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**INTEGRITY, RESPONSIBILITY, AND DEMOCRACY IN
SCIENCE**

David H. Guston

Bloustein School of Planning & Public Policy
Rutgers, The State University of New Jersey and
Center for Science, Policy, and Outcomes, Washington, DC

Issues of integrity and responsibility in science generate headlines, but rarely are they connected with questions of democracy in science. This paper offers some first steps toward a more democratically integrated vision of scientific integrity and responsibility. It contrasts an old, contractual model of the relationship between science and society, which addressed only a narrow scope of issues in integrity and responsibility in but a constrained way, with a new model that manages a wider scope of issues through more democratic processes. These issues include research misconduct, data availability, conflicts of interest, human subjects of research, and cultural limits to knowledge. The paper discusses four themes emergent from the issues – the presence of interests in the research enterprise, the role of collaborations between scientists and non-scientists, the possibility of new limits to inquiry, and the continuing neglect of outcomes – in arguing for further democratization of science.

Introduction

Issues of integrity and responsibility – and even the headlines generated by their breach – are constant companions of relevant research. Because research can, and does, have an impact on the daily lives of citizens, questions about the ability of scientists and their institutions to abide by established precepts for knowledge production continue to surface, often with high profile. Such issues range from the financial accountability of research funds, the protection of human and animal research subjects, and science advice to policy makers, to research misconduct, conflicts of interest, and limits to scientific inquiry.

These issues have generally remained at the periphery of the so-called “science wars,” which have focused on questions of the philosophical justification of scientific knowledge and the appropriate style of the social study of science. However, the issues of the integrity and responsibility of

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science, and the extent to which they should be democratized, involve similar questions about the primacy and privilege of scientific knowledge in society.

Consistent with a model of science and society that assumed that science is some contractually separate domain, meant to be insulated from the corrupting influences of society, suggestions for the productive management of scientific integrity and responsibility have themselves been too insulated from democratic society to be truly productive. But recent changes in federal policies for integrity and responsibility in research suggest that a new model, one with greater participation from persons and institutions previously apart from science, is emerging. As science and society become more integrated, by policy design as well as by consequence (and accident) of innovation, we need a more democratically integrated vision of scientific integrity and responsibility.

This paper takes some short steps in that direction. Its first section describes the traditional science-society model and the issues of research integrity and responsibility manifest in it. These issues were relatively limited in their concern, on one hand, to such inputs to the research enterprise as money and human and animal research subjects and, on the other, to the outputs of the enterprise. The paper then discusses how these particular issues have become more complicated under a new model of science and society that has encouraged consideration of interests within the research enterprise.

Emergent from the new issues are four themes – 1) the role of interests in science, 2) the collaboration between scientists and non-scientists, 3) the possibility of limits to knowledge, and 4) the neglect of outcomes – that can begin to point toward a vision of science policy that makes use of democratic participation to address issues of scientific integrity and responsibility. The paper concludes with a discussion of these themes, engaging possible objections that may be raised but ultimately calling for the greater democratization of science.

The Old Model

The old model of the relationship between science and society was a contractual one, as if between two autonomous entities that agreed on certain principles of exchange in order to achieve independent but mutually beneficial aims

(Guston 2000). In such a model, there were – from the perspective of society – modest but hard-fought controls on some of the valued inputs to the scientific enterprise. The government patron would appropriate funds for science only with some strings attached. These strings traditionally regulated things moving from the more general domain of society into the domain of science. For example, the rules of accounting would apply to monies appropriated for research just the same as for other purposes. Similarly, humans and animals that crossed into the scientific domain to become research subjects retained certain rights and privileges that society generally afforded them. Research with human subjects required recognition of their autonomy through explicit informed consent, and research with animals required socially acceptable levels of care and an absence of cruelty. These arrangements were not entirely without controversy, and they as frequently bent over backward to conform to scientific norms as they did to conform to broader societal ones.

The application of financial accountability to research continued to be fought through the 1960s and beyond. The Government Performance and Results Act of 1993 is now being implemented only with difficulty and with some exceptions for the research agencies. High profile abuses of human research subjects did occur, and when the United States finally adopted its “common rule,” scientists retained substantial control over the decision forum for human subjects research, namely, the Institutional Review Boards (IRBs). The Animal Welfare Act, which originally applied to such large (and easily anthropomorphized) mammals as dogs, cats, and primates in the laboratory, did not apply to the greater number of mice, rats, and birds sacrificed in experiments. Financial accountability and human and animal subjects protection were part of a broader construct of scientific responsibility.

The old model accommodated them because of the patent, mutual interest of society and science in their solution, and because the solutions involved relatively simple regulations of the boundary crossing into science. They were, as philosopher of science Stephen Turner (1990) has argued, “metonyms” for the scientific enterprise that society could understand and grasp, even while not comprehending the

precise conduct of science itself. This institutional incomprehension has contributed to the occasional casting of proponents of such regulation as “anti-science.” But in regulating scientific responsibility this way, society still treated science as a black box, blindly deferential to its internal workings.

Another part of the broader construct of scientific responsibility involved crossing the boundary from science back to society: the production, dissemination, and application of new knowledge. Through the greater portion of the life of the old model, this aspect of scientific responsibility most often considered atomic science and other war-related research enterprises. The dominant position on responsibility was something akin to “science proposes, society disposes” – meaning that whatever knowledge or innovation emerged from the black box of science was socially neutral unless and until societal actors put it to beneficent or nefarious use.

Some researchers publicly refused to work on particular projects they disapproved of, and they often suffered professional and personal consequences of such decisions. However, even to be partially effective in helping society dispose of new knowledge in appropriate ways, scientists had to create new organizations, e.g., the Union of Concerned Scientists, that would allow them to act as citizens without shedding the privileged mantle of their expertise (Moore 1996). Likewise, the federal government chartered new scientific advisory committees to communicate scientific propositions and inform political dispositions, and it was part and parcel of scientific responsibility to advise the government from a presumably neutral standpoint.

Still, science advice to political principals could be vexingly non-neutral, and many scientists’ organizations expressed real political interests beyond expertise. Congressional skepticism of experts in the Executive Branch, along with the social movement toward technology assessment, helped create a congressional Office of Technology Assessment (OTA), which institutionalized the recognition by Congress that science did not speak to power with a single voice (Bimber and Guston 1995).

OTA evolved into an organization more interested in a policy analytic approach to pending decisions involving science and technology than in assessing the potential future interac-

tions of technology and society. Further, Congress designed OTA to take advantage of technical expertise, yet positioned it too distant from the process of innovation to have direct influence over it, as well as too distant from the general public to perform any important role in influencing opinion or education.

At about the same time as the institutionalization of technology assessment, the new technology of genetic engineering began to spur serious questions about the limits, and not just the promise, of scientific inquiry (Holton and Morison 1979). Biologists facing questions of creating novel and potentially threatening genetic chimeras recast themselves in the role that physicists had assumed when facing the nuclear genie, but the biologists hoped to perform better. The eventual resolution here, too, was a modest regulatory one in which publicly funded researchers accepted modest safeguards, devised and administered by scientists, on their experiments, although almost any kind of experiment could still be conducted. The safety protocols did reach into the black box, but scientists themselves were doing the reaching.

The New Model

Under the new model, society views science less as a simple input/output device and instead views it more as a complex social realm in which the full range of human motivations – and attendant opportunities to influence them – are at play. Such new issues as research misconduct and conflicts of interest arise under the new model, and their threat influences the perception of other issues, including human subjects research and the quality of scientific advice. Further, there are potential new limits to inquiry that even the new model has yet to accommodate.

Research Misconduct

The old model failed to incorporate strategies for dealing with misconduct in science. It had relied on scientists as trusted individuals and on self-regulation to protect the integrity of science through systems of social and technical norms thought to reinforce individual integrity by openness, collegiality, and the appeal to evidence (e.g., Zuckerman 1984). But this system frequently operated unfairly: making decisions about careers behind closed doors, worrying more about salvaging the reputations of institutions and senior re-

searchers, and “passing the trash” to other, unsuspecting employers.

Instigated by Congress, the creation of a federal body for the oversight and investigation of research misconduct – the Office of Research Integrity (ORI) – marks a difference between the old and new models (Guston 2000). Long-running and controversial efforts have finally yielded a stable set of policies and procedures for investigating allegations of research misconduct and a new government-wide definition of research misconduct (Bird and Dustira 2000). Nevertheless, significant cases continue to arise, leaving ORI to manage a caseload of about 30 active cases at any given time (ORI 2000b).

Critical to the new model has been ORI’s encouragement and assurance of local capacities to manage misconduct. Accordingly, it has made major efforts in “education in the responsible conduct of research, prevention of misconduct, research on research integrity issues, and the promotion of research integrity in collaboration” among government agencies, research institutions, the scientific community (ORI 2000a).

Specifically, ORI has taken three important steps: 1) announcing a million dollar research program focused on the issues in the occurrence of misconduct and education for research integrity; 2) issuing a proposed rule to apply due process protections to whistleblowers at universities (DHHS 2000a); and 3) publishing new rules requiring funded institutions to train their own research staff in the responsible conduct of research (ORI 2000c). DHHS has suspended the application of these rules, however, at the behest of the House Energy and Commerce Committee, which has suggested that the department did not adhere to the requirements of the Administrative Procedures Act in promulgating the rules. The Commerce Committee did not, however, question the substance of the rules (Brainard 2001).

With the extant rules for managing misconduct, both in the treatment of those accused and those blowing the whistle, grounded in due process protections, ORI has reached into the science system not with the familiar hand of a researcher but with the long arm of a lawyer. The proposed requirement for research institutions to provide instruction in responsible

conduct of research is also grounded in due process, which requires prior notice of what constitutes improper behavior, as well as appropriate procedures after allegations of improper behavior are made.

On one hand, the proposed regulations may make universities and other research institutions more vulnerable to researchers who are subject to potential sanctions if found guilty of misconduct. On the other hand, universities may be more vulnerable to the federal government, which would require them to participate in a detailed elaboration of administrative law. But however threatening it might be in overturning old processes, this maneuver promises a more sound research system for both science and society through a new process in which scientists and non-scientists collaborate to assure scientific integrity.

Reliable Science and Data Availability

Although the 104th Congress refused to continue appropriations for OTA, it and subsequent congresses have continued to recognize the critical role of independent scientific advice for government decision making. Just as OTA was shutting its doors, the House Science Committee's Subcommittee on Energy and Environment raised the gavel on hearings on "Scientific integrity and public trust: the science behind federal policies and mandates."

Subcommittee chair Dana Rohrabacher (R-CA) framed the hearings as an inquiry into whether contrary but sound and relevant scientific opinion was being suppressed, and whether the political preferences of researchers might be interfering with sound scientific advice for public action, particularly in global environmental change. The hearings drew fire from former House Science Committee chair George Brown (D-CA), who alleged that the Republican majority and not researchers were politicizing the science (Brown 1997).

Beneath the allegations of politicization, however, lay not academic conflicts over epistemology but pragmatic concerns about the relative status of empirical observation and modeling, and the challenge of identifying scientific consensus, particularly in the face of vocal minority views and new theories or data. Other institutions had been confronting similar conflicts, including the U.S. Supreme Court in its decisions dealing with the relevance and reliability of expert

testimony in the *Daubert*, *Joiner*, and *Kumho* cases, and state governments in their attempt to deal with “sound science” (CSG 1999).

Motivated by similar concerns that crystallized around a controversial environmental rule, the 105th Congress passed a requirement (hidden as a rider to an appropriations bill) that federally funded researchers make their data available under the Freedom of Information Act (FOIA). In principle, this requirement merely extends financial accountability and the idea of science as a public good. Research sponsored by the public, particularly research that informs public decisions, should be publicly accessible. It also codifies the supposed norm of openness in the scientific community. In practice, however, it could allow private interests to use FOIA cynically to harass scientists who performed research contrary to their liking. Moreover, the anonymity or confidentiality of research subjects could be compromised and thereby threaten areas of research, e.g., public health and epidemiology, that rely on such guarantees. The rules promulgated by the Office of Management and Budget (OMB 1999) to implement the law, however, attempt to protect the privacy of research subjects and narrowly construe “data” to information relevant to research reports after they have been published. Nevertheless, the “FOIA-bility” of federally funded data means that another non-scientific mechanism has reached into the previously secure black box in search of a handle on scientific integrity and responsibility.

Conflicts of Interest

The old model also failed to deal in any direct way with the possibility of conflicts of interests among scientists. Although university researchers have had a long history of interaction with the private sector, it is only since the Bayh-Dole Act of 1980 that the federal government has articulated an explicit policy to create incentives for such interactions by allowing federally funded researchers in universities to patent (and profit from) their research findings in the hopes of facilitating technology transfer to the private sector (Guston 2000). Moreover, only recently have new industries like biotechnology and software proliferated novel roles for university researchers as entrepreneurs, members of boards of governors or advisors, and equity partners.

Under the old model, those fearful of the consequences of corporate domination of both the research agenda and influence inherent in expertise (e.g., Primack and von Hippel 1974) argued for science in the public interest, based in universities and led by federal spending. Now, the corporate share of research sponsorship exceeds two-thirds of the national total, compared to roughly one-third when Primack and von Hippel first expressed their concerns, and university laboratories are crowded with researchers who have financial stakes, large and small, in the results of their research. "Privatizing the university" risks making the research conducted there accountable to the wrong parties (Brown 2000).

The National Institutes of Health did not first promulgate regulations for research institutions' disclosure and management of conflicts of interest until 1995 (NIH 1995). NIH has recently announced additional considerations, suggesting that IRB's in particular take a more active role helping principal investigators identify and manage conflicts (NIH 2000). Research institutions may be lagging behind journals in managing conflicts of interest, rather than simply disclosing them (and some of them may not be in full compliance with the 1995 regulations; see Agnew 2000b). The *New England Journal of Medicine*, for example, maintains strict guidelines for editorialists, which it analogizes to recusal by judges: editorialists may have "no important financial ties to companies that make products related to the issues they discuss" (Angell 2000:1516). *NEJM* requires authors presenting empirical data to abide by the lower standard of disclosure.

There is, however, some evidence that such a policy may still allow biased results into the literature. Bodenheimer (2000), for example, found that among published studies comparing the efficacy of new and old drugs, those studies funded by drug companies showed the new drugs more effective in 89% of the cases, compared with 61% of the cases in studies not funded by drug companies. Bodenheimer has also reported that some 29% of articles published in six major medical journals in 1996 had guest authors, ghost authors, or both, thereby concealing the real authorship of the research and possibly any conflicts that could influence its real or perceived objectivity.

Human Subjects

Particularly disturbing is the intersection of conflicts of interest and human subjects research, a connection that has achieved prominence since the unfortunate death in 1999 of Jesse Gelsinger during a gene therapy trial at the University of Pennsylvania. In that case, the director of the institute housing the research held financial interests in a firm, founded by one researcher, that helped finance the institute (Sacks 2000).

In bringing a civil suit against the university and individual researchers (including the bioethicist who advised the researchers), Jesse Gelsinger's father Paul explained that as he became aware of alleged wrong-doing at the university, his opinion changed from holding the researchers blameless to believing that they placed profits ahead of safety (Weiss and Nelson 2000).

Although the private civil action by the Gelsinger family was settled (with undisclosed terms), the Food and Drug Administration (FDA) began proceedings against the Penn researcher for breaching human subjects protocols; as punishment, FDA could disqualify him from receiving drugs used for clinical trials, effectively preventing him from conducting clinical research (Vogel 2000).

Following Gelsinger's death, Secretary of Health and Human Services Donna Shalala announced five steps to strengthen human subjects protection: aggressive education and training activities for investigators and IRB members and staff; clarified informed consent procedures, including the possibility of their observation by third parties; improved monitoring by NIH of clinical investigations, facilitated by monitoring plans submitted by investigators; public discussions of and additional guidance regarding conflicts of interest; and pursuit of legislation by FDA to levy civil fines against research institutions and clinical investigators for violations (DHHS 2000b).

The scientific community has begun to implement some of these recommendations. Research universities have already begun training programs for faculty from all disciplines engaged in human subjects research, pre-empting NIH's expected requirement of certification for all of its researchers. Public discussion of conflict of interest policy also occurred at a conference organized by NIH in August 2000.

At the conference, the new head of the federal Office for Human Research Protection (OHRP), Greg Koski, expressed support for eliminating some kinds of financial arrangements by researchers (akin to the *New England Journal's* recusal policy); conferees also debated the appropriateness of making full disclosure of financial interests to human subjects (Agnew 2000a). The National Bioethics Advisory Committee (2000) has also released a draft report that recommends expanding the membership of IRBs to include many more non-scientists and persons not affiliated with the universities.

Human subjects issues are not limited to problems introduced by conflicts of interest. Other recent controversies have included: the ethical conduct of research on the Internet, which is difficult because of the ability of researchers to conceal their identities and the lack of clarity between public and private spaces on-line; the use of prisoners as research subjects, which is difficult because of the uncertainty of obtaining true consent in an environment with structured rewards and sanctions; and appropriate rules for the conduct of human subjects research in other countries, which can be complicated not only by commercial interests but also by authoritarian local regimes and mismatches between the knowledge, expectations, and basic levels of health care of local participants on one hand and formal adherence to protocols on the other.

Cultural Limits to Knowledge

The case of Kennewick Man provides insight into what might be called the cultural limits to knowledge, a new domain of scientific responsibility not easily accommodated in the old frame. Kennewick Man is how researchers dubbed the extraordinarily well-preserved, 9,000 year-old remains of a human male found on the banks of the Columbia River in Washington State in 1996. The Army Corps of Engineers took initial custody of the remains, intending to hand them over to five Native American tribes under the provisions of the Native American Graves Protection and Repatriation Act (NAGPRA), which allows tribes to claim culturally affiliated human remains and artifacts.

However, anthropologists wishing to study Kennewick Man – who seemed not physically related to Native Americans upon initial investigation – filed a lawsuit to prevent the

Corps from repatriating the remains. A federal report released in October 1999 concluded that Kennewick Man is related to Asian peoples and not to contemporary Native American tribes, but Secretary of the Interior Bruce Babbitt concluded that the bones had been studied thoroughly and, based on geographic data and oral histories, should be repatriated. A federal court has since ordered DOI to reconsider its opinion, and a trial date has been set for June 2001.

Kennewick Man is but one example of the impact of NAGPRA, and perhaps the most controversial. The act has spurred a large number of exchanges between Native American tribes and research and cultural institutions, most of which have been productive (Kinzer 2000). Like the controversy over recombinant DNA in the 1970s, Kennewick Man raises a question of the acceptability of saying, "we will do no further research here." However, the motivation for limits to inquiry differs in the two cases. In the genetic engineering case, researchers encountered limits to inquiry when they considered the potential health hazards of accidental (or intentional) release of experimental organisms.

In the NAGPRA case, researchers encounter the limits to inquiry most often in a more indirect fashion. Many of the artifacts and remains covered by the law have already been scrutinized by science, although not necessarily by the most modern methods. The opposing interest is not safety but a suite of values ranging from distributionary questions of who benefits culturally and economically from the display of artifacts to religious questions of the sacredness of human remains. Rather than the "researchers-only" solution applied in the recombinant DNA controversy, scientists and non-scientists worked together in crafting NAGPRA and have been brought into closer collaborations because of its authority.

Democratizing the Integrity and Responsibility of Science

As described above, the transition from the old model to the new model of science and society has complicated issues of scientific integrity and responsibility. The cases above suggest four themes important to the future of scientific integrity and responsibility: 1) the presence of (multiple and conflicting) interests in the research enterprise; 2) the role of collaborations between scientists and non-scientists in re-

solving conflicts; 3) the possibility of new limits to inquiry; and 4) a continuing neglect of the social outcomes of research. In the discussion that follows, I will suggest that a route to managing these complications is the increased democratization of science.

Interests in Science and Their Implications

Traditionally, liberal-democratic thinkers treated areas considered devoid of interests as private spaces. Governed by affection, like the family, or by reason, like science, these spaces were separate and distinct from politics. In his *Leviathan*, for example, Hobbes famously distinguishes geometry – his model science – from other human activities because it “crossed no man’s ambition, profit, or lust.” But this distinction is no longer tenable. Not only have we recognized the interests inherent in science and scientists, but we have, as a matter of policy, created incentives to harness their ambition, profit, and lust for technical progress and economic gain. The transition from private to public for science may be a rocky one, as it has been for issues like spousal and child abuse and sexual harassment. But it is just as necessary.

Accepting the presence of interests in science means accepting a role for politics there as well, and not just any politics but a democratic one. The political theorist Robert Dahl (1986) once offered the following, compelling argument for workplace democracy: We favor democratic forms of participation and accountability in the realm of politics because we believe that people should have fair input into decisions about their interests. Decisions in the workplace involve people’s most profound interests and, therefore, we should favor democratic forms even there, where they have been traditionally absent. By a similar argument, we are obliged to make room for democratic forms in science, even though they have been traditionally absent.

Collaborations Between Scientists and Nonscientists

“Democratic forms” refers to the mechanisms for participation and accountability that are critical for popular sovereignty. Including democratic forms in science does not mean, as it is occasionally portrayed, voting on the laws of nature. Such democracy by plebiscite is a caricature often deployed by foes of democracy. But it does mean more than

maintaining that an institutionally separate science is simply compatible with, or even reinforcing of, democracy. Including democratic forms in science means integrating mechanisms for participation and accountability into science in those places where authoritative decisions affecting interests are at stake.

Such integration is a challenge to both theory and practice. Democratic theorists have grappled with the place of non-democratic subcultures within a larger democratic culture – subcultures like the workplace but also, for example, religious orders, clubs and associations, and schools and universities. In practice, this integration has often been facilitated by a political and structural logic in which individuals, perceiving an incongruity in their subculture, expand the scope of conflict to enroll allies from the more democratic larger culture (Schattschneider 1960). In federal civil rights cases, for example, the lever for congruity between the subculture and the larger culture was “public accommodations” and the impact on interstate commerce that legitimated congressional involvement.

For the integrity and the responsibility of research, the lever is the ability of the federal government to attach strings to its discretionary awarding of research funds. Precisely this dynamic was at work in the establishment of due process protections in research misconduct allegations, which allowed both researchers accused of misconduct and whistleblowers to appeal to federal courts if they felt their universities had mistreated them. This dynamic was also evident in the application of FOIA to policy-relevant research data as discussed above, as well as in an earlier federal court ruling that made public some operations of the National Academy of Sciences under the Federal Advisory Committee Act (FACA).

The integration of democratic forms into science has also been won through direct citizen action. Again, in civil rights, the mobilization of many hundreds of thousands of citizens was critical in revealing the non-democratic treatment of African-Americans and in convincing local and national authorities to respond with democratic reforms. Similarly, the mobilization of citizens on issues like the use of recombinant DNA and genetically modified organisms, research on AIDS and women’s health, and experimentation with animals has

led to some conflict with scientific interests, but also to more responsible research and more socially acceptable technologies.

The application of FOIA and FACA to the production of scientific expertise suggests that expertise may not survive challenges to its authority unless it has been developed through a process that is congruent along dimensions important to democratic values. Similarly, direct citizen action can be a potent challenge to new technologies that do not embrace public values, or it can be a powerful ally in reorienting the research enterprise to more relevant and responsible innovations. Practices such as the specific inclusion of diverse interests in scientific advisory committees (Jasanoff 1990), the structuring of expert reviews of policy relevant research along representative lines (Guston in press), and the participation of citizens in the assessment of new technologies (see below) point to the strengthening identity between responsible science and reliable science. These practices are aspects of what scholars have labeled the “co-production” of science (Jasanoff 1996), generally meaning that what counts as science, and what makes that science reliable, is its production by a collaboration of scientists and non-scientists who incorporate values and criteria from both communities.

New Limits to Inquiry

The invitation of democratic forms into science, of course, raises the question of conflicting values and, in the worse case for researchers, potential limits to inquiry. Citizens, even informed ones, may prefer that some research not be performed, some knowledge not be sought, or some technology not be developed.

The safety issues of new research techniques and technologies, such as those raised by biologists around recombinant DNA research, persist. For example, technologist Bill Joy (2000) has suggested that autonomous, self-replicating systems like nano-bots may ultimately be too hazardous to pursue. Moreover, as the case of Kennewick Man suggests, there are instances in which the values of a relevant community conflict with the goal of knowledge acquisition.

As befits a pluralistic democracy, these conflicts will occur in cases both where the values in conflict with inquiry are held by a significant portion of the larger democratic culture, and where they are held by a relatively vocal or strategically situ-

ated minority. The critical question for the future of a democratic science is, “under what conditions does the value of the acquisition of new knowledge trump all other values?”

Many democratic cultures have partially answered this question through the adoption of rules on informed consent. By the doctrine of informed consent, no single experiment’s value trumps the value of human autonomy.

But we have not managed to ask this question about the larger research enterprise, or to consider whether a democratic society possesses the same trump card over it as an individual does over an experiment. Consider, for example, that we ask social scientists to follow requirements for informed consent because of possible mental and emotional risks to their research subjects. Federal regulations even protect the families of human research subjects. In a recent case, researchers at a university in Virginia failed to seek informed consent from family members of study participants when the questionnaire they administered inquired about those family members; the federal Office of Protection from Research Risks (now OHRP) sanctioned the university (Wadman 2000). We do not, however, protect non-subjects in the general population from similar or even more profound risks.

Instead of extending informed consent requirements to those who are affected by but not subjects of scientific research, we labor under the assumption that either there is broad consensus in society for scientific inquiry of any kind, or that the extant mechanisms of funding, priority setting, and conducting research are sufficiently consensual. Rendering this assumption true means that assuring the presence of democratic forms in decision making about research must be prior to discussions about limiting – or for that matter, conducting – research.

In similar fashion, the philosopher Deborah Johnson (1999:461) concludes that “more dangerous...than forbidding knowledge is keeping invisible the decisions by which science is directed,” because such a practice cloaks the interests that direct science and the interests that science serves. Johnson’s argument circles back to the question of participation: there are risks associated with keeping science separate from democratic participation, and questions about the nature and extent of participation should be settled, with

democratic participation and accountability, prior to any confrontation over limits to research.

This conclusion can be true for at least three reasons. First, democratic participation may convince previously skeptical lay-citizens that either the expected benefits of the research outweigh the expected costs, or the research does not truly transgress a value in a way they had imagined. Second, researchers may be convinced that their research is sufficiently contrary to public values that it should not continue, or they may through collaboration discover less contrary routes to the same research goals. Third, democratic decisions – while binding and authoritative – are not necessarily permanent, and decisions to limit inquiry can be but temporary and reversible, while decisions to extend inquiry are permanent and irreversible.

The Neglect of Outcomes

Not only should the discussion, and institutionalization, of democratic forms of participation and accountability be prior to the limits of inquiry, but so too should be the discussion and assurance of the outcomes of scientific research. “Assurance” is the attempt to increase the certainty that research will lead to socially benign outcomes. “Outcomes” are not the relatively direct outputs of research, including published papers, trained students, and patented inventions, but rather the educated populace, growing economy, flourishing public health, sustainable environment, and other societal goals to which research can contribute.

Without some ability to connect research to societal outcomes in a way more specific than the vague positive promise of research – what Daniel Sarewitz (1996) calls “the myth of infinite benefit” – debates about constraining or, for that matter, pursuing research, are woefully incomplete. Strategic planning by federal agencies under the Government Performance and Results Act has begun to articulate societal outcomes as goals and incorporate research as one aspect of their pursuit.

However, to speak, as above, about the increasing identity between responsible science and reliable science is not yet to speak about a fully relevant science. The relevance of “science proposes, society disposes” is at best a haphazard one. Although we intend science to contribute to social change, we make provisions neither for anticipating that

change nor for assuring that the change favors socially benign or productive uses.

The integration of democratic forms of participation and accountability into the scientific subculture can also foster relevant as well as responsible and reliable science. For example, in the absence of OTA, some activists and scholars have advocated mechanisms for participatory technology assessment, variously described as consensus conferences or citizens panels (Brown 2001; Guston 1999; Sclove 1996). Such panels, in which lay-citizens and experts interact to explore the implications of innovation from the citizens' perspective, have successfully advised high-level political decision making and informed public understanding of science in Europe and have begun to spread internationally (Joss 2000).

One of the primary difficulties of technology assessment, however, is encountering the technology to be assessed early enough in its development that action constructive for its relevance – rather than blunt opposition – can be taken. The need for such “constructive technology assessment” (Schot and Rip 1997) is therefore apparent in conjunction with the earliest stages of the research process at universities as well as in government and private laboratories. Collaboration between scientists and non-scientists on relevant research, with attention to outcomes and the values implicit in research, must occur even from the earliest stages in the laboratory (Guston, Woodhouse, and Sarewitz 2001).

Discussion of Objections

Opponents of the democratization of science raise some potentially troubling objections to this approach. Some may reject the claim that science involves interests, or the consequent argument that the presence of interests requires the presence of democratic politics. They may also reject the relativist claim, not made here, that the political ideology or other social circumstances of a researcher influences the outcome of his or her specific research findings (in something other than a pathological way).

Nevertheless, it is quite another thing to reject claims that those same circumstances influence the choices individuals make in becoming scientists in the first place, selecting a scientific field and specific problems within that field, or deciding what kind of research (e.g., fundamental, clinical,

theoretical, field, etc.) to conduct. Such choices have both political inspirations and consequences.

No one who supports the public sponsorship of research would challenge the role of the public in setting priorities to create incentives for people to become scientists, select scientific fields particularly valued by society, and pursue particular kinds of research thought similarly valuable. Yet these decisions create the fundamental outlines – as well as some of the interstitial detail – of scientific knowledge and technical achievement.

Thus, what we know is co-produced by researchers and the public, each of whom makes choices with political and scientific consequences. Debating whether we would know a different reality with a different organization or demographics to research is a distraction. But it is critical to realize that we would likely know a different subset of reality with different arrangements for investigating nature. There should be significant democratic input into the choice of that subset.

Some might wonder whether the public participation, however, would be likely to render co-produced decisions incorrectly. That is surely a risk. But it is not likely a risk greater than or uniquely distinct from the risk of other decisions that democratic societies already put into the hands of the public. For example, individuals are responsible for their own health and well-being, and collective public decisions are responsible for the distribution of access to and resources for health care. We do not seek to limit participatory choices because lives are at stake. Rather, we seek to persuade decision makers and the public that some preferences have substantively better outcomes than others.

Some might also argue that democratic controls on scientific inquiry, like the limits discussed above, are contrary to constitutional and other respected freedoms (of speech, association, etc.) or are manifestations of a tyrannous majority. But democratic governance is constantly at odds with itself about the boundaries of these freedoms. Merely framing the problem as a constitutional question is, in fact, agreeing with the premise that it should be the forms of democratic participation and accountability that govern science.

Similarly, some might see the particular institutions of government, e.g., the annual appropriations process in Congress or the local control of school curricula, as democ-

matic challenges to science. Annual appropriations make planning stable research programs more difficult, and the local control of school boards on occasion has meant the triumph of creationism over evolution in biology texts.

But these particular institutions of government are supportive of such other closely held values as financial accountability and federalism. Arguments for changing these institutions should be embedded within a context broader than simply what is good for science, because these institutions were not created for science, and science is not the sole value upon which they function. Likewise, defenders of the status quo of these institutions should not be cast as “anti-science” if they defend them for the other values they serve. If being “anti-science” means not putting science first in any question of the conflict of values, then being “pro-science” means being anti-democratic.

Conclusion

The transition from a model of science separate from society to one of science integrated with society requires rethinking notions of scientific integrity and responsibility. This paper has argued that the new model requires democratic forms of participation and accountability in the management of integrity and responsibility. Supporting democratic participation and accountability for science does not mean being anti-science, and neither is it more threatening than other commonly accepted democratic practices. By recognizing the interests present in science, encouraging collaborations between scientists and non-scientists, confronting values that may pose limits to inquiry, and attending to the societal outcomes derived from research, we can simultaneously generate a more responsible, reliable, and relevant science.



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