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The “how” and “whys” of research: life scientists’ views of accountability

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Abstract

Objectives—To investigate life scientists’ views of accountability and the ethical and societal implications of research.

Design—Qualitative focus group and one-on-one interviews.

Participants—45 Stanford University life scientists, including graduate students, postdoctoral fellows and faculty.

Results—Two main themes were identified in participants’ discussions of accountability: (1) the “how” of science and (2) the “why” of science. The “how” encompassed the internal conduct of research including attributes such as honesty and independence. The “why,” or the motivation for conducting research, was twotiered: first was the desire to positively impact the research community and science itself, and second was an interest in positively impacting the external community, broadly referred to as society. Participants noted that these motivations were influenced by the current systems of publications, grants and funding, thereby supporting a complex notion of boundary-setting between science and non-science. In addition, while all participants recognised the “how” of science and the two tiers of “why,” scientists expressed the need to prioritise these domains of accountability. This prioritisation was related to a researcher’s position in the academic career trajectory and to the researcher’s subsequent “perceived proximity” to scientific or societal concerns. Our findings therefore suggest the need for institutional change to inculcate early-stage researchers with a broader awareness of the implications of their research. The peer review processes for funding and publication could be effective avenues for encouraging scientists to broaden their views of accountability to society.

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Although scientific progress has been regarded as integral to the health and success of society, the research community has often been viewed as a disparate, isolated entity. Early calls for increased societal support of scientific research built on these sentiments, encouraging public funding for the “free play of free intellects”.¹ The social contract formed from this arrangement was founded on the “myth of accountability,” premised on the idea that internal scientific integrity equates with societal responsibility.² Increasingly there have been appeals to dispel this myth² and to ensure that the use of public funds leads to collective good.³

In arguing for the renegotiation of this contract between science and society, some point to the need to further characterise the goods of science as a profession⁴ and to shift the focus from production of “reliable knowledge” to “socially robust” knowledge.⁵ To encourage science to better meet societal concerns, some scholars propose the training of “civic scientists”^{6–8} or socially responsible scientists.³⁹ Others concentrate on facilitating a greater and more understandable exchange of information and concerns about the “vision, ends and purposes of science”¹⁰ between members of the scientific and broader communities.^{11–13} Still others focus on community engagement in the policy realm, stressing the need for scientists to serve as “honest brokers” taking into account both science and stakeholder concerns.¹⁴

Importantly, this new contract necessitates the realignment of values such that science and society may mutually inform one another's goals. Many scholars note disparities between the internally and externally oriented values of the scientific community, such as the contrast between contextual and constitutive values¹⁵ and between epistemological and moral values.¹⁶ Other scholars point to the need to reconceptualise epistemological and ethical values within an interactive social context.¹⁷

SCIENTISTS' VIEWS OF ETHICS

Empirical studies on scientists' views of values have been limited. Most have explored issues such as scientific misconduct, which are largely internal to the research community.^{18–20} Some have examined scientists' views of values and social responsibility, but only in specific contexts such as among geneticists or subspecialists,^{21–23} in industrial settings²⁴ or in international environments.²⁵ Other studies have investigated scientists' views of how public attention impacts research, focusing specifically on those who use genetic engineering technology in the USA and Europe.^{26,27}

Our paper expands on this literature by presenting the perceptions of values of a wide range of academic life scientists at Stanford University in the USA, from geneticists and cancer biologists to biophysicists and pathologists. These perceptions were captured in a series of interviews and focus groups that explored life scientists' views of the ethical and societal implications of their own work and of biomedical research in general. While other findings from these data have been previously reported,²⁸ this paper examines how life scientists think about accountability in research.

Our analysis of the data reveals the existence of three broad domains of accountability, which are prioritised differently based on a researcher's position in the academic career

trajectory and the perceived proximity of the domains. The findings support the notion of boundary-setting between science and non-science or social concerns but suggest that this demarcation is more complex than simply deferral to regulatory authority, as may be expected in instances of less socially contested research.^{29–31}

METHODS

We received approval from the institutional review board of Stanford University for all aspects of this study.

Telephone interviews

Interview questions were designed based on pilot survey data and were first tested on two volunteers—a faculty member and a graduate student. These interviews were not transcribed, and three trained individuals conducted the pilot and all subsequent interviews. The semi-structured interviewer guide was not substantially changed after pilot interviews; sample questions posed to participants are included in box 1.

After the pilot interviews, 20 life scientists were invited to take part in a 15- to 45-minute phone interview, and 16 did so. Interviews took place during May and June of 2006. The invited individuals were selected through stratified random sampling of a database constructed from publicly available websites of Stanford life sciences departments including biology, cancer biology, biochemistry, biophysics, genetics, pathology and psychiatry. Interviewees were also stratified by position; three graduate students, three postdoctoral fellows, four instructors, two assistant professors and four senior research staff participated. All participants consented to audio-recording and transcription of the interviews, and they received a complimentary 10-dollar gift certificate in exchange for participation.

Focus groups

Focus group questions were piloted on two postdoctoral fellows and two research staff in August, 2006. These individuals were contacted and recruited through a Stanford University-wide listserve. They received complementary breakfast and a 5-dollar gift certificate in exchange for participation. The pilot focus group lasted for approximately 1 hour, and participants consented to audio-recording and transcription of the conversation. Two trained individuals conducted the pilot and all subsequent focus groups. The focus group moderator guide was not substantially changed after the pilot; sample questions posed to participants are included in box 2. In addition to these questions, focus group researchers presented scenarios to facilitate discussion of ethical and societal issues in biomedical research. These scenarios involved the *in vitro* synthesis of the infectious polio virus and the reporting of incidental findings with potential, but uncertain, clinical significance.

After the pilot focus group, approximately 120 individuals were invited to participate in four 2-hour focus groups. Individuals were selected using stratified random sampling from the same database used for interviews. These focus groups were conducted during September, 2006. Twenty-five scientists ultimately participated in the focus groups; each group included between five and seven individuals. The groups were stratified based on the researcher's position: one consisted of graduate students, one of postdoctoral fellows, and two of faculty,

senior research staff and clinical instructors. All participants consented to audio-recording and transcription of conversations. Individuals participating in the focus groups received a complementary lunch and a 75-dollar gift certificate.

Analysis

Transcripts of all 16 interviews and all five focus groups were imported into MaxQDA qualitative software for analysis. The data was iteratively coded, and an individual analyst identified recurring themes that emerged from the data. After themes had been identified from the data, the transcripts were coded word by word and line by line, to glean more detailed insight into broader issues and relationships between themes. This coding was approached by hand to allow for more in-depth understanding of the data than the software afforded. Then a second individual independently and iteratively coded a subset of the data for themes and relationships. Conclusions regarding these themes and relationships arising from the data were reached by consensus.

RESULTS

The “how” of science

In both interviews and focus groups, scientists discussed responsibilities within their internal community, or what we have called the “how” of science. These responsibilities pertained both to how researchers conducted themselves and to how they conducted research experiments.

Honesty was often cited as vital to the research enterprise. Professional integrity was described in terms of ensuring “the fidelity of results” (male, graduate student, interview 2) and trusting that other scientists will do the same. As a research associate stated,

It seems to me, being in academic science for so long, that everything works on a very strict honor code. But there's really no checks and balances. (Female, interview 11)

Nonetheless, respondents observed that group meetings provide an internal system monitoring scientific rigour and ethical quality. As a graduate student explained, formal discussions provide the opportunity for critique by colleagues and the principal investigator (PI), who sets the laboratory's research agenda.

All of us give lab meetings. People know what we're doing, and I think that if you're doing something that somebody views as unethical, there's a built-in system for all of us ... (Female, participant 1, graduate student 3)

Additionally, respondents identified replication to validate results as an essential responsibility of the scientist; they thus reflexively described another type of internal checks and balances. They pointed to the sharing of reagents and disclosure of results as essential to the process of replication. Simultaneously, however, participants unhesitatingly mentioned the atmosphere of competition in scientific endeavours. A postdoctoral fellow remarked,

You've spent a lot of time discovering that particular piece of data and so ... you're gonna be a little bit careful ... to share that data right away because it's a discovery,

and you wanna make sure that no one steals it from you, and it sounds horrible now that I'm saying that, but I've seen it time and time again. (Male, interview 6)

The language used when describing experiments, including considerable use of *I*, *me* and *my*, reinforced the individualised, often competitive nature of research. Respondents also voiced pressures to be the first to publish novel findings in order to achieve recognition in the field and promotion within the academic career hierarchy to the position of PI.

The “whys” of science

In addition to delving into the “how” of science, both interview and focus group participants discussed reasons for engaging in scientific pursuits, which we have called the “whys” of science. Analysis revealed that these “whys” generally fell into one of two categories: (1) the desire to positively impact the research community and science itself or (2) the desire to positively impact the external community, broadly referred to as “society”. Our analysis demonstrated that if respondents discussed both of these categories of accountability, impact on science was primary:

When you decide on different experiments that you want to do, the first consideration is of course to make sure you have the appropriate techniques to be able to do it, but secondly, is it an interesting question just scientifically speaking, just academically, aside from any beneficial contributions it could possibly make. And once you've established that, it's up to you ... if you wanna also emphasize therapeutic applications ... (Male, interview 2)

As this graduate student specified, research questions are devised to obtain novel information that furthers the state of scientific knowledge. Only after this first responsibility is satisfactorily met does the researcher contemplate meeting the secondary “why”, ensuring that potential results will positively affect those outside the scientific community. A medical student described this latter responsibility:

I think there's also another side of science that ... has an obligation to society to do things that better society and advance society. (Male, participant 2, graduate student 3)

As a graduate student summarised, research is conducted

so that you're able to benefit others and science in general, and then ultimately, presumably society. (Male, participant 5, graduate student 3)

The social systems underlying scientific endeavours

Nevertheless, respondents indicated an awareness that scientific processes do not operate in a vacuum. Laboratories are created and maintained within social contexts, and science thus cannot solely be conducted for the primary pursuit of knowledge. Instead, the structure surrounding science often pushes accountability to society to the forefront.

For example, participants indicated that the “how” of science dictates dissemination of novel findings; publication is therefore a mechanism of scientific accountability and a necessary aspect of career advancement. The system of publication, however, also stresses the

secondary “why” of science, requiring that scientists emphasise the societal impacts of research in dissemination of their findings, even if the research was not initially conducted to realise this benefit. A cardiology fellow noted,

In some ways, by default, every paper you publish, you talk about societal implications because you always talk about the significance of what you're doing ... you always frame it. (Male, participant 4, graduate student 2)

The organisation of grant and funding systems also obliges researchers to think of science in broader terms. Possible societal impacts must be detailed in submitted papers and also in grant applications. As one faculty member described,

It's a requirement. If you do not include sufficient societal impact, your proposal's returned without review. It's like forgetting to attach your budget. (Female, participant 2, graduate student 5)

The same faculty member expressed the perception that societal impacts also dictate which projects are awarded funding:

If there's two grants that are equal in peer review and one has a superior societal impact, it gets the money. (Female, participant 2, graduate student 5)

Therefore, it is the second “why” of accountability to society that potentially affects the types of questions researchers pursue. However, our data did not reveal whether or how the societal impact requirement affects specific research questions in practice or whether this grant requirement is simply fulfilled by researchers in a cursory manner. A societal impact requirement may not be effective in encouraging scientists to integrate societal values into their research if the requirement is seen as imposed by forces external to the scientific community (ie, as not part of *peer* review, as was suggested by the faculty member above).

Nevertheless, the funding system undoubtedly has a significant effect on the research enterprise. A senior research associate suggested that scientists adjust their research projects to match societal concerns but intimated that these systematic funding pressures may neglect some other socially responsible directions of research.

People change their research to fit the dollars that are available ... It has a big impact for a decade or so on research, research dollars available for one field versus another. (Male, participant 1, graduate student 4)

Prioritisation based on career position and “perceived proximity”

All researchers expressed recognition of the “how” of science and the two tiers of “why”. In articulating these domains of accountability, respondents explained the need to establish priorities. Participants, including the postdoctoral fellow quoted below, explicated constraints that made it difficult to simultaneously further one's career and directly interact with societal concerns. This postdoctoral fellow defined his balancing act as adhering to scientific responsibilities while also engaging with the public and considering their concerns:

It's hard to have the energy and time ... to fight battles on behalf of science and still be a scientist, still have enough time to do your scientific research. (Male, participant 1, graduate student 2)

Although all respondents commented on the balancing of responsibilities, the priority assigned to each domain of accountability differed according to the person's position in the academic career trajectory. Scientists at the beginning of their careers, such as graduate students, focused more on the internal practices of science, whereas those later in their careers, such as PIs and faculty members, were also obligated to devote more time and energy to considering the societal implications of their research. Here, the environment in which science is conducted accounts in part for the reordering of priorities over a scientific career. Respondents communicated that scientists must necessarily first concentrate on the internal practices of science and on elucidating valid findings in order to become PIs. After reputations are established, however, emphasis can be slightly shifted to include deliberation of the external impacts of research along with scientific accountability. As a graduate student explained,

I think it depends on what level you're at. I mean, if you're a graduate student ... then most of your life is doing the research and writing the publications that go to the science press ... But if you're a PI ... then I guess [it'd] be more important ... to communicate with others outside of science. (Female, interview 1)

These differences in prioritisation along the career trajectory also suggest the importance of what we are calling “perceived proximity”, or, as one respondent described, “how close you are” to each domain of accountability. Our analysis suggests that participants used qualifiers of career position, such as “if you're a PI ...,” as well as general qualifiers of “as a scientist” to distance themselves from specific types of accountability. For example, graduate students view scientific accountability as much more relevant to their immediate needs than concerns regarding the societal impacts of their research. Postdoctoral fellows, straddling the middle of the career hierarchy, continue to stress scientific impact but view societal responsibilities with increasing attention. PIs, on the other hand, generally spend less time performing experiments than graduate students and postdoctoral fellows and more time securing funding for the laboratory. Whether directly writing grants or assisting laboratory members in grant writing, PIs may therefore focus more on accountability to society than at earlier times in their careers. The perceived proximity of different societal and scientific concerns was also apparent in our respondents’ ease of commenting. For example, PIs were more comfortable engaging in conversations regarding ethical and social considerations than were more junior researchers.

Respondents also hinted at the shift from strict competition to interdisciplinary collaboration as they moved up the academic hierarchy and focused more on grants and funding. Although competition is always an inherent aspect of science and publishing, more senior researchers are increasingly engaging in work with scientists in other fields. As a cardiology fellow noted,

Very few people can succeed as an island, and it's becoming much, much, much more common to be a part of a much larger picture. (Male, participant 4, graduate student 2)

Analysis of the data revealed that participants were aware of this changing environment. Respondents noted the benefits of cooperative endeavours, including the ability to address more complex hypotheses and the opportunity to learn scientific techniques once confined to a single discipline. Aspects of the grant and funding systems were therefore communicated as informing the internal practices of science. These systems can influence the very techniques and methods that are utilised in scientific endeavours and can serve to counteract the disincentives to teamwork created by publication and career advancement mechanisms. The boundary-setting between science and non-science thus becomes more complex as science does not simply concede responsibility to social systems, but may instead incorporate new responsibilities to enrich its internal systems of accountability.

DISCUSSION AND CONCLUSIONS

Our analysis of life scientists' comments reveals that these researchers consider accountability in three broad domains: (1) the internal practices of science, (2) the impact of research on the state of scientific knowledge and (3) the impact of research on society. The data indicate that, in part due to the competitive nature of science, researchers are primarily concerned with devising scientifically sound experiments to generate valid and novel results. This finding supports previous works suggesting that in determining experimental questions, researchers favour scientific criteria over societal concerns, justifying decisions through the "myth of accountability".²

Despite this primary focus, all respondents were aware that the research enterprise involves more than scientific concerns. Participants communicated that science operates in and through social systems that promote specific, society-focused interests. The system for scientific publication, for example, was discussed both as an example of the competitive nature of science and as a mechanism for emphasising the social implications of research. Grant and funding systems were also presented as mechanisms that encourage scientists to consider the societal implications of their research. In the academic environment in which these life scientists practise, much funding stems from public dollars, awarded through grants from US government institutions such as the National Institutes of Health (NIH) and the National Science Foundation (NSF). As may be expected, the research proposals deemed worthy of acceptance are those that are scientifically sound *and* have positive societal impacts. NSF grant applications, for example, "must describe as an integral part of the narrative, the broader impacts resulting from the proposed activities," which includes wide dissemination of findings and benefits to society.³²

Through both publication and funding mechanisms, how-ever, social accountability may serve merely as a cursory means to secure status or funding in order to conduct work that makes a scientific impact. The peer review of grant proposals provides another layer of complexity through which internal scientific values may influence which societal concerns are deemed most important, potentially skewing social accountability mechanisms to address more scientific needs. Despite these possibilities, many respondents expressed that these systematic mechanisms encourage researchers to better attend to societal responsibilities and ensure that this accountability is not neglected in the fast-paced pursuit of knowledge that often dominates academic science. This finding echoes the negotiations

between scientific processes, funding and the community explored in international studies,²⁵ suggesting that the concerns expressed by our sample of academic researchers limited to one institution are more broadly considered. Taken together, our data therefore suggest that although a boundary is drawn between science and social systems, scientists do not merely defer to these non-science regulations,²⁹ but instead integrate questions of social accountability into their scientific concerns.

We further found that specific assignment of priorities of accountability was related to a researcher's position in the academic hierarchy and what we have called the person's perceived proximity to each domain of accountability. At the beginning of the career trajectory, honing scientific techniques and finding novel results predominate; graduate students in our sample thus perceived scientific accountability as a more proximal consideration than social accountability. Continuing along the career trajectory from postdoctoral fellow to PI, more established scientists in our sample perceived a smaller chasm between science and society, viewing accountability to society as a more proximal value than at earlier points in their careers. This notion of changing priorities based on perceived proximity parallels theories on the stages of moral development: more educated and experienced individuals reach higher stages of development in which they consider the implications of their actions on progressively larger communities and more complex social relationships.³³

Our findings further reveal that these more senior, socially aware scientists perceive the benefits of collaboration, stemming perhaps in part from their focus on meeting grant proposal criteria. Both NIH and NSF guidelines carve out an application section especially for this type of work; the NIH has a separate, multiple-PI initiative to foster "team science".³⁴ This finding supports the need for "institutional bootstrapping",³⁰ in which universities and other research institutions foster a collaborative environment in order to attract cooperative researchers and produce more "socially robust" knowledge.⁵

In addition to encouraging collaboration, changes in institutionalised academic practice can help to alleviate disparities of perceived proximity in order to promote socially responsible science from the beginning of one's career. Although the stark boundaries between science and society proposed by Bush have long dissipated, these divisions and the "hands-off" mentality are still somewhat persistent. As has been noted in psychology, training programmes tend to focus on technical qualifications to the detriment of exploring moral and societal concerns,³² and the same may be said of training programmes in other life sciences. Incorporating awareness of grant mechanisms and funding sources from the beginning of institutionalised training programmes can help junior scientists better integrate societal concerns into the primary concerns of generating and publishing novel findings. By increasing the perceived proximity of societal issues, these programmes can encourage a focus on research that benefits the larger community as well as science. Additionally, implementing programmes to evaluate societal impacts that include non-scientists³¹⁷ can help to ensure that these implications of research are not given a cursory glance in composing a grant, but are instead thoughtfully considered.

Our findings suggest that the boundary-setting between science and non-science is not as stark as the deferral to regulatory authorities or social systems evident in the more contested embryonic stem cell research.²⁹ Instead, there is a more complex boundary negotiation in which researchers add scientific concerns to questions of social accountability while also incorporating new, socially mediated responsibilities into their internal systems of accountability. This renegotiation and collaboration is tempered by scientists' perceived ability to negotiate these boundaries, which often varies according to career stages. To encourage accountability to society, we advocate that academic institutions increase awareness of societal considerations from the very start of life scientists' careers and increase the robustness of the peer review process to evaluate the value of research projects to the public.

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Box 1 Sample questions from semi-structured interview guide

- ▶ Tell me about the research you do.
- ▶ What are some of the ethical, social, and policy implications related to your research that you think about?
- ▶ To whom do you talk about these kinds of issues?

Box 2 Sample questions from focus group moderator guide

- ▶ What are the societal and ethical issues related to biomedical science research that keep you awake at night?
- ▶ What about societal and ethical issues that come up in your day-to-day research?
- ▶ How often do you have to deal with some of the issues like the ones we've been discussing?
- ▶ To whom do you talk about these issues?
- ▶ What do you think the role for scientists is, or should be, in dealing with societal and ethical issues?