Target Article

The Absent Professor: Why We Don't Teach Research Ethics and What to Do about It

Arri Eisen, Emory University
Roberta M. Berry, Georgia Institute of Technology

Keywords

ethics
research
education
social implications
bioscience

Open Peer Commentary

Ruth R. Faden, Nancy E. Kass, Michael H. Klag, and Sharon S. Krag, p. 50
Nicholas H. Steneck, p. 51
A. M. Charkrabarty, p. 53
Richard R. Sharp, p. 55
Paul Brodwin, p. 56
Kelly Fryer-Edwards, p. 58
Rob Schwartz, p. 59
Kenneth A. Richman, p. 61
Paul Root Wolpe, p. 62
Karen J. Maschke, p. 63
Elisa J. Gordon and Kayhan P. Parsi, p. 65
Jeanne M. Sears, p. 67
Madeline M. Motta
Rosamond Rhodes
Howard Trachtman

Research ethics education in the biosciences has not historically been a priority for research universities despite the fact that funding agencies, government regulators, and the parties involved in the research enterprise agree that it ought to be. The confluence of a number of factors, including scrutiny and regulation due to increased public awareness of the impact of basic research on society, increased public and private funding, increased diversity and collaboration among researchers, the impressive success and speed of research advances, and high-profile cases of misconduct, have made it necessary to reexamine how the bioscience research community at all levels provides ethics education to its own. We discuss the need to and reasons for making ethics integral to the education of bioscientists, approaches to achieving this goal, challenges this goal presents, and responses to those challenges.

Research Ethics at the Turn of the Century

The vast majority of principal investigators in bioscience have received little to no formal training in responsible research conduct. Bulger and Reiser describe a graduate research ethics course developed in 1984 at the University of Texas at Houston—to their knowledge, the first of its kind (Bulger and Reiser 1993). In summarizing recent surveys, Stern and Elliot (1997) write that, although nearly 90% of graduate students from major research institutions reported having supportive faculty mentors, less than half said they received "a lot" of help from those mentors with the details of good research practice. A fifth of these graduate students reported that they got *no* help in this area. Most said the help their mentors provided did not qualify as effective education in research ethics. Of 2000 faculty members surveyed, 99% believed that "academics should exercise collective responsibility for the professional conduct of their graduate students," but only 27% felt that they followed through with this responsibility.

Only in the last decade has ethics education for any bioscience researchers, primarily graduate students and in some cases postdoctoral fellows, been stipulated as a requirement for National Institutes of Health (NIH) funding (NIH, Alcohol, Drug Abuse, and Mental Health Administration 1989). In 1999 the secretary of the U.S. Department of Health and Human Services (HHS) greatly extended the requirement for education in the responsible conduct of research to include not only those supported by institutional training programs, as was stipulated in the earlier policy, but *all* research institution staff supported by Public Health Service funds (Public Health Service 2000)[1]. These policies, spurred by a growing number of high-profile cases involving questionable scientific conduct and the ensuing response from the public, Congress and the scientific community brought ethical issues in bioscientific research and ethics education into the spotlight (see, for example, Kevles 2000; Somia and Verma 2000).

Now, in the glare of that spotlight, age-old questions not often asked in the context of basic scientific research are being considered more carefully. Can ethics be taught? Should ethics be taught formally or learned informally as part of an apprenticeship, or both? What should be taught: Ethical rules governing research in bioscience that are imposed by law, the university, the workplace, or a professional code? Methods of ethical reasoning as applied in the laboratory setting? Alternative ethical theories, ethical principles, and non-

1. This updated policy, however, was suspended in February 2001 pending review of its substance and whether the document should have been issued as a regulation rather than a policy (Public Health Service 2001).

theoretical approaches to ethics as they bear upon the practice and social implications of bioscience research? Who should do the teaching, and how should they do it? And who should be taught—only graduate students, or also principal investigators, or anyone involved in bioscience research?

Few would disagree that ethics education is a fundamental component of the transmission of human culture and that all of us are "taught" ethics by our parents, peers, teachers, mentors, and other role models. The question we consider here is, specifically, how explicit and formal should research ethics education be in the formative years of bioscientists' training and in the subsequent years of their careers? We argue that it should be formal and explicit from the beginning, and we suggest that continuing education in research ethics should become an integral part of the life of the practicing bioscientist.

Other professions—medicine, law, and engineering among them—long ago established codes of professional ethics to guide and regulate their conduct (American Medical Association 2001; American Bar Association 2001a; National Society of Professional Engineers 2001a) and increasingly incorporate formal ethics training in their educational programs (see, for example, American Bar Association 2001b; Shaw 1997; Accreditation Board for Engineering 2000; Heckert 2001). Adopting these codes of conduct and ensuring that professionals learn about them makes sense given the connection between certain ethical norms and the important social functions of these professions. If doctors fail to keep patient secrets, patients will no longer confide secrets potentially important to their care; if attorneys encourage their clients to commit perjury, confidence in the legal system as a means for just and peaceful resolution of social conflicts will diminish and self-help will grow more attractive; if civil engineers cut corners to save costs, the efficiency and safety of public travel will be undermined.

Bioscience research also is a profession that serves an important social function: improving well-being through advances in understanding of biological processes and the development of new and improved biotechnologies—a function thought important enough to justify huge expenditures of public dollars. And certain ethical norms are key to performing this function: if bioscience researchers fudge their data, public dollars and researchers' efforts will be squandered on unworthy projects, while projects with real promise for generating improvements founder. If our comparison to the salient features of these other professions is apt, and if we are right about the connection between ethical norms and social functions, why, then, is there no code of professional ethics for bioscience research and no widespread integration of ethics instruction in the bioscience curriculum?

We believe that ethics codes and ethics instruction are coming—and should come—and that the lag time in the coming-of-(ethical)-age of bioscience research is due, in part, to a collection of factors: a strong research community ethos prizing autonomy and informality and associating these characteristics with creativity and productivity; the extraordinary success of the modern bioscientific enterprise, lending credence to the claimed association; the apparent long-standing success of the community in policing itself and in transmitting norms of conduct even in the absence of an explicit code of conduct or formal training in ethics; the difficulty of devising a code broad enough to apply to most bioscience researchers but specific enough to be meaningful; and the absence of any traditional clients who might complain of research negligence or malfeasance and the corresponding lack of any formal licensure and related disciplinary mechanisms.

If we are right about the factors explaining this lag time, what leads us to believe things will change—and why do we write of a "lag time" rather than of a continuing and permanent exemption from the path taken by other professions? While the immediate impetus to the 1999 HHS policy was a particular high-profile case and its sequelae, we believe there are underlying reasons why bioscientific research will soon join the path of these other professions.

Bioscientific Research after World War II: Professional Ethical Issues Come to the Fore

A confluence of relatively new and powerful forces is revising the relationship between bioscience and the larger community. Bioscientific research has been transformed from an insular practice—of concern and interest primarily to its practitioners and to healthcare professionals—to a profession that operates in increasingly prominent public view. Expectations that research show promise for improving human well-being—and concerns that ethical problems may undercut this promise—have grown in tandem with expanding public budgets.

Public Money: Paying the Piper and Calling the Tune

The post-World War II growth in federal dollars allocated to basic research, especially in the life sciences, has been phenomenal. Initially, increased funding did not bring increased scrutiny. But continuing funding growth spurred increased competition for funds, increased public visibility for the research sector, and, eventually, increased scrutiny of the product and process of scientific research (Starr 1982; U.S. Congress 1991; Judson 1996). The deep dependence of modern science on government funding has turned the public into a "client" with an ever increasing stake in the practical payoff from "big science." In the 1990s alone, federal funding of research and development, driven primarily by funding in the natural sciences, increased by 42% (National Science Board 2002). When public attention is riveted upon a claimed or real occasion of negligence or malfeasance, the consequences can be much more far-reaching—extending to the survival of a research program—than when a private client is aggrieved by the conduct of a professional.

Private Money: Incentive, Temptation, Conflict, and Constraint

The potential for making significant amounts of money in basic research has never been greater. Opportunities for bioscience researchers to find significant financial rewards for their work expanded following enactment of the Patent and Trademark Law and Amendments Act, known as the Bayh-Dole Act, in 1980. The purpose of the act is to facilitate technology transfer from universities to industry, allowing universities to patent their own inventions developed with federal support and to become directly involved in their commercialization (Council of Government Relations 1999).

The policy rationale for the act was the encouragement of basic research and, ultimately, the generation of socially beneficial knowledge and biotechnologies (Goodwin 1996)—a rationale that experience appears to have vindicated since the passage of the act. More than 2,200 companies were formed based on the licensing of inventions from universities between 1980 and 1999, with over 330 companies formed in 1997 alone. These companies have brought over 1,000 products to market (Council of Government Relations 1999).

But the Bayh-Dole Act has also generated worries that new opportunities to fund research programs and to obtain personal financial rewards—intended as incentives to the production of social benefit—could also constitute temptations to abuse and could result in conflicts of interest and values. Promising research programs might be distorted in response to narrow or short-term industry goals, the benefits of research subsidized by the taxpayer might accrue primarily to private industry, and scientists might be corrupted into self-dealing by the lure of personal financial rewards (Cohen 2001; Moses and Martin 2001).

Diversity: Enrichment, Challenge, Explicit Norms, and Formal Education

The demographics of those doing bioscientific research in the United States has changed dramatically in the past 15-20 years. Sixty-five percent of science and engineering graduate students in 1975 were white; by 1999 the figure was 53%. Women made up 43% of all graduate students in the natural sciences in 1999. Graduate students and their postdoctoral colleagues today represent a diverse array of cultural backgrounds. In 1998-1999 foreign nationals earned over a third of all natural science Ph.D.'s granted in the United States, and over one-third of all scientists and engineers in American industry were foreign born (National Science Board 2002). The degree of collaboration in science has also increased significantly due to the increasing sophistication and complexity of modern science. Much of this collaboration is international; the percentage of papers published by U.S. authors collaborating with international authors has doubled in the past decade (National Science Board).

The chief benefits—and challenges—of diversity and multicultural engagement come from the different ways of perceiving and knowing, the different styles of communication, and the different assumptions and commitments that diverse individuals bring to the scientific enterprise. It is probably no longer true, if it ever was, that there are well-understood and uncontroversial norms within this diverse scientific community and that these norms are transmitted and internalized without dissent or misunderstanding in the classroom and at the bench. As the community of science expands and diversifies, the need to articulate norms governing the conduct of research, to thrash out disagreements and misunderstandings about their formulation and their application to concrete cases, and the need to engage in explicit education of future generations seems inescapable.

The Wages of Success: New Visibility and Accountability

For as long as bioscience labored in the shadow of giant physics, its ethical quandaries, both those involving professional misconduct and those related to its social implications, were likely to remain hidden from public scrutiny. But, in this new era of ascendant bioscience, the culture is saturated with stories of success and controversy, from disputes about accurate reporting of data to questions about conflicts of interest, from the safety and environmental consequences of genetically modified foods to the social implications of the new knowledge and new biotechnologies following upon the Human Genome Project. The new, far more transparent relationship between science and society is one consequence of the extraordinary advances in understanding biological processes and developing biotechnologies in the past 50 and, especially, the past 10 years. Public dollars, private dollars, and diversity have supported these advances and have followed upon them in a complex, interactive, ongoing evolutionary process. The extraordinary success of the modern research enterprise no longer serves as the trump card in the defense of its autonomy and informality. With success of this magnitude, the consequences of ethical failures are too visible, costly, offensive, and potentially threatening to the surrounding community to be overlooked.

We acknowledge that we have identified and only sketched here an account of the continuing influence of just a very few sociohistorical factors at work. Nonetheless, it is clear that these factors have contributed to a transformation in post-World War II bioscientific research, and we find it difficult to imagine reversals in current trends or the intervention of new forces that would undo this transformation. We conclude that twenty-first-century bioscientific research cannot maintain a simple homeostasis in isolation from the larger society: scrutiny and ethical accountability will flow back and forth across the laboratory wall. What is not yet clear is who will mediate the exchange and how.

Bioscientific Research and Ethics Education: Finding the Path

The responsibilities imposed by the transformation we describe should not be lamented but, instead, should be embraced by the bioscientific research community as appropriate to the role of a mature profession. The question, then, is how the community can rise to the occasion. Academic bioscientists, in particular, should lead the way. The central component of their response should be the integration into science curricula of formal ethics training encompassing instruction in professional norms, methods of ethical reasoning, and alternative approaches to assessing the social implications of bioscientific research.

Explicit education in and enforcement of norms developed by practitioners and tested against the requirements of the practice are hallmarks of a mature profession, and with good reason. Junior researchers should learn from their senior colleagues that, like other professionals, they are free to pursue the personal joys and rewards of the practice, but only if they effectively discharge the ethical responsibilities owed their fellow practitioners and the larger community in light of the social function of the profession. Junior researchers also should learn methods that are effective in discharging these responsibilities; vague admonitions to behave ethically without instruction both in the norms of the profession and the basic skill set for honoring them will do no more good than vague admonitions to do good science without instruction in both the theory and the skill set of the laboratory. Finally, bioscientists have a distinctive obligation to study the social implications of their work and to understand something of the alternative approaches to assessing these implications. If we are right that enforcement of ethical norms is key to achieving the social function of bioscience research—improving well-being through advances in knowledge and biotechnologies—then an important dimension of this ethical education is to understand the controversies surrounding what we mean by "well-being."

This call for research ethics education in the biosciences is not meant to graft onto research practice any new or alien ethical content, nor is it meant to impose any extraordinary or onerous educational responsibilities. As we have noted, few would dispute that ethics is a fundamental component of human culture and that it belongs in the core of the cultural curriculum that we transmit in a variety of ways from one generation to the next. Science, as a human cultural practice, has always been ethically fraught, and responsible scientists have always recognized their responsibility to practice ethically and to transmit the norms and methods of ethical practice and an appreciation of the social implications of their work to subsequent generations of researchers. What we urge here is that effective discharge of this responsibility—in an era of a transformed bioscience research profession—will require a substantial investment of thought and effort in devising effective programs of formal ethics instruction.

Challenges to Integrating Research Ethics Education into the Curriculum

If our argument to this point is correct, and if, as the survey data we cited at the outset indicate, most graduate students are not receiving effective research ethics education and most faculty members know that they are not and believe that they should, then it appears that our future collective effort might best be applied to devising and implementing workable plans for curricular innovation. We offer some beginning thoughts along this line in the next section. In this section we address some necessary preliminaries: if we are to be effective in designing and implementing research ethics education, we first must have a better appreciation of the challenges involved in doing so.

Sins of Omission

There is no doubt that good and useful ethics education is now going on in research laboratories throughout the country. As developing researchers learn how to do the work of scientists—to perform particular techniques, accurately record results, and so on—they observe and absorb the traditions and conventions of doing science. In this way they learn *how* to act in the modeled circumstances but not necessarily *why* (Elliott and Stern 1996). Why should they collaborate with one investigator and not another? Why should they include certain investigators as authors and not others? Why should they pursue a relationship with industry or not?

It is the exploration of these "why's" that is the chief contribution of formal research ethics education. If researchers are to be equipped for a lifetime of ethical decision making in a wide variety of presently unimaginable circumstances, they will need to learn to cope with gray areas, where values conflict, where justifications for one choice or another are not obvious, where difficult decisions nonetheless must be made. If researchers-in-training are to achieve this level of ethical competence, they will need more than modeling of the right thing to do in given circumstances that arise during their training in the lab. They will need formal ethics instruction that includes explicit identification of professional norms, training in the methods of ethical reasoning, and exploration of alternative approaches to assessing the social implications of bioscientific research, and instruction that relates all of these to the social function of the profession.

Perhaps in an ideal world there would be no need to issue a call for academic bioscientific researchers to develop and implement a formal curriculum in research ethics. Faculty members and laboratory mentors would be the perfect role models, teaching members of their labs the "rules of the game" both explicitly and by example; interspersing commentary about how, for example, separation of research from personal motives might be justified as best serving the mission of science; as well as leading probing discussions of the social implications of their work.

It should not be surprising that this does not describe our world. Faculty members and mentors generally have received little or no formal ethics instruction themselves. They endure numerous competing demands on their time and resources, and they are likely to be concerned that yet more demands upon them may interfere with the competitiveness of their labs. And many faculty members are far more comfortable with serving as role models for behavior aimed at developing knowledge and expertise than as role models for ethical behavior (Piper, Gentile, and Parks 1993). There are understandable reasons for our sins of omission.

To the extent that faculty members and mentors lack the knowledge, time, resources, or comfort level to teach ethics, then they and their universities will need to work together to ensure that those are supplied. Most research universities have developed their own set of rules governing the conduct of their research, and many have undertaken ethics education initiatives in response to grant requirements or in addition to, or independently, of these requirements (Mastroianni and Kahn 1998). This is a start.

Disciplinary Integrity and Control

Academic researchers understandably may feel defensive about outside forces attempting to regulate behavior that many feel they can regulate themselves and about the perceived implication that researchers are not already behaving ethically (see, for example, Wenger et al. 1997). On these points we may be able to learn something by consulting the historical experience of other professions.

In 1968 Senator Walter Mondale held hearings on the need for a commission to explore issues of the protection of human subjects and ethical problems in medicine and behavioral research. As described by Jonsen in *The Birth of Bioethics* (1998) these efforts were met with disdain and, sometimes, hostility by leading physicians. A Senate committee exploring these issues would be "an insult to doctors;" physicians did not need ethicists, theologians, or philosophers telling them what to do; institutional review boards would only hamper progress. A prominent heart surgeon denied that the advent of public funding for surgeries should have any effect on regulation of the medical profession: "Who pays the costs of war? The public! Who decides where the general should attack? The public? The general makes the decision. He is qualified to spend the public's money the best way he thinks fit" (Jonsen, 92).

Jonsen chronicles the evolution of the relationships among the medical community, other disciplines, the public, and Congress that have led to a system that, while not perfect, has integrated regulation of the profession and instruction in medical ethics, and that fosters ongoing discussion of ethical issues. Although the comparison can only carry so far—the professions are different for many reasons, including the fact that physicians work directly with human subjects and are much more likely to be involved in life-and-death decisions than are bioscientific researchers—it is useful to consider the initial reactions of medical professionals as the bioscience research community struggles with similar issues.

It is essential that researchers rather than lawyers, philosophers, or government officials run the lab, just as it is essential that surgeons run the operating room. But if bioscientists are to deal with the complex ethical issues posed by modern research, they will need to turn to their colleagues in other areas for help. Research ethics is a multidisciplinary field, and just as research teams spanning a number of scientific subfields must pool their expertise to save time and get results in appropriate cases, so bioscience researchers must pool their expertise with ethicists, lawyers, philosophers, and others to develop timely and effective educational programs in bioscientific research ethics.

Even if they are persuaded that interdisciplinarity could be useful to their educational mission, bioscientists may be worried that the call to ethics education is the leading edge of a stealth attack on the core ethos of the practice of science, an effort to inject rules and rigidity into a practice that brings joy and results by insulating scientists from authority and formality. It is true that in meeting the demands of its transformed relationship with society, the bioscience research community likely is going to be called to account not only to educate its members in the norms of the profession, the methods of ethical reasoning, and the social implications of their research, but also to develop a more comprehensive set of rules and to cooperate in the effective discipline of those who violate these rules. The recent rocky history of the development and enforcement of federal bioscience research guidelines—including the issuance and recall of the most recent guidelines and the removal of the Office of Research Integrity from the NIH—suggests an underlying tension between efforts to regulate bioscience researchers' behavior and efforts to preserve the core ethos of the practice of science.

If we are right about these coming developments, then the challenge to bioscientists will be to develop educational programs and enforcement mechanisms that preserve the core ethos while policing abuses of it. After all, the tension between the core ethos and the rules regulating the conduct of all scientists is a long-standing tension, one that has evolved historically within the practice of science. Scientists, not government officials, first determined that the ethos of freedom and informality does not encompass license to present the work of another without attribution or to fabricate data that leads, more or less, to the "right result" on a particular occasion. The core ethos is key to doing good bioscience research, and good research is key to fulfilling the social function of the profession. If ethics education is ignored or is ineffective, junior researchers still learn something about ethics: they learn that it is separate from and unrelated to preservation of the core ethos. If violation of the rules brings neither disrepute nor reprimand, then those scientists for whom virtue alone is insufficient reward will be free to violate the rules with impunity to advance their immediate self-interest.

Finally, with respect to the concern that these educational efforts are fundamentally about judging the ethical character or conduct of bioscientists, comparison to the more recent move to ethics education in business schools may be helpful. One of the most comprehensive and integrated programs in ethics education was developed at the Harvard Business School. In the book describing this program, *Can Ethics Be Taught?* Piper, Gentile, and Parks discuss a major reason for its development: the public expects a "strong sense of leadership, ethics, and responsibility" from business today in order "to meet the expectations and urgent requirements of society." In short, business ethics is good business. Likewise, research ethics is good for research. No doubt there are bioscientists as well as business leaders who engage in unethical conduct, through ignorance, carelessness, misunderstanding, confusion, or, rarely, malicious intent, and the goals of ethics education clearly include reducing the incidence of this conduct. But the focus of the educational initiative is instrumental and proactive rather than judgmental and reactive.

Integrating Research Ethics Education into the Curriculum

Good educators, like good experimental scientists, hypothesize, experiment, test, and observe. In this dawning age of research ethics education, there is lots of room for hypothesis and experiment. We offer suggestions below and look forward to learning more about the ideas and approaches of others.

An epistemological hunch underlies our thinking about the initial efforts we propose below: The best way to learn more about what we should be teaching and how we should be teaching it is to begin to teach what we now know—or think we know. There will no doubt be variation in initial approaches and evolution in approaches over time. Again, we might look to the experience in biomedical ethics: Beauchamp and Childress's *Principles of Biomedical Ethics* (2001), now in its fifth edition, and *Tough Decisions: Cases in Medical Ethics* (Freeman and McDonnell 2001), now in its second edition, are different in their approaches to teaching medical ethics, and their most recent editions are different from their first editions. This should not come as a surprise to any scientific researcher: different research programs also take different approaches and also evolve over time. We will learn from the continuing scholarly debate about research norms, methods of ethical reasoning, and the social implications of research, and, of course, we will also learn from the experience of teaching itself.

Learning Objectives: Equipping Ethical Decision Makers

Regardless of the particular approach taken, bioscience research ethics instruction should aim at equipping researchers to think through what they should do and why in their ethical decision making. For that purpose, we propose the following four instructional objectives:

1. Conveying knowledge of the substance of a core set of bioscientific research norms, which might consist of the rules governing research at the institution where students are training;
2. Developing the ethical reasoning skills needed to apply these research norms in practice;
3. Developing an understanding of the ethical and policy concerns surrounding the implications of the institution's scientific research and an understanding of alternative approaches to assessing these implications; and
4. Developing an appreciation of the relationships among 1, 2, and 3 and the important social function of bioscience in advancing human well-being.

The achievement of these instructional objectives involves information transfer, the development of skills, and intensive discussion aimed at equipping researchers for a lifetime of professional ethical decision making, but does not involve indoctrination in a particular ethical theory or attempts to change scientists into philosophers. Ethics education should take its professionals-in-training as it finds them, the products of diverse sorts of moral education and character-forming experiences who are brought together as members of a professional community engaged in a common activity—an activity that, among other things, performs an important social function entailing professional ethical responsibilities.

Measuring the Effectiveness of Ethics Education: Can Ethics Be Taught?

That research ethics can be taught and that there is a value to such education finds general acceptance in the literature. Debate continues, however, about the effectiveness of ethics education and about how to measure that effectiveness.

Many attempts have been made to measure the effectiveness of ethics education; some claim success, others not. Elliott and Stern (1996) make an important distinction in discussing the efficacy of teaching ethics—that between "pedagogical hope" and the attainment of instructional objectives. Educators have a pedagogical hope that students will become ethical researchers, but this hope should not to be confused with the attainment of specific instructional objectives, which can be used to measure the effectiveness of a course.

Indeed, much of the variation in reported success in measuring effectiveness can be accounted for by confusion between pedagogical hope and attaining instructional objectives. Changes in behavior and moral development are difficult to measure, often take years, and depend on an array of factors

(Caplan 1980; Elliot and Stern 1996); measurement of the attainment of instructional objectives is much easier. For example, Kalichman and Friedman (1992) found in a survey of biomedical trainees, and Eastwood et al. (1996) found in a similar survey of postdoctoral fellows, that education in research ethics did not predict significant improvement regarding willingness to engage in misconduct; however, a later study confirmed these results, but also showed that training resulted in improved knowledge of what to do when ethical quandaries occur (Brown and Kalichman 1998). Similarly, specific moral reasoning skills have improved after ethics training as measured by the Defining Issues Test (note that the test was given at the end of a four-year curriculum; Bebeau and Tohma 1994) and as measured by consistency with "consensus professional judgment" after a yearlong first-year medical school course (Goldie et al. 2001). Many studies from the field of moral psychology strongly suggest that formal education promotes moral reasoning skills and that development in solving moral problems continues well into adulthood (summarized in Garrod 1993).

In sum, there is reason to believe that measurable success in attaining instructional objectives of the sort we propose is possible. We hold out pedagogical hope that this success will lead to further success: that scientists equipped with this knowledge and skill set will in fact become ethical researchers. It will be difficult to prove that this pedagogical hope is justified. Given the alternative of nonaction, however, pursuing this hope appears to us the better path.

Integrating Ethics Education into the Curriculum: Meeting the Challenges

If faculty members are to find the time and resources and are to develop the comfort level needed to do their part in the effort we call for here, it will take more than federal mandates. They will need opportunities to develop subject-matter expertise and pedagogical competence in different methods of instruction, such as case studies and problem-based learning, to observe colleagues who already employ these approaches, to work together with faculty from other departments to offer interdisciplinary instruction, and to discuss with peers ideas for making real their commitment to ethics as a central component of research education. As with all things in scientific research, significant support at the institutional and departmental levels will be essential (Piper, Gentile, and Parks 1993; Gunsalus 1993). On this point, we note that North Carolina State University (1998) has developed an ambitious plan that serves as an effective model for research institutions seeking to integrate research ethics education into graduate curricula.

Support from professional societies and journals and from federal funding sources will also be important in generating incentives and support for change. Ethics training mandated by federal funding sources can jump-start both faculty development and the education of junior bioscientists. Professional societies and funding agencies can host forums and sponsor websites with sets of problems, cases, analytical papers, and the like that faculty can adapt to local needs. Professional research journals can encourage rigorous exploration of the ethical implications of the papers they publish.

Opportunities to seize the initiative abound. At Emory University the Hughes Initiative, the Program in Science and Society, and the Center for Ethics have taken the lead in instituting courses and programs and providing faculty education in pedagogy, and in proclaiming the need for innovation and support for such programs. At the Georgia Institute of Technology, the School of Public Policy and the Petit Institute for Bioengineering and Bioscience, together with other cooperating units, have cosponsored a biotechnology ethics and policy speaker series and a transatlantic workshop on policy, legal, and ethical issues in biotechnology, and these two units are working together to develop a public policy minor for biomedical engineering graduate students and a biotechnology minor for public policy graduate students.

Integrating Ethics Education into the Curriculum: Pedagogy and Content

Assuming an institutional and faculty commitment to provide research ethics education, what are the best ways to teach ethics? Who should teach and who should learn about ethics, and what should be taught? We survey below the current state of pedagogy and content, and offer observations and suggestions.

Most current instruction is conducted pursuant to the funding requirements of the NIH. The NIH is not particularly prescriptive in outlining program requirements for its graduate student training-grant applications, other than to encourage instruction in the areas of conflict of interest, responsible authorship, policies for handling misconduct, policies regarding the use of human and animal subjects, and data management (NIH 1989). To comply with this mandate, most institutions have developed courses, short-courses, or workshops to teach responsible conduct in research (Mastroianni and Kahn 1998).

Pedagogical approaches to these "one-shot" ethics courses vary, but the most widely used approaches generally involve a combination of traditional lecture, small-group analysis of specific case studies, and discussion of at least some limited theoretical framework in which to consider ethical dilemmas. Courses include a review of the federal and institutional governing in responsible conduct in bioscientific research. How much theory is discussed and which theories depend on the faculty involved, their background, and the nature of the course (Glagola et al. 1997)? If these mandated courses satisfy only the letter of the law, are cursory in content, and are conducted from only a limited number of faculty and without visible support by senior scientists, they will be of limited value in attaining the instructional objectives we identify, let alone achieving the pedagogical hope we hold out. In ethics instruction, as in other instruction, if students do not perceive that the material is considered important, they are unlikely to invest the effort required to learn it well.

While institutions must move beyond mere mandated compliance, the graduate student/postdoctoral fellow ethics courses and workshops developed pursuant to these mandates can be an especially good taking-off point for integrating research ethics education into the curriculum; indeed, this is how the ethics education program began at Emory University. Departments and programs can use these courses and workshops as places for faculty to get involved in and learn more about ethics and ethics training and as catalysts for educational ideas and approaches faculty can then integrate into their own courses and laboratories.

One strategy for expanding faculty competence in ethics instruction is to have faculty other than the regular instruction team rotate through a mandated research ethics course each semester. Ideally, the visiting team will include senior and junior faculty members; participation by faculty of every rank is important if ethics is to be—and is to be seen as—central to the curriculum. These additional faculty can assist in course development and instruction and then carry their experiences back to their home departments.

Faculty involvement should also inspire collegial discussion and ideas for more broadly advancing the integration of ethics into research; for example, whether to include questions on ethics on qualifying exams, as is done in other professional licensing exams (see, for example, United States Medical Licensing Examination 2001; American Bar Association Section on Legal Education and Bar Admissions 2001; see also National Society of Professional Engineers 2001b). With appropriate leadership, incentives, and a carefully considered, incremental approach, the mandated ethics courses can be a useful mechanism for integrating issues in bioscientific research ethics and ethical conduct into the academic research community.

Interdisciplinary teaching can be difficult to coordinate, but it can be done with institutional and departmental support, and, as we have argued, it can bring very welcome resources to bear on the problems of research ethics. One especially notable and comprehensive course—apparently the first of its kind, as we noted at the outset—has been taught at the University of Texas Health Sciences Center at Houston (Bulger and Reiser 1993). This course has been taught by a combination of ethicists, bench scientists, physicians, and historians; meets for many sessions; and explores "traditional" ethics issues as well as the broader context of scientific discovery, creativity, and cultural differences in policy and practice. An interdisciplinary team with the resources to address this range of issues is ideal for developing and teaching ethics in research.

Active participation by students in ethics instruction is essential for a number of reasons. The skills for applying professional norms to concrete complex human situations can best be developed through interactive discussion and practice. Interactive discussion, role-playing, and case studies can also be very helpful in leading students to understand others' points of view and to reflect on the justifications for their own points of view. Also, for the foreseeable future, many students will enter bioscience ethics courses having had no prior exposure to the subject matter and having no reason to believe that ethics is central to the work of research professionals. Active engagement is crucial to avoiding the semester-long seat-warming phenomenon. Regardless of the forum and the particular materials employed, it is important to provide sufficient time and a safe space for active engagement with and reflection on ethical issues (Elliott and Stern 1996).

At Emory University we have found the moral-reasoning framework and case studies developed by the Poynter Center (Bebeau et al. 1995) to be effective in engaging students and developing their skills. We have also used a simulation game in which students are assigned roles in a "laboratory" and are challenged with realistic ethical scenarios (adapted and developed by S. Olson and P. Marsteller, personal communication). Research ethics education is also integrated into our undergraduate science curricula, including discussions in introductory and cell biology courses and weekly moral reasoning development sessions for our summer undergraduate researchers. These sessions encourage students to grow in their knowledge and understanding of complex conflicts. In addition, we emphasize and demonstrate through case studies and discussion that strategies developed to resolve everyday laboratory ethical dilemmas can also be used to help resolve "big" ethical dilemmas, as with gene therapy or stem cell research. At the Georgia Institute of Technology a number of courses with significant ethical content are offered both to meet the particular requirements for ethics education for engineering students and also as part of the larger goal of Georgia Tech's Philosophy, Science, and Technology program to offer interdisciplinary coursework making the study of ethical issues in science and technology an integral part of the curriculum of a technological institution.

Excellent resources exist, although more are needed, to help develop ethics courses. The Poynter Center at Indiana University, the National Science Foundation (NSF) Office of the Inspector General, and the U.S. Office of Research Integrity frequently offer courses and workshops for faculty or students in research ethics. Funds are available from the NSF to teach ethics as part of their Research Education of Undergraduates summer grants program. Excellent sources for course materials and sample case studies include The Online Resource for Instruction in Responsible Conduct of Research (The University of California at San Diego); onlineethics.org (Case Western Reserve University); the Poynter Center's *Moral Reasoning in Scientific Research* (Bebeau et al. 1995); *The Ethics of Scientific Research: A Guidebook for Course Development* (Stern and Elliott 1997); and the NIH (NIH 2001).

Concluding Observations

Basic researchers in academic bioscience are regularly faced with complex ethical issues in and out of the laboratory and classroom. Many receive taxpayer-supported funding, have close relationships with industry, collaborate with diverse colleagues around the world, and are working—with often astonishing success—on problems with significant social implications. The focus of our discussion has been ethics education primarily at the graduate training level—the central component of the response that will be required by the bioscientific research community in an era in which the relationship between science and society has been transformed. But we have at several points alluded to a broader integration of research ethics into the practice of bioscience. In these concluding remarks, we suggest some of the other components of that broader integration.

If ethics is to become an integral part of science, it must become an integral part of all science education. Ethics instruction will be especially important in undergraduate education, when students are deciding whether to enter careers in science, and in graduate school, when students are learning firsthand what it means to be a scientist. But junior and senior high school students can and should learn about ethics in science as well. Introducing ethics instruction early on in the educational cycle should eventually reduce the challenges for those who teach ethics to graduate students. In addition, if science is taught in relation to its ethical and social implications, more students may be motivated to understand science and more good teachers may be attracted to science education.

We have discussed ways in which faculty can learn about research ethics and participate in ethics instruction for their junior colleagues in training. We can also imagine a time in which faculty participate in the drafting of a code of professional conduct to which researchers in a variety of settings across a variety of bioscience disciplines subscribe. This code, reflecting the integration of ethics in the lives of practicing scientists, could also include a requirement for continuing education.

The integration of ethics into the practice of bioscience can be encouraged in a variety of ways by a range of important actors in the research community. We have noted the influence of federal mandates on ethics education. Funding agencies should require the same. Examples of other contributions to this broader integration include, *Nature* and *The Lancet* testing or employing the policy of requiring that the contribution of each listed author be described in order to address the problem of honorary authorship (*Nature* 1999), and the detailed response offered by the American Society of Gene Therapy (ASGT 2001) to proposed changes in NIH gene-therapy guidelines.

We see a transformed bioscience as a foregone conclusion. We welcome its coming of ethical age and we urge recognition of and response to the demands of its new role in the larger community. ■

Acknowledgments

We would like to thank those colleagues who offered important advice on and insight into the development of this manuscript, especially Patricia Marsteller and John Banja. We also thank an anonymous reviewer for providing comments that were very helpful to us in preparing the final version of this paper.

References

Accreditation Board for Engineering and Technology. 2000. Criteria for accrediting engineering programs. Baltimore: ABET.

American Bar Association. 2001a. Model Rules of Professional Conduct. Available from: http://www.abanet.org/cpr/mrpc/mrpc_home.html.

———. 2001b. Standards for approval of law schools and interpretations, ch. 3. Available from: http://www.abanet.org/legaled/standards/chapter3.html.

American Bar Association, Section on Legal Education and Bar Admissions. 2001. Bar admissions, the multistate professional responsibility examination. Available from: http://www.abanet.org/legaled/baradmissions/bartests.html.

American Medical Association, Council on Ethical and Judicial Affairs. 2001. Code of medical ethics: Current opinions with annotations. Available from: http://www.ama-assn.org/ama/pub/category/2503.html.

American Society of Gene Therapy. 2001. Official response. Available from: *http://www.asgt.org/policy/index.html.*

Beauchamp, T. L., and J. F. Childress. 2001. *Principles of biomedical ethics,* fifth ed. New York: Oxford University Press.

Bebeau, M. J., and S. J. Tohma. 1994. The impact of a dental ethics curriculum on moral reasoning. *Journal of Dental Education* 58(9): 684–92.

Bebeau, M. J., K. D. Pimple, K. M. T. Muskavitch, S. L. Borden, and D. H. Smith. 1995. *Moral reasoning in scientific research: Cases for teaching and assessment.* Indiana University: Poynter Center.

Brown, S., and M. W. Kalichman. 1998. Effects of training in the responsible conduct of research: A survey of graduate students in experimental sciences. *Science and Engineering Ethics* 4(4): 487–98.

Bulger, R. E., and S. J. Reiser. 1993. Studying science in the context of ethics. *Academic Medicine* 8(9): S5–S9.

Caplan, A. 1980. Evaluation and the teaching of ethics. In *Ethics teaching in higher education,* ed. D. Callahan and S. Bok. New York: Plenum Press.

Cohen, J. J. 2001. Trust us to make a difference: Ensuring public confidence in the integrity of clinical research. *Academic Medicine* 76(2): 209–14.

Council of Government Relations. 1999. *The Bayh-Dole Act: A guide to the law and implementing regulations.* Available from: http://www.cogr.edu/bayh-dole.htm.

Eastwood, S., P. Derish, E. Leash, and S. Ordway. 1996. Ethical issues in biomedical research: Perceptions and practices of postdoctoral research fellows responding to a survey. *Science and Engineering Ethics* 2(1): 89–114.

Elliott, D., and J. E. Stern. 1996. Evaluating teaching and students' learning of academic research ethics. *Science and Engineering Ethics* 2(3): 345–366.

Freeman, J. M., and K. McDonnell. 2001. *Tough decisions: Cases in medical ethics,* second ed. New York: Oxford University Press.

Garrod, A., ed. 1993. *Approaches to moral development: New research and emerging themes.* New York: Teachers College Press.

Glagola, C., M. Kam, M. C. Loui, and C. Whitbeck. 1997. Teaching ethics in engineering and computer science: A panel discussion. *Science and Engineering Ethics* 3: 463–80.

Goldie J., L. Schwartz, A. McConnachie, and J. Morrison. 2001. Impact of a new course on students' potential behaviour on encountering ethical dilemmas. *Medical Education* 35(3): 295–302.

Goodwin, C. D. 1996. Technology transfer at US universities: Seeking public benefit from the results of basic research. *Technology and Health Care* 4(3): 323–30.

Gunsalus, C. K. 1993. Institutional structure to ensure research integrity. *Academic Medicine* 68(9): S33–S38.

Heckert, J. R. 2001. ABET's engineering criteria 2000 and engineering ethics: Where do we go from here? Available from: *http://www4.ncsu.edu/~jherkert/.*

Jonsen, A. R. 1998. *The birth of bioethics.* New York: Oxford University Press.

Judson, H. F. 1996. *The eighth day of creation: Makers of the revolution in biology,* expanded ed. Plainview: Cold Spring Harbor Press.

Kalichman, M. W., and P. J. Friedman. 1992. A pilot study of biomedical trainees' perceptions concerning research ethics. *Academic Medicine* 67(11): 769–75.

Kevles, D. J. 2000. *The Baltimore case: A trial of politics, science, and character.* New York: W. W. Norton & Company.

Mastroianni, A. C., and J. P. Kahn. 1998. The importance of expanding current training in the responsible conduct of research. *Academic Medicine* 73(12): 1249–54.

Moses, H. III, and J. B. Martin. 2001. Academic relationships with industry: A new model for biomedical research. *JAMA* 285(7): 933–35.

National Institutes of Health. 2001. Bioethics resources on the Web. Available from: http://www.nih.gov/sigs/bioethics/casestudies.html.

National Institutes of Health, Alcohol, Drug Abuse, and Mental Health Administration. 1989. Requirement for programs on the responsible conduct of research in National Research Service Award institutional training. *National Institutes of Health Guide for Grants and Contracts* 18(45): 1.

National Science Board. 2002. Science and engineering indicators-2002. NSB-02-1. Arlington: National Science Foundation. Available from: http://www.nsf.gov/nsb.

National Society of Professional Engineers. 2001a. Code of ethics for engineers. Available from: http://www.nspe.org/ethics/eh1-code.asp.

———. 2001b. Proposed licensure model law. Available from: http://www.nspe.org/etweb/1!-00-2000_Licensure_Model_Law.asp.

Nature. 1999. Policy on papers' contributors. *Nature* 399:393.

North Carolina State University. 1998. *Report of the committee on research ethics.* Available from: http://www.fis.ncsu.edu/Grad/ethics/report.htm.

Piper, T. R., M. C. Gentile, and S. D. Parks. 1993. *Can ethics be taught?* Boston: Harvard Business School.

Public Health Service. 2000. Policy on instruction in responsible conduct in research. Available from: http://ori.dhhs.gov/html/programs/finalpolicy.asp.

———. 2001. Responsible conduct in research education policy suspended. Available from: http://ori.dhhs.gov/html/programs/congressionalconcerns.asp.

Somia, N., and I. M. Verma. 2000. Gene therapy: Trials and tribulations. *Nature Reviews Genetics* 1(2): 91–99.

Shaw, G. 1997. Charting medical education's future with MSOP. *AAMC Reporter* [online version]. Available from: *http://www.aamc.org/newsroom/reporter/mtg97/msop.htm.*

Starr, P. 1982. *The social transformation of American medicine.* New York: Basic Books.

Stern, J. E., and D. Elliott. 1997. *The ethics of scientific research: A guidebook for course development.* Hanover: University Press of New England.

United States Medical Licensing Examination. 2001. USMLE bulletin: Examination content. Available from: http://www.usmle.org.

U.S. Congress, Office of Technology Assessment. 1996. Federally funded research: Decisions for a decade. In *Law, science, and medicine,* second ed., ed. J. Areen, P. A. King, S. Goldberg, L. Gostin, and A. M. Capron. Westbury: Foundation Press: 371–75. Originally published May 1991.

Wenger, N. S., S. G. Korenman, R. Berk, and S. Berry. 1997. The ethics of scientific research: An analysis of focus groups of scientists and institutional representatives. *Journal of Investigative Medicine* 45(6): 371–80.