully highlighted recently, an expanded perspective has begun to take shape in many innovative undergraduate engineering ethics courses.[5] Yet – perhaps due to the lack of accreditation and the diversity of degree programs – few such broadening efforts seem to be found in graduate ethics training. Those that do exist tend to focus on particular sets of issues in specific disciplines (for example, issues of privacy in computer security), which are laudable but not widely transferable. This omission is especially troubling given that the impact of the work, and the resulting responsibility, is arguably larger in cutting-edge research than in

the routine practice of engineering. Yet reflection on the traits and skills necessary for a scientist or engineer to productively engage with the social impact of his or her work reveals another reason why relevant training is usually missing: the difficulty in specifying what such training might look like, much less how to provide it.

SRR at Notre Dame

For these reasons, in 2013 the Reilly Center for Science, Technology and Values at the University of Notre Dame applied for and received an NSF EESE award to research, pilot and assess training in the Social Responsibilities of Researchers (SRR).[6] The resultant year-long training program formally began operation in 2014 with its first cohort; at present it is operating with its second cohort and recruiting for its third and final cohort, which will begin the program in May, 2017. The SRR project personnel consisted of Prof. Don Howard of the Philosophy department, PI; Dr. Melinda Gormley, then Assistant Director of Research at the Center and co-PI (who has since left the University and the project); and Dr. Mark Bourgeois, who was recruited to help design, implement and run the program.

Each cohort consists of 15 Notre Dame PhD students from a STEM field, broadly construed. Students are drawn from all fields of science and engineering, including natural science, social science and engineering. All are either in the second or third year of their doctoral program. By design, these students are generally just completing their coursework and have not yet formally begun their dissertation research; this allows them to apply their social responsibilities training to it once they do start. To apply, students submit a cover letter, a CV or resume, and one letter of recommendation (from their advisor, if assigned). Applications typically exceed spaces by around two-to-one, making admissions competitive. We do select students based on the strengths of their interest in the social relevance of their work or field, so this selection should be kept in mind when generalizing the results of the program. We also strive for diversity in disciplines as well as gender and race.

As a participation incentive, students in the program do receive a $1,400 stipend and three course credits. This modest stipend serves two purposes. First, it incentivizes the investment of time and effort in the program by the student, when so many other activities and priorities are competing for these. Second, it demonstrates to the student's advisor that we value the time that we take of their student, which might otherwise be spent in the lab or on research. While we may never know of students whose advisors did not support their application, we have been gratified to find that advisors of applicants uniformly endorse the value of the program and are happy to allow their student's participation in it.

What is needed for Social Responsibilities training?

One of the challenges of designing training in social responsibilities is that the scope and nature of those responsibilities are large and will vary greatly by field and by student. The

ultimate goal is to produce an enlightened, empowered and socially-aware researcher who knows how their work may affect people or institutions – and who shapes their work with these impacts in mind and can lead others in doing so. Of course, we cannot hope to equip students to tackle any and all social ramifications in their field. But we do hope to provide them with the confidence, motivation and an initial foundation of skills to begin to engage those issues that they find to be most relevant or significant to them.

The range of skills potentially required to productively engage with the impacts of research is extremely broad. However, it can be helpfully broken down into four main areas:

1. *Values and ethics*: basic understanding of ethical theory and virtue ethics; ability to self-reflect on values and priorities; ability to make difficult ethical decisions
2. *Knowledge of relevant non-science social contexts*: this may include areas such as policy, business, economics, healthcare, politics, media, religion, or culture
3. *Communication skills*: including science communication to laymen; general public speaking and presenting; interviews and speaking to media; interacting with policy makers; and learning to listen
4. *Leadership and decision making*: this includes leadership and management skills, personal values and priorities, personality types and skill sets of self and others, and weighing ethical concerns in decision making

The SRR program focuses in particular on areas 1 – 3. Area 4, leadership, along with area 1, values and ethics, are the focus of a sister program to SRR at Notre Dame, the NSF CCE-STEM project known as EL-STEM (Ethical Leaders in STEM), operated out of the Graduate School at ND.[7] Both programs share the goal of producing an enlightened, empowered and socially-engaged researcher and leader. SRR focuses primarily on the research and its impact, presuming that the researcher who is immersed in these issues will become an enlightened, responsible leader who attends to them as a researcher and beyond. EL-STEM focuses primarily on the researcher as an agent, presuming that if the researcher gains leadership skills and insights, the work they do as a researcher and beyond will take broader considerations into account. The EL-STEM program runs in parallel with SRR, with a comparable student population. The two programs use a largely overlapping set of assessment instruments which will allow us to assess the two programs comparatively as well as independently. Future publications and presentations will detail the EL-STEM program as well as the comparative assessment results. Here, most of the focus will be on the SRR program, except as EL-STEM is relevant.

While these four areas are a helpful schematic, they are each still too broad to either build program activities around or assess against. For these purposes, a more specific set of goals is required. These can be elucidated by thinking through the tasks an idealized socially responsible researcher will face, and the skills involved in successfully accomplishing them.

For example, imagine a biologist researching antibiotic resistance, as a student in the first cohort of SRR was doing. To begin with, he or she needs to branch out of the lab. They should understand the social context that their research work will (or could) enter into. An obvious area here is healthcare and medical facilities, where antibiotic resistance poses the most serious problem. But in this case that turned out not be the most salient area, for the bulk of antibiotics in this country are in fact used in livestock and it is in livestock that bacteria most often develop resistance. Only from there do they typically present a serious threat to human health. As is often the case, this context, therefore, presents both a causal factor (an input) and an area of impact (an output) for this research.

Having understood, at a basic level, the relevance and contours of this real-world context, and how their own work might both influence and be influenced by it, the next task is to engage that context to learn more about it and, as possible, to explain the research results or related results from his or her field. In this scenario, this means speaking to policy makers tasked with setting rules for the provision of antibiotics to farm animals, and, eventually, to farmers themselves. This requires communication skills to non-scientists and policy-makers, both to explain the student's own research but also to learn more about the practical constraints involved.

Having begun this interaction, the ongoing aim is to incorporate insights, concerns and impacts back into the research project. This could take many different forms, such as modifying the goal of the research to address a practical problem encountered in the field, or changing research methods to take account of available data sources. Perhaps no changes will be necessary, but in this dynamic process the engaged researcher will know this, too – and know when and if it changes.

Throughout this process the researcher must know their own moral values and priorities and learn to bring them to bear in the work – for as the person performing the research, ultimately it is these which drive the entire activity. Likewise, they (like the rest of us) must be able to critically evaluate their own motives and assess their success from time to time. Finally, any researcher who elects to engage in this fashion must recognize that he or she is setting themselves up as an ethical role model in doing so, and must be prepared to bear that responsibility as well. This includes mentoring junior personnel and students generally and in social engagement. Putting this sequence of activities together yields a set of six goals for social responsibility training. They are for student researchers to:

1. Become more sophisticated in their understanding of the broad social and political context their work takes place within
2. Learn to think about the impact their work could have, whether in downstream consequences or in social relevance

3. Communicate and interact better and more responsibly with the general public, with stakeholders in their research, with cross-disciplinary collaborators, and with policy makers
4. As appropriate, adapt their research to enhance its social relevance and impact, including modifying its direction or its conduct
5. Become more cognizant of their own values, motivations and ethical orientation, so they can drive further ethical change and defend against complacency
6. Act as a mentor and ethical model, and help change the culture of their lab, field or discipline by serving as an example of ethical engagement

These six goals, collectively, have effectively become the definition of social responsibilities of researchers training at Notre Dame. As such, they guided both the program development of SRR and its assessment strategy. They did the same for the EL-STEM program as well. We now turn to the concrete training activities of the SRR program before examining its assessment techniques.

SRR program design

SRR as a training program is a mix of activities, including classroom instruction, self-guided work and, centrally, an extended social engagement project of the student's design. As students progress through the one-year-long program, their autonomy increases. To begin with, the SRR program kicks off with a one-week "Boot Camp" in mid-May. The first week following graduation – after the spring semester has fully concluded but as soon as possible afterwards to avoid summer travel conflicts – the 15 SRR fellows meet for 45 hours of classroom instruction, socialization and a field trip.

The classroom content covers a wide range. There are lecture-discussions on ethical theory, on virtue ethics, and on practical ethical decision-making. There are also in-depth case studies of the impacts of science and the reactions of scientists – for example the so-called Scientists' Movement following from the development and use of atomic weapons. Rather than hear only from the SRR faculty, at least two sessions are dedicated to bringing in local faculty who exemplify socially engaged research. The 2016 Boot Camp, for example, featured talks by Prof. Jennifer Tank of the Biological Science department, who collaborates with local farmers to study water pollution run-off, and Prof. Marya Lieberman of the Chemistry department, whose research has produced low-cost tests of pharmaceutical purity for the developing world. These talks help show students that social engagement is not an unattainable ideal but a daily reality for many researchers on their own campus.

During Boot Camp students also receive instruction, practice and feedback in public communication, as they 'pitch' themselves and, later, their projects.[8] Other sessions are dedicated to exploring the opportunities and resources on campus that they can turn to for

support with their project, including the large and diverse Center for Social Concerns. Finally, a local field trip is part of the camp, typically to a firm, emNet LLC, that grew directly out of research at Notre Dame and is now making a material difference to how South Bend and numerous other cites deal with wastewater management. Each cohort is deliberately selected for diversity of fields and research interests, with particular attention paid to representation from social sciences, natural sciences and engineering. Beginning in Boot Camp, these different viewpoints begin to cross pollinate in conversation both inside and outside of the classroom. This, too, is an important aspect of the SRR Boot Camp.

Beyond Boot Camp, the focal point of each student's time in SRR is a social engagement project of their own design. Boot Camp provides students their first opportunity to begin articulating and developing these projects. Projects in SRR have taken many different forms. The student studying antibiotic resistance mentioned above, for example, ended up giving a public "Science Café" talk. These talks are coordinated by a local organization to increase understanding of science by the general public and are usually given by senior researchers.[9] His talk highlighted the crucial connection between public policy, medical research and health issues – connections which the student himself was not aware of before starting SRR.

After discussing ethics in Boot Camp, a student in anthropology and peace studies became taken with the profound ethical issues implicit in research conducted in the conflict zones of the world. As her SRR project she undertook to develop a novel framework for recognizing and addressing these issues. This framework then became the basis of a peer-reviewed published paper. [10]

A third project took the results of the student's engineering research and, using a smartphone app, made them available in a clear and accessible form to practitioners. This tool allowed the construction of safer foot bridges in the developing world by leveraging the latest findings in aero-elasticity. Notably, this student also went on to compete in and win – at both the local and regional levels – the Three Minute Thesis (3MT) competition.[11]

While student projects in SRR are typically fairly small scale, they represent far more than their products alone might suggest. They are, hopefully, the beginning of a life-long engagement with at least some relevant dimensions of the student's research area. Moreover, they also serve to show students that they can actually make a difference there, countering the attitude that scientists both cannot and need not engage with the social impacts of their work.

Following Boot Camp, students have the remainder of the summer to further develop their project plans, or fulfill any prior research commitments they may have. When the academic year starts, SRR convenes occasional meetings, approximately 5 times per term. In the fall term, these generally consist of further instruction and outside speakers. For example, at the first

meeting in fall Dr. Bourgeois provided a workshop on Design Thinking aimed at developing projects in SRR. Other talks included sessions on writing for a general audience given by Dr. Jessica Baron, Communications Coordinator and Director of Media and Engagement for the History of Science Society; a talk on working in the public policy space by Dr. Melinda Gormley, then a AAAS fellow at EPA; and a talk by a member of the Templeton-funded Developing Virtues in the Practice of Science project here at Notre Dame on that research. In the spring term, these meetings come to consist mainly of the SRR students presenting on the status of their projects. These are useful as practice for the students, as a check on progress, and as a chance for students to get support and advice on any issues they may be facing in executing their project.

SRR assessment development

As noted above, the six goals of the SRR and EL-STEM programs were crafted both to guide program development and to provide a touchpoint for their assessment. To reiterate, the six goals are as follows: 1. Better understand the social context of one's work; 2. Perceive the social and ethical impacts one's work might make in that context; 3. Effectively engage in public communication; 4. Adapt research as needed for improved impact; 5. Self-reflect on ethical issues; and 6. Model and mentor others in these skills. Notably, the programs seek both to increase skills in each of these areas and also to increase student interest in, motivation for and prioritization of them. Indeed, developing such skills is a lifelong process which we hope merely to initiate, not complete. This dichotomy is reflected in the assessment instruments.

In measuring any results of the SRR program, we recognized the value of using validated scales, as relying on scales without validation makes the measure itself subject to interpretation and effectively results in an experiment with two dependent variables and no independent variable. With the program goals specified, the first task became to find validated scales in the psychological literature that would reflect them. The number and range of our goals mandated that we would need to use a number of different scales in tandem. SRR personnel were assisted in this work by Dr. Seth Berry, then of the Notre Dame Center for Social Research, and Prof. Darcia Narvaez of the Notre Dame Psychology department.

We eventually identified four validated psychological scales that spoke to central aspects of a number of the program goals. These were Schlenker's Integrity and Character Scale; the New General Self-Efficacy Scale; the Community Service Attitudes Scale; and the Defining Issues Test version 2, or DIT-2 (paired with additional scenarios from the Engineering and Science Issues Test, ESIT). A word about the nature and role of each is in order.

Integrity Scale

Schlenker's Integrity Scale is a measure of moral identity.[12] That is, it is a measure of whether the student sees the moral principles he or she holds (whatever they may be in

particular) as central to his or her identity, versus as external factors to be complied with or compromised as convenient. In other words, it is about whether the student sees his or her ethical priorities as central to who he or she is as a person. We see the Integrity scale as reflecting the motivation of the student for pursuing goals 5 and 6; that is, moral self-reflection and moral modeling.

New General Self-Efficacy Scale (NGSES)

The NGSES measures the student's attitude towards their own sense of efficacy.[13] For example, it tries to capture how easily they may give up or how persistent they see themselves as being, and whether they see themselves as someone who usually succeeds or not, or who seeks out challenges or not. A sense of self-efficacy is critical to moral development, because it is critical to actually following through with moral actions. A person who has a keen sense of ethics will not be an effective ethical actor unless he or she also has a sense that his or her actions can make a difference and unless he or she will have the perseverance to follow through even when obstacles are encountered. We see the Self-efficacy scale as measuring an important prerequisite for goals 1-4; that is, learning to understand context, project impact, communicate well and adapt research. Of these, goal 4, adapting one's research to enhance its social impact, is perhaps most relevant.

The Community Service Attitudes Scale (CSAS)

The CSAS measures student attitudes towards community service projects in terms of both benefits to themselves and others as well as costs.[14] It probes whether and how highly students value community volunteering, and how sensitive they are to the personal costs (e.g., time and effort) of doing so. Because the SRR training program involves a service project as a major component, we want to see how the experience changes their attitudes towards service, and whether it encourages them to engage in further public engagement activities or discourages them from doing so. We see the CSAS scale as reflecting the level of student motivation to pursue essentially all 6 goals; albeit goal 5 and 6, moral reflection and modeling, may be relatively less implicated depending on context.

The Defining Issues Test 2 (DIT-2)/Engineering and Science Issues Test (ESIT)

The DIT-2 is a measurement of the sophistication of the student's moral development.[15] Specifically, DIT2 measures the degree to which the taker sees ethical conduct as complying with rules to avoid punishment (pre-conventional), or because that's simply a rule everyone is supposed to follow (conventional), or, at the highest level, because there are universal ethical principles that must be upheld (post-conventional). It was co-developed by SRR consultant Darcia Narvaez. The results of the test place the taker in one of the three levels: pre-conventional, conventional, or post-conventional, with an increasingly sophisticated conception of morality at each level. ESIT is an adaptation of the DIT-2 developed by Jason Borenstein and collaborators using the same structure but with the scenarios rewritten to apply directly to

science and engineering contexts.[16] The premise and results of the test remain unchanged from the DIT-2. Over the course of the three administrations of the assessment package (as described below), we will administer the complete set of five DIT-2 stories and four scenarios from ESIT, providing three unique scenarios in each of the three assessment administrations. We see the DIT-2/ESIT as measuring skills associated with goals 5 and 6, moral reflection and modeling, respectively, and also as reflecting the requisite motivation to pursue goal 1-4.

In addition to these four scales, we also decided to include the brief Moral Foundations Questionnaire, or MFQ. The MFQ measures the degree to which the test taker relies on each of five moral foundations in making moral judgment.[17] The five are harm, fairness, loyalty, respect for authority, and sanctity. Creators Graham, Nosek and Haidt et al hold that these five dimensions collectively account for moral judgments in everyone, but different types of people rely on different dimensions to different degrees. As this is held to be a property of a person's established personality, we do not expect to see changes in these basic moral outlooks as a result of the training program. However, we were curious to see if there was any pattern to the foundations of the students who chose to pursue training in (and expressed the greatest interest in) social responsibility.

We had thus arrived at a collection of five validated scales drawn from the psychological literature. Together, these did a reasonable job of measuring relevant changes in student outlook and skills related to the program's goals. However, because of the diversity and number of the skills the program targets, there were critical aspects of the program for which we could only infer inclination or motivation, and not skill. For example, while improved skill in communicating research is a major goal, no psychological survey could directly capture growth in such a skill. Rather than subject each student to a live performance examination, we decided to simply break down each goal into a number of distinct skills and ask students to self-report on their level of proficiency in each.[18] We called this the "Personal Assessment". Each of the six goals was represented by approximately ten questions (for example, "I am able to explain complex or difficult concepts in basic terms and language" or "I am able to proactively recognize potential challenges caused by environmental factors/context"). Each of these is self-rated on a Likert agree-to-disagree scale of 1-6, with N/A also an option.

Finally, it was felt that with this large number of multiple-choice response questions, some opportunity for students to respond to questions in their own words would also provide useful insights. In this, we would hope to glimpse enhanced nuance and complexity or depth of moral thinking. Therefore the seventh and final assessment instrument consists in short-answer responses to two ethics case studies drawn from the WebGURU undergraduate research training website.[19]

The final assessment package in SRR is therefore a set of 7 distinct instruments: 4 validated psychological scales that we hope to see growth in, plus a fifth scale as a check on ethical foundations; a set of direct self-report questions on skills related to program goals; and a set of short-answer ethics scenario text responses.

Assessment scales:

1. New General Self-Efficacy Scale
2. Integrity and Character Scale
3. Community Service Attitudes Scale
4. Moral Foundations Questionnaire
5. DIT-2 and ESIT (combined scenarios)
6. Text response cases (from webguru.neu.edu)
7. Personal Assessment of program goals (custom)

Mapping of scales to program goals:

Scale/Goals	1) Context	2) Impact	3) Communicate	4) Adapt	5) Reflect	6) Model	Notes
DIT2/ESIT	M	M	M	M	S	S	
MFQ (Moral Foundations)							Test for self-selection type
Community Service	M	M	M	M	M		
Text Responses							
Integrity					M	M	
Self Efficacy	P	P	P	P			
Personal Assessment	S	S	S	S	S	S	Self-reported
Social Network Analysis						S	EL-STEM only; not used in SRR

M	Motivation
P	Prerequisite
S	Skills

Assessment administration methods

The SRR assessment package of 7 instruments, described above, is completed by each student in SRR three times. The first is a pre-test, taken after admission to the program but before any activities are convened or any materials distributed. The second instance is a post-test, completed immediately after completing their year in the program (late April). The third instance is given one year after the post-test – this is to test for the durability of any changes detected in the post-test.

The assessment package is administered online via the Qualtrics platform, supported by the Center for Social Research (CSR) on campus at Notre Dame. The CSR also assisted in selecting the validated instruments used in the assessment and will assist in data analysis, including a planned factor analysis effort. Students admitted to SRR complete an informed consent form agreeing to take the assessment package three times. Student responses are kept confidential and results are anonymized before being provided to the researchers.

While both SRR and EL-STEM admit 15 STEM PhD students each year, SRR admits second- and third-year students while EL-STEM admits third- and fourth-year students. Third-year students are thus admitted to both programs and are the focus of the comparative assessment. In addition to the students in one or the other program, third-year doctoral students are also recruited as controls, matched by department (or at minimum by college). Control subjects are recruited with the incentive of book store gift cards in modest denominations, and surplus numbers are recruited to account for attrition. Control subjects take the same assessment at the same frequency and in the same time periods as the experimental subjects.

With only 15 students in each program at any given time, reaching statistically reliable sample size is a hurdle. However, each program has initial funding to train three cohorts, for a total of 45 students each. As each student takes the assessment three times, this is a total of 135 samples from each program.

For the program comparison, with two programs, each slated to run for at least three cohorts, each cohort will have approximately 8 third-year students, plus a control set of another 8 students per cohort (representing the overlapping third-year population). This means that there are 24 students in each cohort taking the assessment three times for three cohorts, resulting in a total assessment sample size of 216. As is apparent, the longer the program runs, the more data is accumulated from both current and prior cohort members as well as controls. In this fashion, we hope to gradually compensate for the small cohort size, itself limited by available funding and personnel.

As of this writing, both SRR and EL-STEM are in the midst of training their second cohort and recruiting their third. As such, only one round of post-tests on a single cohort has been administered and no one-year-out assessments have been completed. While data from this single post-test has been analyzed at a basic level, unsurprisingly the results are not yet statistically significant. As they become so, future publications will describe results.

At the moment, we can only rely on feedback collected upon the first cohort's completion of SRR. This feedback was first collected with a structured survey administered confidentially via Qualtrics by the CSR. With this collective and anonymous data in hand we then convened a final cohort meeting in order to collect more personalized, detailed and interactive feedback, as well as follow up on suggestions for improving the program. We took this dual pronged approach because we felt it important to have both confidential as well as face-to-face opportunities for the students to provide input.

Feedback from the first cohort in SRR was extremely positive. Fully 2/3 of students reported that their time and effort in SRR had been "well worth" the effort or "more than worth"

the effort. None reported that it had not been worth their effort. Likewise, every student responding reported that they would either "probably" or "definitely" recommend SRR to their friends. Students shared that they found many valuable aspects to SRR, from the training in communication to ethical frameworks.

Two particular aspects are worth noting here. First, voicing a common theme, one student noted that SRR had provided him or her with the welcome opportunity to focus on the ethical and social ramifications of their research; but more than this, the student felt that SRR had validated their interest, calling the program a "mark of legitimacy" on their CV. In other words, this student felt that not only had SRR been valuable for exploring the issues in which they were already interested, but that having a formal program in which to do so helped demonstrate to their discipline that such interest had a place alongside their technical training. This is in fact a deliberate aim of the program.

Secondly, all but one of the nine students who completed the feedback survey commented on how valuable it had been for them to be put in close, frequent contact with students from entirely different disciplines yet with similarly strong interests in social engagement and ethics. One student commented that "[d]iscussing the ethics and responsibilities of researchers with people outside my field … gave me a different perspective on researchers actions and a way to think about issues that I never had before." Indeed, the SRR faculty observed how important this was from the first Boot Camp, when the social scientists and the natural scientists engaged in extended conversation over particular issues, such as global healthcare, that have both social and scientific dimensions.

We believe that programs like SRR represent a new and promising approach to a deeper, broader and more substantial level of ethics training for science and engineering students. While not every graduate student will have the time or the interest to participate in a year-long program of these kinds, we think that those who go through them will have a profound and multiplied effect on the culture of their field. We also believe that these programs will demonstrate the substantial value for the professional development of the student, for the benefit of society and for the quality of the work itself in bringing considerations of social impact into ethics training for all science and engineering students.

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[17] Mapping the Moral Domain. Jesse Graham, Brian A. Nosek, Jonathan Haidt, Ravi Iyer, Spassena Koleva, Peter H. Ditto. Journal of Personality and Social Psychology, Vol 101 No. 2, August 2011, pp. 366–385.
[18] Examinations of this sort would have been disruptive in several ways – they would have fundamentally shifted the nature of the relationship between program mentors and students, and also forced attention onto specific performative aspects which, depending on the student and the nature of their project, may or may not have been seen as relevant by the student. Moreover, it is not entirely clear how to make such evaluations quantitatively objective and reliable.
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