The Social Responsibilities of Scientists and Engineers: Developing a Global Survey

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Introduction

AAAS is engaged in a three-part effort to expand existing knowledge about the social responsibilities of scientists and engineers. The first part involved launching an online questionnaire in April 2013, as a preliminary data-gathering initiative. Scientists, engineers and health professionals internationally were invited to complete the questionnaire, the aim of which was to learn how they view the nature and scope of their “social responsibilities” and to identify any apparent similarities or differences in perspectives according to multiple demographic variables. The survey produced 2153 useable responses, but because it relied on convenience sampling, the results cannot be generalized beyond the study sample. (The findings of this effort can be found in Wyndham J. (et al.), Social Responsibilities: A Preliminary Inquiry into the Perspectives of Scientists, Engineers and Health Professionals, March 2015; doi: 10.1126/srhrl.aaa9798.)

Nevertheless, the initial study was viewed by AAAS as a useful step toward development of a more scientifically rigorous and representative international survey that would enable generalization beyond the sample completing the questionnaire. A follow-up survey was seen as an opportunity to explore the potential significance of some of the observations and themes arising from the questionnaire, to document the understanding of scientists and engineers about their social responsibilities, to acquire a deeper appreciation for the different sources of their beliefs about such responsibilities, to identify what they see as the opportunities or challenges that affect their ability to discharge those responsibilities effectively, and to establish a strong empirical record on which to base recommendations to scientists, engineers, policy-makers, educators, and the public.
The **second part** of the AAAS effort, which is the focus of this report, was to design and pre-test a survey that would produce generalizable results about the views of scientists and engineers on their social responsibilities. Upon completion of a draft survey, it would be pre-tested on a subset of those we intended to survey more broadly. The deliverables for this project included the following: (1) a robust survey instrument, informed by adequate cognitive and usability pretesting and translated into the five UN languages beyond English; (2) development of a global sampling process; and (3) a clear plan for reaching the targeted sample, including commitments from various national and international collaborators. The **third part** of the AAAS effort is to launch the survey in 2018. In the long term, the results of the survey are expected to influence ongoing global conversations about the roles and responsibilities of scientists and engineers in society, help clarify public expectations of scientists and engineers, lead to the development of materials for the education of scientists and engineers, and provide empirical data for consideration when developing specific recommendations on the nature and scope of the social responsibilities of scientists and engineers.

**Context**

In thinking about how professional groups establish a “culture of responsibility” for the work they do, the project began with the premise that scientists and engineers have two basic types of responsibilities: (1) internal, those that require fidelity to the standards of practice agreed upon by the scientific community; and (2) external, those aimed at the larger community (Carlson and Frankel, 2011). The first set of responsibilities traditionally fall under the umbrella of professional ethics, or the accepted practices of how members of a profession/discipline are to perform their work, and cover issues such as data management, authorship and crediting the work of others, conflict of interest, and the protection of human and animal subjects. Those in the second set are often referred to as “social responsibilities,” or responsibilities to society.

During the past four decades, a considerable amount of academic, policy and public attention and resources have been applied to examining the scope, content and boundaries of researchers’ professional responsibilities, leading to a substantial knowledge base about the factors affecting a culture of responsibility related to research practices. The same cannot be said, however, for the social responsibilities of scientists and engineers. There is no consensus inside or outside the scientific and engineering communities on the nature or sources of such responsibilities—what they are, why they came to be, how they can be operationalized, to whom they are owed, and in what circumstances. Yet, calls for scientists and engineers to accept and fulfill such responsibilities are widespread, both from within and outside science and engineering. It is in this larger context that the project described here is situated.

The notion that scientists have a responsibility to society that goes beyond their responsibilities to the profession is long-standing. Yet, in the proposal submitted to the National Science Foundation (NSF) for support of this project, we documented through a literature search a paucity of empirical research that probes scientists’ or engineers’ views about their social responsibilities. With just six studies addressing the topic, it is not possible to confidently generalize from them—they reflect different understandings of
“social responsibility” by those studied; the number of subjects per study was relatively small, with only one exceeding 350 scientists/engineers; some focused on a range of disciplines, while others included only a single discipline or a subset of a discipline; they used different data collection methods and their analyses focused on a range of research questions, some overlapping and some very different; none was intended to be global in the selection of subjects; and generalizing from a total of six studies scattered over 16 years, when much about the social context of science and engineering has changed, is not likely to be very useful. What is needed is something more comprehensive and diverse with regard to both numbers of participants and disciplines represented, as well as a methodologically more rigorous research design. In the absence of such a study, the “negotiation of responsibility between practicing scientists, innovators and the outside world remains an important and contested area of debate to this day” (Stilgoe, Owen, and Macnaghten, 2013).

Current interest in scientists’ and engineers’ social responsibilities arises from multiple perspectives on the preferred role of science and engineering in society as well as society’s expectations of scientists and engineers, which are summarized as follows. Given the public’s financial support of research, there is a reasonable expectation of a return on investment that benefits humanity as well as calls for a greater public voice in deciding priorities for how those funds will be spent. As science and engineering have become increasingly intertwined with major social, economic and political issues, scientists and engineers have been subject to competing claims from an expanded number of stakeholders who have come to view research and innovation as critical to their core concerns. Put another way, the social relevance of science and engineering has become crucial to securing public support. There have also been increasing demands that policy decisions affecting society be grounded in scientific findings, thereby creating the expectation that the public will have access to an objective and disinterested voice of reason in the policy arena. Moreover, the search for and uses of scientific knowledge and innovation are not without consequences. Although people recognize the enormous power and influence of expert knowledge on their lives, and often look to scientists and engineers for authoritative answers to complex problems, they are also leery of the sometimes unwelcome effects new knowledge brings, leading to a growing recognition of the need to consider the societal benefits and risks/harms generated by knowledge and its applications.

Furthermore, as noted by others, “science and society...have each invaded each other’s domain, and the lines demarcating the one from the other have virtually disappeared ... Experts must respond to issues and questions that are never merely scientific and technical, and must address audiences that never consist only of other experts ... science must now be sensitive to a much wider range of social implications” (Gibbons, 1999). Today “Science...has to meet a series of public expectations, not only about its products but also about its processes and purposes” (Jasanoff, 2010). Scientists and engineers are being held accountable not only for how they apply their knowledge and skills to social problems, but also for their decisions about what problems to address and how they interact with the larger society. One of the challenges in navigating this complex terrain is how scientists and engineers understand and discharge their responsibilities in the face of resistance to scientific authority from some sectors of society that view science as merely another perspective that competes with their preferred view of the world (Hoffman 2011).
While no consensus has emerged about the boundaries of social responsibility, there does appear to be agreement that it must start with the education of future scientists and engineers. A 2006 report by the Council of Graduate Schools advocated that “Graduate programs...have a responsibility to prepare future scientists for the social responsibility that goes with being a scientist” (Tate and Denecke, 2006). Others have stressed that education should empower scientists to “reflect upon, discuss, and evaluate” issues related to the “organizational, legal and political context in which they work,” giving scientists “important competencies...for deciding and acting in a socially responsible way” (Zandvoort, et al., 2013).

Although STEM education has been increasingly infused with teaching on the responsible conduct of research, the predominant focus has been on research practices rather than their societal impacts. It is not surprising, then, that in a recent set of essays by those committed to broadening such education to encompass researchers’ social responsibilities, the volume’s editors concluded that “education aimed at preparing future scientists and engineers for social responsibility is presently very limited and seemingly insufficient in view of the enormous ethical and social problems that are associated with current science and technology” (Zandvoort, et al., 2013). The call for greater emphasis on social responsibility in the education of scientists and engineers is compelling, but it should be informed by more conceptual and empirical study of what “social responsibility” means in the context of the science, engineering and society relationship and, in particular, how scientists and engineers view their responsibilities.

Project Goals

The grant had two primary goals:

(1) Design a global survey intended to produce generalizable data about the views of scientists and engineers on their social responsibilities; and

(2) Design a sample frame of scientists and engineers globally based on random stratified samples of members of partnering scientific and engineering membership organizations in the United States and overseas.

The survey developed by AAAS would be used to document empirically the following:

- What scientists/engineers identify as their responsibilities to society;
- Source(s) of their beliefs that they have/do not have special responsibilities to society;
- The ways those responsibilities or sources differ or are similar across disciplines/fields, sector, age, gender, level of higher education degree(s), professional role, years of professional experience, institutions where they work, and the region where they received their education; and
- Factors that influence the fulfillment of their social responsibilities.
Project Products

Survey design

AAAS established an ad hoc advisory group to provide guidance on survey methodology, sampling, design and analysis, including topical experts, both domestic and international (see Appendix I for full list of advisors). Several factors were considered when developing the survey instrument: the fact that the survey sample will be inclusive of those working in both basic and applied fields, from academia to industry, and across diverse cultures, political and social realities; that the language needed to be as clear as possible given the international nature of the intended sample; and that funding and time constraints would likely limit the number of open-ended questions requiring translation that could be incorporated into the final survey instrument.

The survey instrument, which will be administered online, consists of four core sections: (I) demographic questions; (II) social responsibilities; (III) information, guidance, experiences relied upon in shaping perspectives on social responsibilities; and (IV) factors influencing fulfillment of social responsibilities.

Before invited respondents access the full survey instrument, they must indicate their consent to participate in the study. The first question, before Section I, is “Please click one of the two options below:” with answers “Yes, I will participate” and “No, I will not participate.” If they indicate they will not participate, they will not be able to continue the survey.

Section I: The demographic questions in the survey are based on what was determined to be appropriate and necessary with a view to useful comparative analyses. The list of fields was created based on the National Science Foundation (NSF) Federal Support Survey Field Fields of Science and Engineering Codes and Definitions. The original NSF list was modified only to the extent that the separate field of ‘psychology’ was removed and the field of ‘social and behavioral sciences’ was created. As a check on the sampling process, there is an option in this section for respondents to confirm whether they are a scientist or engineer. When presented with the list of fields, the final option is “I am not a scientist or engineer.” If they choose this option, they will not be able to continue the survey. In the question concerning gender, the response option of ‘not listed: (write-in answer)’ was created in recognition that not everyone identifies as female or male. Finally, given the possibility that the number of respondents in some countries would be too few for use in comparative analysis, we decided to focus on region, as reflected in questions l.8 and l.9. The list of options presented in these questions was drawn from the list of United Nations regions, with the addition of the Middle East and North Africa, as defined by the World Bank. This addition was made based on the potential for cultural differences arising from the unique characteristics of that region to be of relevance to our analysis. Of the demographic questions, those related to field, sector, gender, age and region were determined so
integral to the analysis of results that they are designated as ‘required’. No other questions in the survey are required.

Section II: Two questions are posed concerning potential social responsibilities and are intended to capture both how important the respondent considers certain behaviors of scientists and engineers to be, as well as information about how often they engage in the behaviors. These two questions are posed in reference to a list of specific behaviors, including the option for three write-in responses. In developing the list of behaviors, the starting point was the list included in the AAAS questionnaire on the same subject and existing literature on the topic of social responsibilities. The list was then reviewed by the advisory group and revised. Effort was made in consultation with the international members of the advisory group to ensure that the list of potential responsibilities would resonate globally.

Section III: This section focuses on the sources or factors influencing the views of respondents regarding their social responsibilities and asks respondents to identify how influential a source or factor is. The section is intended to capture information about a wide range of potential influences, including early and later influencing factors and sources internal and external to their professional experience. This section of the survey is divided into five sub-sections: childhood; professional education; workplace and professional experience; factors external to your professional education, work and/or experience; and a final question gives respondents the option to list up to three additional influences.

Section IV: In the final substantive section of the survey, questions are asked regarding factors that influence the fulfillment by respondents of their social responsibilities. In framing this section, the decision was made not to ask respondents directly the factors that influence their fulfillment of their responsibilities, but rather to ask contextual questions about their work, work environment, professional activities, and positions held, with the aim to correlate the answers provided in this section with the answers in Section II about the extent to which a respondent engages in certain activities. Finally, Section V invites respondents to add “any further comments about the social responsibilities of scientists and engineers, or comments regarding anything addressed or not addressed in this survey.”

Translation

Once drafted, the survey instrument and all associated instructions were translated from English into the five additional languages of the United Nations (Arabic, French, Mandarin, Spanish, and Russian). The translation, back-translation and editing were carried out by a translation company, using professional translators with a tertiary science degree and/or at least 5 years’ scientific/medical translation experience. The translators translated into their native language. The translation was conducted by one translator. That initial translation was then reviewed by an expert editor, who then sent any comments or concerns to the original translator for correction. The translation was then back-translated to confirm accuracy of the revised translation. AAAS reviewed the back-translation to ensure consistency with the original English version and, in that process, nuances of language and challenges in translation of certain concepts were identified. In each such instance, the closest approximation to a term or concept replaced the original.
**Pre-test**

Once the survey instrument had been translated, AAAS created the digital version of the instrument using the online survey platform SurveyGizmo. SurveyGizmo was chosen primarily for its adaptability and customizability. SurveyGizmo provides options to customize the survey to ensure quality is not diminished across platforms, such as mobile phones or tablets. The language functionality within SurveyGizmo allows for multiple translation options within one survey. Furthermore, it will not collect the IP addresses of respondents, increasing the security of respondent information. The SurveyGizmo account held by AAAS will enable the collection of responses from a sample of at least 12,500 scientists and engineers globally. These responses can be analyzed within the platform, seen simultaneously for all languages, and exported in a variety of file formats.

AAAS worked with a member of the advisory group who is an expert in cognitive and usability testing, to design a protocol for testing the survey instrument in each of the six languages and across four platforms: desktop, laptop, tablet, and mobile phone. The protocol included general probes asked in each interview, as well as language-specific probes based on questions concerning specific words, concepts and phrases that had arisen during the translation process. AAAS reached out to its networks to invite a breadth of participants to take part in the cognitive testing, including at least two for each language: AAAS members in the Washington, DC area; AAAS On-call Scientists; AAAS Science and Technology Policy Fellows; members of the DC-based diplomatic science community; AAAS/Science staff; and members of the AAAS Science and Human Rights Coalition. Additionally, AAAS asked two particular individuals to reach out to their networks. Dr. Tom Wang, AAAS Chief International Officer, and Dr. Mary Gray, a statistician and AAAS On-call Scientist, were asked to recruit respondents whose native languages were those other than English. In total, 26 cognitive and usability testing interviews were held, each respondent giving their express written consent to participate in the process. The interviews were conducted in-person by a combination of AAAS staff and interns. Most interviews took place at AAAS headquarters, however if a respondent was not able to travel to AAAS, interviewers would travel to a location convenient for the respondent, such as a local library or the respondent’s place of work. Only the interviews involving Spanish-speaking respondents were conducted by interviewers native in that language. Interviewers conducted these interviews following the direction of the cognitive testing protocol. Interviewers entered the respondent’s answers, as well as any general observations, into the observation boxes.

The products of the interviews consisted of the completed surveys, audio recordings of the interview, and notes taken by the interviewers. The audio recordings were transcribed as edited summaries. These, together with the other products of the interviews, were then analyzed by the expert advisory group member, and a summary of the interview, with recommendations, provided to AAAS.
The pre-testing generated several significant findings and recommendations, including with regard to length, formatting, and translation, as well as specific feedback on the wording of prompts and questions. After reviewing these findings and recommendations, AAAS revised the survey instrument. These revisions included adding specific instructions for choosing the language of the survey; removing or editing ambiguous questions, for example a question about “correcting the scientific literature” that was read consistently in two different ways; editing language that appeared to contribute to unintentional biasing of responses, such as changing the reference to the items in Section II from “responsibilities” to “behaviors”; and decreasing the overall length of the survey, specifically by reducing the length of Section IV. The revisions were then translated, following the process described above for the initial translation.

Sample frame development

AAAS designed a sampling process that will accommodate up to 12,500 scientists and engineers globally based on random stratified samples of members of partnering scientific and engineering membership organizations in the United States and overseas. To identify potential partners, and with a view to achieving both disciplinary and geographic diversity, AAAS developed a comprehensive list of organizations according to the following five categories: organizational members of the AAAS Science and Human Rights Coalition; Affiliated organizations of AAAS; National Members of the International Council for Science (ICSU); members of the Inter-Academy Panel; and institutional members of The World Academy of Sciences (TWAS). In total, and allowing for some overlap in affiliations and the fact that some organizations identified are not membership organizations per se, approximately 400 organizations were identified and the contact details for their executive officers recorded.

By email to the executive officers of each of the organizations, they were invited to collaborate with AAAS in the project. The organizations were asked to respond to a brief questionnaire indicating ‘yes’, ‘no’ or ‘maybe’ they would collaborate with AAAS, how many members they have, what percentage of their membership is international, and whether they collect demographic information about their members. In total, 55 organizations responded to this questionnaire, 48 indicating they are or may be interested in collaborating with AAAS and revealing that most collected at least the following demographic information about their members: discipline, age, gender, and country. Following discussions with organizations interested in partnering with AAAS in this project and depending on their willingness/ability to share their membership data with AAAS, three approaches for developing the sample frame and reaching organizations’ members were identified:

1. Organization X provides its membership list to AAAS so that we might identify the specific individuals who will receive the survey. AAAS reaches out to these individuals directly.
2. Organization X provides AAAS its membership list containing only a member identifying number and the specific demographic information we seek in order to populate the sample frame. Organization X would retain the contact information that correlates with the unique member identifying number. After populating the sample frame based on the demographic information, AAAS would then ask Organization X to send the survey to specific members.
based on their identifying number. Thus, communication with the member would be
directly from Organization X and not AAAS.

3. Organization X sends AAAS the email addresses of a random sample of their membership,
taking into account the demographic data we would like to collect. AAAS will then send the
survey to the random sample of members identified by Organization X. Organization X
would give AAAS a demographic assessment of the overall sample initially provided to aid in
determining the profile of non-respondents.

As of the date of this report, AAAS has received signed letters of collaboration from 15 organizations,
and is in communication with several others.

All partner organizations will be asked to announce the survey to their members who are part of the
sample frame, and encourage them to participate. Ideally, AAAS will develop the email invitation and
send the invitation, but this protocol will depend on the needs and requirements of the organizations
with which we collaborate. Similarly, it is anticipated that AAAS will track the responses and will send
reminder follow-ups to non-respondents.

The sample frame will be constructed to avoid, as much as possible, the chance of including in the frame
the same individual more than once. Nonetheless, since scientists and engineers are often members of
multiple professional societies, survey recipients will be asked at the outset not to take the survey more
than once. The selection will be done using random sampling with strata. Replicates, i.e., random
subdivisions of the sample, representing the demographic variables, will be created to allow additions to
the sample if the response rate is lower than expected.

AAAS will submit the survey and sampling frame plan to an Institutional Review Board for approval.
References


Wyndham J. (et al.), *Social Responsibilities: A Preliminary Inquiry into the Perspectives of Scientists, Engineers and Health Professionals*, March 2015; doi: 10.1126/srhrl.aaa9798.

Appendix I

Advisory Committee

- Survey analysis: Dr. Ali Arab, Associate Professor, Department of Mathematics and Statistics, American University, and Dr. Susan Hinkins, Senior Statistician, National Opinion Research Center (NORC);

- Survey design: Dr. Michael Saks, Faculty Fellow, Center for Law, Science and Innovation, Arizona State University, and Dr. Michael Stern, Methodology Fellow, NORC;

- Topical experts: Dr. Robert Albro, Research Associate Professor, Center for Latin American and Latino Studies, American University; Dr. Melissa Anderson, Professor, Department of Organizational Leadership, Policy and Development, University of Minnesota; Dr. Frederick Grinnell, Professor, Department of Cell Biology, University of Texas Southwestern; and Dr. Maya Sabatello, Assistant Professor of Clinical Bioethics, Columbia University; and

- International advisors: Dr. Amane Koizumi, Professor, National Institute of Natural Sciences, Japan; Dr. Roger Pfister, Executive Secretary, Committee on Freedom and Responsibility in the Conduct of Science, International Council for Science (ICSU) and Head of International Cooperation, Swiss Academies of Arts and Sciences; Dr. Carthage Smith, Senior Policy Analyst, Directorate for Science, Technology and Innovation, Organisation for Economic Cooperation and Development; and Dr. Sonia Vasconcelos, Associate Professor, Institute of Medical Biochemistry, Federal University of Rio de Janeiro.