PHILOSOPHICAL FOUNDATIONS OF SCIENTIFIC ETHICS

David Resnik
Department of Philosophy
University of Wyoming

A philosophical foundation, like an architectural one, provides an underpinning for a larger structure. Its bricks and cinder blocks are basic concepts and assumptions that support a system of beliefs and practices. The support provided by a philosophical foundation is logical and conceptual, not physical: a foundation justifies the structure it supports. If we view scientific ethics as a system of rules, concepts, beliefs, and practices, then its foundation consists of basic principles and concepts that justify this system. My aim in this paper is to explore the basic principles and concepts that underlie scientific ethics. I will argue that scientific ethics is founded both on concerns and goals internal to science and on societal norms. This two-tiered foundation supports six basic principles of research as well as other ethical principles that apply to science. I will also develop some policy implications based on this philosophical analysis.

A more recent paper covering similar territory may be found at https://www.niehs.nih.gov/research/resources/bioethics/whatis/index.cfm

1. ETHICS: A SYSTEM OF MORAL RULES

In approaching the topic of scientific ethics, it will be useful to first make a few remarks about ethics. A simple definition of ethics (or morality) might be as follows:

> Ethics is a system of public, general rules for guiding human conduct (Gert, 1988).

The rules are general in that they are supposed to apply to all people at all times and they are public in that they are not secret codes or practices. The rules guide conduct by forbidding, permitting, or requiring particular actions in various circumstances (Fox and DeMarco, 1990). Philosophers have offered a wide variety of moral theories to justify moral rules, ranging from utilitarianism to Kantianism to social contract theory (Fox and DeMarco, 1990). Although there are some fundamental differences among various ethical theories, most of them support (or can be interpreted to support) roughly the same set of general principles (Beauchamp and Childress, 1979). Some of these are as follows:

> The non-maleficence principle: Do not act in ways that cause needless injury or harm to others.
>
> The beneficence principle: Act in ways that promote the welfare of other people.
>
> The principle of autonomy: rational individuals should be permitted to be self-determining.
>
> The formal principle of justice: treat equals equally and unequals unequally.
>
> Material principles of justice: Punish on the basis of desert. Distribute goods on the basis of need, merit, social contribution, effort, or equality.

From these general principles we can derive a variety of other rules, such as

> Do not kill, Do not torture or maim, Do not steal, Do not lie or deceive, Keep your promises, Don't cheat, Be fair, Do not deny people freedom, Respect privacy.

And of course many more principles can be derived from the ones mentioned here.

Sometimes the same action will be supported by a variety of rules but sometimes the rules will endorse different actions, i.e. they will conflict. For instance, if someone asks you if you like the new dish they have prepared and you do not, you may have to choose between telling them the truth and (possibly) hurting their feelings. You have a duty not to lie but you also have a duty not to harm, and in this case you cannot fulfill both duties at one. You must resolve this conflict. Since moral rules can conflict, they are what W.D. Ross (1930) refers to as prima facie rules (or duties). When conflicts arise, we have to decide which rule(s) to follow. Some of the ethical theories discussed by philosophers may recommend different ways to settle these conflicts, even though they agree on most of the basic rules.

2. JUSTIFYING MORAL RULES: REFLECTIVE EQUILIBRIUM

Earlier I said that a philosophical foundation provides a justification. So what's the foundation of moral rules (or theories)? This is not an easy question to answer, in part, because our method of justifying moral rules, as many writers have noted, does not resemble our method of justifying scientific theories or hypotheses (Harman, 1977). Science uses the experimental method to justify its claims: in science we can conduct tests and experiments that provide empirical evidence or data to justify theories or hypotheses. But we cannot use this method in ethics.

Since the experimental method cannot be used in ethics, many writers have urged that we use the method of reflective equilibrium to justify ethical principles and theories (Rawls, 1971). According to this method, we use our considered (i.e. unbiased, reflective) judgments (or intuitions) about what is (or would be) right or wrong, good or bad in particular situations as a database. We can then propose theories and principles intended to provide a coherent account of these judgments. The reflective part of the method comes in when we use these principles and theories to revise our original data, and modify our principles in light of the revised database, and so forth and so on. Reflective equilibrium is an ideal state in which we have carried out this process to the point where we are no longer revising our database or principles.

Although this method is accepted by many ethicists, some have objected to it on the grounds that it leads (or could lead) to moral relativism (Gert, 1988). It could be the case that two different societies reach equilibrium points characterized by radically different principles and databases. Hence, what is "right" or "wrong" would vary from society to society. Of course, other writers might use its relativistic implications as a reason for accepting the method (Herskovits, 1972). Although I have no intention of entering this thorny debate here, I'll return to the relativism problem later in the context of scientific ethics.

3. SCIENTIFIC ETHICS

The general ethical code discussed above can be applied to many different practical contexts, such as law, medicine, sports, business, personal relationships, and of course, science. When the general code is applied to a particular area of human life, the resulting code is an institutional code. Institutional codes are not simply miniature versions of the general ethical code; otherwise they would be superfluous. An institutional code differs from a general ethical code in that it reflects the practical concerns and goals of members of a community, discipline, or profession. For instance, medicine is chiefly concerned with promoting the health of patients and safeguarding their welfare (Beauchamp and Childress, 1979). If a conflict arises between telling the truth and preventing harm, many physicians will decide to lie. In medicine, at least, truth is sometimes sacrificed for health (Beauchamp and Childress, 1979). Although institutional codes are sometimes represented by explicitly formulated professional or communal codes, such as the Hippocratic Oath or a university's code of conduct, they cannot be identified with these explicitly formulated codes. The reason for this is that people may accept parts of an institutional code that are not found in explicitly formulated codes and people may pay little heed to many of the rules that are explicitly formulated (Gibbard, 1990). We can now arrive at a definition of scientific ethics:

> Scientific ethics is an institutional code of conduct that reflects the chief concerns and goals of science.

In this definition, `conduct' refers to all aspects of scientific activity, including experimentation, testing, education, data analysis, data storage, data sharing, peer review, government funding, the staffing of research teams, etc.... It does not include conduct that does not have a direct bearing on science. `Science' refers to academic science, not military or business science. Although academic science, military science, and business science share some common principles, they have different goals and concerns. These different goals and concerns give rise to different ethics. In the military, national security is the primary goal, and secrecy is essential to achieving this aim. Secrecy is also important in business science in order to promote its main goal, the maximization of profit. There has been much debate among philosophers about the aims of academic science, but clearly two of its chief concerns include the search for explanatory knowledge and true beliefs about the world (NAS, 1989). Since ethical rules in science should promote these goals, several of science's most important principles emerge. My list is not original, since some of these principles have been identified by other authors, including Jacob Bronowski (1956), Nicholas Rescher (1965), Sanford Lakoff (1980), David Hull (1988), and the National Academy of Science's Panel on Scientific Responsibility and the Conduct of Research (1992). However, my compilation provides a useful synthesis:

FUNDAMENTAL PRINCIPLES OF SCIENTIFIC RESEARCH

1. <u>Scientific Honesty</u>: Do not commit scientific fraud, i.e. do not fabricate, fudge, trim, cook, destroy, or misrepresent data.[1]

2. <u>Carefulness</u>: Strive to avoid careless errors or sloppiness in all aspects of scientific work.

3. <u>Intellectual Freedom</u>: Scientists should be allowed to pursue new ideas and criticize old ones. They should be free to conduct research they find interesting.

4. <u>Openness</u>: i.e. share data, results, methods, theories, equipment, and so on. Allow people to see your work, be open to criticism.

5. <u>The principle of credit</u>: Do not plagiarize the work of other scientists, give credit where credit is due (but not where it is not due).

---

[1] For further discussion of the difference between fabricating, fudging, cooking, trimming, and destroying data, see Broad and Wade (1982) and the paper by Segerstråle in these proceedings.

> <u>6. The principle of public responsibility</u>: Report research in the public media when a) the research has an important and direct bearing on human happiness and b) the research has been sufficiently validated by scientific peers.

In addition to these six general principles--principles that apply to all academic sciences--there are also some specialized principles that apply only to specific sciences. For instance, the biomedical and social sciences have, in addition to these general principles, principles governing the use of human and animal subjects (Beauchamp and Childress, 1979).

One can derive a variety of subsidiary principles and rules from these basic ones. For instance, the principle of honesty will also imply principles for data acquisition, data storage, the reporting of results, and so on. The principle of intellectual freedom will imply that the peer review process and funding decisions should be fair and unbiased. The principle of credit will imply rules concerning co-authorship and acknowledgments. All of these basic principles also imply rules (or policies) for educating scientists and enforcing the basic rules. For instance, scientists have a responsibility to teach their students about these rules, scientists who make errors and publish retractions should be forgiven, scientific "whistle blowers" should be protected from reprisals, and on. Finally, in addition to these principles of scientific research, science is also governed by other general ethical principles, such as the principle of non-maleficence, the principles of justice, and so on. The other general ethical principles imply rules concerning sexual and other forms of harassment, vandalism, discrimination, mentorship, science's role in public policy, and so on.

All of the principles mentioned above either directly or indirectly promote science's chief goals and concerns. The principles of scientific research most directly promote science's chief concerns and goals, while the other general ethical principles only indirectly promote science's goals and concerns. Directness, we should note, is a matter of degree: some principles more directly promote science's chief goals than others, but all can contribute to the realization of science's aims.

The principle of honesty is the most important of these principles because without honesty, science as we know it would not be possible: You can't effectively find truth if lying is permitted. The principle of carefulness is necessary to avoid careless errors and oversights. Although some amount of carelessness is unavoidable in science--scientists are human beings after all--too much carelessness can significantly impede the search for truth and knowledge by requiring scientists to spend too much of their time eliminating and correcting errors. The principle of intellectual freedom promotes the search for knowledge and truth because we cannot obtain these things if scientists are not free to explore ideas that interest them, consider new ones, or criticize old ones. The principle of openness is justified on the grounds that sharing of data and resources increases our ability to obtain knowledge and because an essential feature of the experimental method--a method for obtaining scientific knowledge--involves criticism.

The principle of credit is important in motivating scientists to do good work and in providing a way to make them accountable for their work. Although many scientists are motivated by the pursuit of truth for its own sake, recognition and respect are important too. Accountability is important because if all scientific work were done anonymously, it would be difficult to punish scientists who commit fraud, do sloppy work, and so forth. The principle of public responsibility is important in maintaining the public's trust and respect. A public that constantly learns of fantastic, though ultimately erroneous and misleading scientific findings, will lose its respect and support for science. But a public that gains important and useful information from science will respect and support science. Public respect and support are important because they result in funding, which leads to the pursuit of knowledge and truth. Although the justification for the principle of public responsibility is highly indirect, the principle is still an important one for scientists to follow. Finally, we should note that the search for knowledge and truth will be hampered if scientists violate society's other general ethical principles because these principles help to provide stability and trust in the scientific community and public support for science.

4. SCIENTIFIC ETHICS IN PRACTICE: CONFLICT RESOLUTION

Although it might seem like applying this system of scientific ethics might be easy, it rarely is. The principles are abstract and formal, and they do not reflect the contexts and conundrums of daily life. But we should not use this obvious difficulty as a reason to dismiss principles as useless. We should recognize what principles can and cannot do. Principles cannot (and should not!) provide us with an algorithm for living, but they can provide us with some general guidance and methods for thinking about moral problems and ways of making moral decisions.

With these comments in mind, we should also recall that society consists of many different social institutions with their own rules that guide conduct. Some of these institutions include business and industry, religion, law, government, education, medicine, the military, families, and of course, science. Most people have many different social roles defined by rules governing the various institutions to which they belong. Thus, a person might be a husband and father, a scientist, a U.S. citizen, and a Christian. Earlier we noted that moral dilemmas can arise when ethical principles conflict, but dilemmas can also arise when principles of one social institution conflict with principles of another social institution (Gibbard, 1990). These dilemmas force people to choose between different social institutions, rules, and roles.

For example, suppose you discover that a drug company you are working for is grossly overcharging its customers and is claiming that its high prices are based on high costs for research and development. You know that it has, in fact, spent less money on research and development than it claims. In this case, you have to choose between "blowing the whistle" on the company and remaining loyal. You have moral and legal obligations to "blow the whistle" but you also have obligations to the company to be loyal. Obligations to your family may come into play, since you will probably lose your job if you "blow the whistle" and you need the job to support your family. You must find some way to resolve this conflict that arises from being governed by many different norms and rules. Indeed, the concept of "conflict resolution" is a useful way of thinking about the wide variety of ethical issues that occur in daily life (Fox and DeMarco, 1990).

So how does one resolve conflicts? I have no general answer to this question, but some steps can be helpful. The first step is to describe the details of the situation in sufficient depth to understand the conflict. The second step is to identify the various principles and concepts relevant to the conflict (Fox and DeMarco, 1990). The third step is to explore the details of the situation in even more depth. This secondary probing of the situation may reveal details that become important once one understands the basic conflict. If the first three steps have not resolved the conflict, the fourth step is to carefully reflect on the situation and make a "gut-level" or intuitive judgment. This intuitive step should not be the basis of all conflict resolution, but it is often necessary in order to resolve extremely difficult dilemmas. After all, many important dilemmas require expeditious resolution. At some point reflection must end, and action must begin.

5. THE SPECTRE OF MORAL RELATIVISM

The problem of moral relativism besets practically all discussions of ethics these days, and scientific ethics is no exception. Concerning the rules of scientific ethics discussed above, one might ask whether the rules are universal--whether they apply to all sciences in all cultures at all times--or whether they only reflect the historically-bound, socially-defined concerns of the kind of science we typically find in the Western world. One might ask whether these principles are mere social conventions, not absolute, moral rules. A bit of reflection on some of the various principles described above feeds these relativistic worries.

For instance, at one time Western academic science was highly secretive (Goldstein, 1980). Scientists kept their results confidential in order to make sure that their ideas would not be stolen. Some scientists went so far as to write down their notes in secret codes. One also finds the same kind of secrecy in military and business science. Thus, one might conclude that the principle of openness is not a universal principle of scientific ethics; it only holds for specific sciences and particular historical periods.

Concerning the principle of credit, one might argue that this principle is also not absolute because it depends on some social/political values that dominate Western culture, namely, glorification of the individual and respect for property rights.[2] In the West, we are concerned with holding individuals responsible for their vices and virtues and we search for the heroes and villains in historical events. The notion of property is important in the West, and this notion includes physical as well as intellectual property. In Western science, most people want to receive credit for what they do in order to get money, status, prestige, etc....But not all cultures have had these same values. Some cultures have (and still do) value humility and do not respect property rights (Herskovits, 1972). Many scientists in the non-Western world (and even some in the West) do not place as high a value on individualism and property rights (Ronan, 1980). For some scientists, simply making an anonymous contribution to the search for knowledge is

[2] For a contrary view, see Hull (1988). Hull bases a principle of credit on human nature: the principle is universal because humans are fundamentally selfish.

enough. Credit is not needed. Thus, the principle of credit may not be an absolute principle of scientific ethics.

So are there no absolute ethical principles of scientific research? What about the principles of honesty and carefulness? Are these also not absolute? Although it seems like various sciences have violated the other principles discussed above, the principles of honesty and carefulness would appear to be absolute. These two principles are so central to scientific research that to reject them is to cease doing science. Indeed, if a community committed fraud and did excessively sloppy work, I would say that they were not practicing science. We might call their activity "pseudoscience" or "magic" but not science.

One can accept these conclusions without holding that everyone, not matter who they are, should obey the principles of honesty and carefulness. Thus, these principles apply to all sciences but not necessarily to all human activities. Thus, we could say that they are conditional principles, not unconditional ones. That is, these principles apply if your goals are the acquisition of knowledge and truth. They are what philosophers call hypothetical imperatives: if your goal is X, and Y is the best means of obtaining X, then you should do Y.

The other principles discussed above can be understood in the same way, even if they are not as absolute as the principles of honesty and carefulness. If one fails to follow these other principles, one may still be doing "good scientific research" if by "good scientific research" one only means "research that obtains scientifically valid and significant results." People can do good scientific research while working in secret, plagiarizing, violating the public trust, torturing animals, and so on. A result is a result no matter how one obtains it. However, some ways are more effective than others at obtaining results, given a particular social/political environment. Given a social/political environment in which people value intellectual property rights, science is conducted more effectively if people follow a principle of credit. Given an environment in which there are mechanisms for protecting intellectual property and for insuring fair exchanges of ideas and techniques, a principle of openness makes good sense. The same points apply to public funding of science, intellectual freedom, treating people fairly, and so on. These principles also hold under certain social/political conditions.

Finally, I should make it clear that this defense of anti-relativism in science need not assume an unconditional anti-relativism concerning ethics in general. I have not assumed that the goals that guide scientific conduct are absolute or that some of the social/political conditions in which Western science is conducted should obtain. However, in order to undermine the ethical system we find in Western science, one would have to argue that knowledge and truth are not goals worthy or pursuit and that individual rights, equality, freedom of speech, and other values we find in Western culture have no legitimate basis. I can see how one might make this argument, but I will not attempt to assess the merits of this position here.

6. CONCLUSIONS AND POLICY IMPLICATIONS

To briefly summarize, I have argued that scientific ethics has two foundations, one internal to science, the other external. The internal foundation consists of the fundamental goals and concerns of science; the external one consists of societal norms. Both of these foundations provide justification for the ethical rules of science and its research practices. So what does any of this have to do with science policy? A great deal, I think. Although questions about justification are "philosophical" questions, their answers can play an important role in formulating policies concerning more practical concerns, such as education, enforcement, and punishment.

Socrates once wondered whether virtue could be taught. I believe it can be. But teaching virtue is not like teaching mathematics or chemistry. One does not learn to be an ethical scientist by memorizing formulas or anatomical parts or by doing laboratory work. If we think of virtue as a habit that can be acquired, then it must be practiced. Thus, a large part of learning to be virtuous simply consists in imitating a virtuous person and practicing what they practice. But if this were all there is to learning virtue, then most science students would become ethical simply by some kind of osmosis, and we know that this is not the case. Learning to be virtuous also requires something beyond practice; it requires knowledge that can motivate action. What kind of knowledge can motivate? Knowledge that provides reasons or justifications for action. In the context of science, this type of knowledge consists of 1) knowledge of various rules and standards and how they conflict; 2) knowledge of the "deeper" justification of these rules. Justification can motivate in that it can help students to see why rules should be followed (Gibbard, 1990). I should add that one does not learn rules simply by memorizing them; one must see how they apply to various cases. For instance, rules of grammar can only be learned by "seeing" or producing grammatical sentences. To summarize, in order to teach scientific ethics, scientists must:

a) Provide examples of good conduct in laboratory work, data analysis, etc.

b) Explicitly discuss ethical rules in the classroom and discuss specific examples.

c) Discuss the justification of ethical rules.

Concerning punishment, I have distinguished between several distinct principles of scientific ethics. Punishment should reflect these distinctions. Thus, violations of the most basic rules should be treated differently from violations of the other rules. The punishment should fit the crime; the more serious the crime, the more serious the punishment.

Concerning enforcement, the scientific community has a responsibility to enforce its own rules, especially those that reflect goals and concerns internal to science. Scientists cannot and should not rely on "outsiders" to take care of ethical problems in science. Scientists do not want people outside science meddling in affairs properly internal to science. And even if they did, it is likely that outsiders have other more pressing concerns to worry about besides scientific fraud or plagiarism. Given a complaint about scientific fraud and one about bank fraud, most local authorities will ignore the former complaint and act on the latter.

Finally, in order to promote responsible education, punishment, and enforcement scientists need to establish public codes and disciplinary and educational bodies. The codes can be established by academic institutions or scientific societies and organizations. The disciplinary and educational bodies can preside over academic institutions, scientific fields, or even entire nations or groups of nations. Since modern science is international in scope, it will also be useful to establish international codes and disciplinary and educational bodies.

REFERENCES

Beauchamp, T. and Childress, J. (1979). Principles of Biomedical Ethics. New York: Oxford University Press.

Broad, W. and Wade, N. (1982). Betrayers of the Truth. New York: Simon and Schuster.

Bronowski, J. (1956). Science and Human Values. New York: Harper and Rowe.

Fox, R. and DeMarco, J. (1990). Moral Reasoning: A Philosophical Approach to Applied Ethics. Chicago: Holt, Rinehart, and Winston.

Gert, B. (1988). Morality: A New Justification of the Moral Rules. New York: Oxford University Press.

Gibbard, A. (1990). Wise Choices, Apt Feelings: A Theory of Normative Judgment. Cambridge, Mass.: Harvard University Press.

Goldstein, T. (1980). Dawn of Modern Science. Boston: Houghton Mifflin.

Harman, G. (1977). The Nature of Morality. New York: Oxford University Press.

Herskovits, M. (1972). Cultural Relativism. New York: Random House.

Hull, D. (1988). Science as a Process. Chicago: University of Chicago Press.

Lakoff, S. (1980). "Ethical Responsibility and the Scientific Vocation," in S. Lakoff (ed.), Science and Ethical Responsibility. Reading, Mass.: Addison-Wesley, pp. 19-31.

National Academy of Science (NAS), Committee on Scientific Conduct (1989). On Being a Scientist. Washington, D. C. :National Academy Press.

Panel on Scientific Responsibility and the Conduct of Research (1992). Responsible Science: Ensuring the Integrity of the Research Process. Washington, D.C.: National Academy Press.

Rawls, J. (1971). A Theory of Justice. Cambridge, Mass.:Harvard University Press.

Rescher, N. (1965). "The Ethical Dimension of Scientific Research," in Beyond the Edge of Certainty, R. Colodny (ed.). New York: University Press of America, pp.261-75.

Ronan, C. (1980). The Shorter Science and Civilisation in China (vol. 2). Cambridge: Cambridge University Press.

Ross, W.D. (1930). The Right and the Good. Oxford: The Clarendon Press.

DISCUSSION

It was suggested that one must be careful to differentiate between "good science" (science performed using proper procedures and adhering to accepted ethical standards) and "right science" (science which achieves a correct result). It may be tempting to overlook ethical lapses in a situation when the final result is accepted as scientifically correct.

Several questions arose regarding the mechanisms for identifying and dealing with unethical scientists. Among the most fundamental is whether or not science can be trusted with policing itself. Clearly, there is the possibility for conflict of interest due either to personal friendship with someone under investigation or desire to avoid negative publicity for the field; yet many scientists would argue that *they* are the ones with enough technical expertise to make the kind of analysis required to pass judgment. If scientists cannot provide objective policing, does the non-technical segment of our society have the ability to police science?

On a more specific level, is peer review an ethical requirement? One could argue that peer review is a necessary step to stopping incorrect scientific results from being broadly disseminated and that maintaining quality in disseminated results is an ethical concern. However, it can also be argued that one has a personal responsibility to disseminate only those results which the scientific community will find useful, and the peer review process is merely a structural aspect of science which comes into play if one neglects one's own responsibilities. This approach views peer review as effective policy but not an ethical requirement. If this latter approach is accepted, then is it ethical to publish in the popular press first, prior to submitting work to peer review? What protection does the public have from being misled, given the majority of them will not be in a position to judge the quality of the underlying science?

The question of whether or not there is a duty to science was raised. Some argued that no such duty exists; rather one has a duty to society, employers, family, etc. Others argued that such a duty is necessary to the health of the field. It may be argued that there is a duty not to science, but to the community of scientists, since every scientist in that community owes at least some of their scientific training to the existence of the scientific community.

It is worth reiterating that as the author of this paper has stated, his focus is on ethical issues associated with scientific research in an academic environment. If one were to teach a class on ethical issues in physics, other roles of physicists would need to be investigated.

Finally, there are some fundamental questions that need to be addressed at some point. For instance, what is meant by the term "science"? Is there an unstated assumption that science is good, and if so what effect does this have on our understanding of scientific ethics? Is science gender neutral? If so, do we have a gender-neutral understanding of science?