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Moral Rules, Moral Ideals, and Use-Inspired Research

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Abstract Moral rules provide the baseline for ethics, proscribing unacceptable behavior; moral ideals inspire us to act in ways that improve the human condition. Whatever the moral ideals for pure research, science has a practical side so it is important to find a moral ideal to give guidance to more applied research. This article presents a moral ideal for use-inspired research based on Norman Care's idea of shared-fate individualism This ideal reflects the observation that all human lives, both present and future are tightly coupled and, as a result, research projects should be chosen, where possible, with the goal of service to others. Together with the ideals of the habit of truth and the gift economy, shared-fate individualism provides the basis for a humane ethics of science.

Keywords Moral ideals · Use-inspired research · Social responsibility of scientists · Project evaluation

Introduction

Considerations of ethical questions in science usually focus on moral rules, standards of conduct that may not be violated without consequences (although appropriately justified exceptions are permitted). For example, chapter 1 of the recent publication on research ethics issued by the Office of Research Integrity, is entitled ''Rules of the Road'' and formulates the standards of conduct for science in terms of rules and government regulations [1]. David B. Resnik's recent book, *The Ethics of Science: An Introduction* [2], uses rule-like language to describe the standards of ethical conduct in science. For example, the first standard he lists is

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''Honesty: Scientists should not fabricate, falsify or misrepresent data or results. They should be objective, unbiased, and truthful in all aspects of the research process'' [2, p. 52]. Although the language is gentler, Resnik's rules for scientists are analogous to Bernard Gert's development of common morality in terms of rules such as ''Do not kill,'' or ''Keep your promises'' [3]. Resnik's standards include carefulness, openness, freedom, credit, education, social responsibility, legality, opportunity, mutual respect, efficiency, and respect for subjects, all stated in similar rule-like language. It is a good list; the same kinds of rules can be found in essentially all discussions of responsible conduct of research, although expressed in different ways. The Federal Policy on Research Misconduct developed by the Office of Science and Technology Policy defines research misconduct as ''fabrication, falsification, or plagiarism in proposing, performing, or reviewing research,'' a more limited set of rules [1, p. 21].

A rule-based approach, such as the one developed by Bernard Gert, is a good way to define common morality, and by analogy, the common morality of science [3]. Rules are the baseline of moral behavior. As Gert argues, without broad adherence to the moral rules, a society could not function. Similarly, without broad adherence to the rules of scientific ethics, the scientific community could not function. Science is based on trust; if individual scientists cannot be certain that the published research on which they base their new work has been performed well and honestly, the progress of science is impeded. It is impossible to repeat, or sometimes even to understand completely, the entire background of a sophisticated scientific investigation.

But rules only set the minimum standards for behavior. There is another side to ethics that goes back to ancient Greece, the concept of moral ideals or moral virtues. Moral ideals help answer the question, what is the right thing to do? Following the insights of Michael Davis [4], I have previously argued that the ethics of science derives from moral ideals that help define the profession, just as moral ideals form the basis of the ethics of other professions such as law and medicine [5]. Davis begins with the question, what is the moral authority of a professional code? A professional code can be regarded as part of a social contract which a member of a profession agrees to, but a social contract does not provide a moral authority. Davis argues that if the profession is organized around a moral ideal of service, then the professional code has a moral authority. He lists three conditions for an ideal to be moral. First, achieving the ideal must be possible without doing anything morally wrong. Second, failing to meet the ideal must also not be morally wrong. Finally, the achieved ideal must result in a state of affairs which any rational agent would favor, even if it means some restriction on what that agent could otherwise do.

Davis's paradigm example is law where he identifies the moral ideal of equal justice under law which underlies the principles of legal ethics. Preventing avoidable death, pain and disability, all moral ideals, are major goals of medicine. Professions are more than mere occupations; they are based on an ideal of service. A profession is a calling and the moral ideal is both the essence of what the profession stands for and the basis of its professional code of ethics. Moral ideals inspire people to act in ways that improve the human condition and represent the best in humanity.

For primarily service-oriented professions such as medicine and law, the moral ideals are relatively easy to identify. Science, however, is more complicated because it involves both the search for fundamental understanding about the natural world and the use of that knowledge to benefit humanity: two different ideals of service. The two motivations are independent, but compatible. One can pursue fundamental knowledge without regard to its eventual use, or apply known science to practical problems, or some combination of the two. Consequently, the profession of science requires several moral ideals. In previous articles I have proposed moral ideals for pure science [6–8], but left aside the more difficult question of applied research. In this article I propose a moral ideal for science where use or application is an important, if not the primary, motivation. Since most of the practical goals of applied science are morally acceptable, is there an ideal by which to judge which is the right goal to pursue? If the applications of science are to benefit humanity then this ideal must take into account the morally-relevant facts about today's world. To frame this discussion it is first necessary to clarify the relationship between the two major motivations for science: the search for fundamental understanding and the application to practical problems, then to examine what morality requires of competent people including scientists.

Classification of Research and Pasteur's Quadrant

In his book, *Pasteur's Quadrant: Basic Science and Technological Innovation*, Donald Stokes [9] shows that the traditional linear classification of research on a spectrum from pure to applied is inadequate and proposes a quadrant model as an alternative. The two-dimensional quadrant model accounts for the two independent motivations for research: the search for fundamental understanding and the consideration of the use of the results for practical, and often commercial, purposes. The four quadrants are illustrated below.

Quadrant Model for Scientific Research

Quest for Fundamental understanding	Consideration of Use? No	Consideration of Use? Yes
Yes	Pure fundamental research (Bohr)	Use-inspired basic research (Pasteur)
No		Pure applied research (Edison)

Stokes's scheme results in four broad categories of research, three of which he has named after famous people. The pure fundamental research done in Bohr's quadrant is what philosophers of science usually consider; it is a significant proportion of the science done in universities and in the premier private and government research institutes. Research on the fundamentals of the quantum theory

or the measurement of fundamental constants clearly fits in Bohr's quadrant. Edison's quadrant, the realm of applied research, is also familiar. This is much of the research done in industrial laboratories, application of fundamental principles to the development of useful products and processes. This includes the chemistry of dyes and personal care products, the rheology of chocolate making, the legacy of the craft tradition in science.

As Stokes points out, the lower left quadrant where the research is inspired neither by a quest for fundamental understanding nor any consideration of use is not empty. For example, the systematic study of the markings and distribution of species that go into books such as *Peterson's Guide to the Birds of North America* fits here, but essentially all the work done in this quadrant is irrelevant to science policy, which was Stokes's primary interest. Stokes did not give this quadrant a name, but perhaps it should be called the ''cabinet of wonders'' quadrant after the collections of fascinating objects that were popular in the 17th Century.

The important insight of Stokes's two-dimensional classification scheme is the existence of Pasteur's quadrant: use-inspired basic research. Stokes uses Pasteur as his example, and certainly much contemporary work in biochemistry and molecular biology lies squarely in this quadrant as does much of chemical research, that done not only in industrial laboratories, but also in universities. As another outstanding historical example I would point to the work of Wallace Hume Carothers at DuPont [10]. Not only did Carothers make important fundamental contributions to polymer chemistry, but in the process also developed nylon, the first synthetic fiber.

Moral Ideals for Science

The moral ideals of pure science, science that is directed at fundamental understanding, what Einstein poetically referred to as the ''secrets of the old one'' [11, p. 275], are relatively easy to identify [6–8]. Following Jacob Brownowski, I have argued that the search for understanding requires a ''habit of truth,'' acting in ways that make possible the discovery of the truth about the natural world [5, 12]. This ideal leads to what Richard Feynman called a ''principle of utter honesty'' [13, p. 341]. Because science is a form of public knowledge it requires open communication of both results and of experimental or theoretical procedures. This means that science is a gift economy where contributions to the scientific community are a condition of membership [8, 14]. Even more fundamentally, as John Hardwig has argued, ethics and epistemology are tightly connected. Because science is based on trust that the research has been carefully done and the results objectively interpreted, the moral character of scientists is integral to all scientific knowledge [15]. Without the moral ideals of the habit of truth and the gift economy, the entire scientific enterprise would collapse.

These two ideals are sufficient for Bohr's quadrant, but the issue becomes more complicated when attention is turned to applied science, where the goal involves the development of practical, usually commercial, products, and even more complicated for weapons research. This highlights the need to identify and discuss a moral ideal for use-inspired research, an ideal that supplements those for pure research and

provides a basis for a more complete and humane ethics of science over the entire range of its activity. Although science has always been linked to technology and industry, the ethical problems of applied research have become increasingly important and complex in recent years, so a discussion of the moral ideals that should govern such work is particularly timely.

Research in all four quadrants must adhere to the moral ideal of the habit of truth and the specific moral rules that follow from it. There is no place for fabrication or falsification anywhere in science. The second ideal, the gift economy, however, has a more limited role in Pasteur's and Edison's quadrants. A gift economy implies open communication, the free sharing of techniques and results, but these are incompatible with the need to keep information proprietary. Although it is essential to share information freely within the research laboratory or company, broader communication must be limited to maintain a competitive advantage. In its pure form the patent system requires full disclosure of the technical details of an invention in return for an exclusive license to produce and market; however, many patents are written to keep the important information as secret as possible to thwart the competition. Although the need for proprietary information and the patent system raise important ethical questions, such as whether information concerning the human genome or life forms should be patentable, this paper will focus on another issue: the moral ideals that should inform the choice of research problems? Should moral considerations affect the practical goals of use-inspired or applied research? In other words, is there a moral ideal for Pasteur's and Edison's Quadrants? Although the discussion is framed in terms of the decisions made by individual scientists, similar moral considerations should also inform science policy, such as the funding priorities of the private and federal agencies that support research and the missions of both government- and privately-funded research laboratories.

Shared Fate and Use-Inspired Research

In Bohr's quadrant, where the goal is fundamental understanding, the choice of a research area and a specific problem is primarily governed by the background, abilities, and creativity of the individual scientist and by the dominant paradigm, to use Thomas Kuhn's [16] view of science. The paradigm defines the important problems. A revolutionary scientist like Einstein is motivated either by anomalies, or by new insights, but in both cases, it is the progress of science as a form of human understanding that is important. Of course there are practical considerations, especially the availability of resources (for example, laboratory facilities and instrumentation, materials, personnel, and funding) which can limit or direct an individual scientist's choices, but within those constraints, the researcher has a lot of freedom. Although questions have been raised as to whether all knowledge is good [17–19], there is widespread agreement in the scientific community, and in society at large, that the pursuit of fundamental knowledge about the natural world is the primary goal of science and that this goal is a moral good.

On the other hand, not all practical ends are morally justified. To take an extreme example, research to develop better methods to torture human beings violates a

fundamental moral rule, the rule that prohibits causing harm to other people, even if it results in new discoveries. Of course, very little research is explicitly directed at morally objectionable ends, although the results of legitimate research certainly can be misused. Such judgments are not the concern here. Instead, I want to propose a moral ideal that will help to differentiate among different morally-acceptable projects.

Freeman Dyson [20, p. 47, 21] has written that science is in trouble on a global level because of a poor choice of goals: ''As a general rule, to which there are many exceptions, science works for evil when its effect is to provide toys for the rich, and works for good when its effect is to provide necessities for the poor.'' This is a strong judgment, but it contains the essence of a moral ideal. Dyson is arguing for a more socially-responsible science, one in which the uses or applications of research are chosen based on moral considerations, which is exactly what a moral ideal can provide.

This proposal is based in a moral position that Norman S. Care [22, 23] has articulated and called ''shared fate individualism''. Care's position derives from two questions. The first is normative: what does morality require? The second is motivation: why should people do what morality requires? In trying to understand what morality requires he examines the needs of others, both those living and what he calls ''future people,'' those of future generations. The question he grapples with is whether human needs have an independent justificatory force in moral deliberations. The usual way of justifying a need is to look at the end for which it is needed. If J is in need of x for p, then the need can be justified if p is a morally legitimate end. This makes sense, but Care goes further to look more closely at the relationship between J and p. Some ends are more important than others. For example, if J is in need of food or shelter or medical care to lead a decent and productive human life, Care would argue that these needs must be met, whatever the cost. Meeting such needs is morally required. Moreover, Care would argue that for social beings like humans such needs are pressure-generating normatively-loaded facts. He quotes Rousseau, ''It is plainly contrary to the law of nature, however, defined, that children should command old men, fools wise men, and that the privileged few should gorge themselves with superfluities, while the starving multitudes are in want of the bare necessities of life'' [23, pp. 84–85].

Care goes on to list the circumstances of today's world, circumstances of which all are aware, which he finds morally compelling. These include

(1) Destitution: Much of the world's population lives in a state of severe deprivation relative to basic human needs.
(2) Extreme Disparity in Levels of Life: The difference in the standard of living between the United States and many countries in Africa, Asia and Latin America is staggering.
(3) Efforts to help: Although both governments and non-governmental agencies have programs to aid people in poor countries, these efforts are demonstrably inadequate. The disparity between the richest and poorest people in the world is growing.

Care frames his discussion in the context of individual responsibility which he divides into self-responsibility and other-responsibility. Both are important, but

the essential moral question is which of the two is emphasized in making crucial life decisions. Care [22, p. 29] asks, ''What degree of importance should I attach to the individual life that is, in fact, my life? What degree of importance should I attach to the individual lives that are not, in fact, my life?'' Care's position is that in light of current world circumstances it is essential that ''competent individuals,'' by which he means ''persons who are *positioned* to self-realize and to contribute to the lives of others'' [22, p. 31], put other-responsibility ahead of self-realization in significant life decisions. Among these decisions is career choice, but for a scientist the choice of both a research area and specific problems to pursue would also qualify.

Care's position derives from the idea that all humans are part of a tightly-connected moral community, that all are in life together and share fate. Shared-fate individualism is a very strong position which Care does not completely justify philosophically, although the arguments and evidence he does provide are strong and fit nicely with Dyson's plea for a science where the moral considerations influence the choice of goals. But Care does find suggestions for his position in at least two philosophical sources. One is Rawls's [24] theory of justice which requires that one make decisions about the organization of a just society from behind a ''veil of ignorance'' in which everyone is ignorant of his or her own and everyone else's capabilities and station in life. He quotes Rawls, ''Once a morality of principles is accepted, moral attitudes are no longer connected solely with the well-being and approval of particular individuals and groups, but are shaped by a conception of right chosen irrespective of these contingencies. Our moral sentiments display an independence from the accidental circumstances of the world'' [23, p. 114]. This idea of an extended tightly-connected moral community is similar to Kant's view that human beings are members of the ''realm of ends'' [25]. All people should be treated as equal moral persons, and all personal acts should be judged based on universal laws applicable to all people.

Care has extended the shared-fate concept to include not only people living today, but also future generations. This extension is important. A variety of political and technological decisions made today have long-term effects. For example, nuclear wastes will continue to be dangerous for thousands of years, so decisions regarding their production and disposal should not just consider short-term consequences. Economic and political decisions made today have serious, long-term implications. Including future generations in the moral community is unusual, but essential in a world where human decisions have such profound and long-term consequences.

These philosophical and empirical considerations lead to the concept of shared-fate individualism which means to Care that putting other-responsibility above self-realization is not a choice but is morally required in such important decisions such as career choice. A career of service to others should be chosen over one that only provides self-realization.

Care emphasizes the moral aspects of career choice, but his ideas are readily applicable to scientists involved in use-inspired research. Scientists are certainly competent in Care's sense. They have already made a career decision, but have some freedom to choose the situation in which they will work (college or university, government-funded research laboratory, or industry) and in university and government laboratories have considerable freedom to choose both the broad area

and specific problems for research. In all of these significant life decisions, the concept of shared-fate individualism can be applied and the scientist, wherever possible, should choose service over self-realization.

Care's position is that the conditions of today's world are sufficiently dire that heavy sacrifice is morally required of competent individuals in life decisions such as career choice. He contrasts shared-fate individualism with separate-fate individualism, in which the moral connection between individuals is weak, and with liberal individualism, an intermediate position that attempts to accommodate both convictions. A liberal individualist would emphasize self-realization in certain circumstances, but in others would concentrate on service. One can imagine a world in which all persons are in a position to undertake individually defined self-realization projects. In such a world, separate-fate individualism is morally justified. In a slightly less ideal world where not all persons are sufficiently well situated to pursue self realization but there are effective institutional mechanisms for alleviating human deprivation, the position of liberal individualism would be appropriate. Unfortunately, the circumstances of today's world do not fit either of these cases, so Care concludes—and I concur—that shared-fate individualism is the only morally justifiable position.

The view that the moral community is so tightly connected that human suffering anywhere imposes moral requirements on everyone has been eloquently expressed by Russell Banks in *Cloudsplitter* [26], his novel about the abolitionist John Brown. Brown's son, the narrator, tries to articulate his father's position on slavery, ''... Father's work. The Lord's work, as he constantly reminded us, of freeing the slaves. For until the slaves were free—as he told us over and over again—none of us were free . . . It was unarguably true to Father that man's essential task while on this earth was to bring both his personal and his civic life into total accord with the will and overarching law of God. And since a republic is a type of state that by definition is governed by laws created and enforced by its citizens, whenever in a republic those laws do not conform to the laws of God, because those laws can be changed by men, they *must* be changed by men'' [26, pp. 254–255]. This cannot justify some of the methods that John Brown used to try to free the slaves, but it is a powerful statement of the idea of shared fate and its moral requirements. The problems of today's world may be less visible, at least to those living in affluent societies, but they are as morally compelling as the problem of slavery.

In their decisions about their research, most scientists would fit into the categories of separate-fate individualists or perhaps liberal individualists, primarily concerned with self-realization, development of their own careers, but recognizing that their work might have effects on the rest of society. There are exceptions, of course: scientists who devote their careers to projects that benefit humanity, particularly the disadvantaged, and others who study diseases such as malaria or river blindness, or work on environmental problems. Some of these scientists become highly successful in more conventional terms, achieving an international reputation and occasionally great wealth. Other scientists whose primary goal is self-realization happen to discover something of enormous social benefit. But, overall, the pressing needs of today's world are minor considerations in the kinds of research that scientists choose to do. Their choices are made based on their

background and interests, the current trends in the field, and the constraints of obtaining funding and the other resources for their work.

Money is an important constraint. Because most science is expensive, the choices are limited by what will be funded by the major government agencies: in the US these are the National Science Foundation, the National Institutes of Health, NASA, and the Department of Defense. The priorities of these agencies reflect current political realities. For example, diseases that affect Americans have a higher priority than those like malaria which are epidemic in Africa. Over the past few decades there have been efforts such as the ''War on Cancer'' and a focus on coal as an energy source, which are research funding priorities driven by political agendas. Since the research offices of these agencies are directed by scientists and all agencies use some sort of peer review process, research priorities also reflect current paradigms and fashions of the various fields.

In use-inspired basic research, the priorities of industry are an important factor, partly because industry provides funding to academic scientists and partly because of the influence of corporations on government. In the development of new drugs, the enormous costs of clinical trials are often funded by pharmaceutical companies so some of the drugs chosen are those that will yield high profits. With the Bayh-Dole act that allows individual scientists and universities to own the patents that derive from federally-funded research, use-inspired basic research is increasingly undertaken with an eye to potential commercialization and significant additional income for the scientist. Both Brian Coppola [27] and I [8] have recently discussed some of the ethical problems raised by the increased commercialization of research within the academic environment.

As profit becomes a factor in research, either through existing industry or through new ventures, Dyson's critique that science is in trouble because it focuses on toys for the rich is even more compelling. Although the goal of profit and the goal of service are not incompatible, the development of products for affluent countries usually yields higher profits than for those aimed at supplying the basic needs of people in poor countries. More importantly, if profit and self-realization are the primary goal, then service is secondary. In light of the conditions of today's world, the traditional position of separate-fate individualism does not withstand moral or practical scrutiny. The current needs of others and the need to leave a world for future generations that is not just a garbage dump are pressure-generating moral facts that cannot be ignored. It is becoming increasingly clear that ignoring environmental or public health problems has practical consequences for all of us. Separate-fate individualism is a short-sighted perspective. Therefore, an appropriate moral ideal for research in Pasteur's and Edison's quadrant is a form of shared-fate individualism: in choice of research problems, scientists should put service to others ahead of self-realization. In Dyson's words, necessities for the poor should have priority over toys for the rich.

The moral ideal of shared-fate individualism can help the individual scientist and those who make science policy resolve the inevitable conflicts between the values of self-realization and public service and the lures and demands of the market. These same conflicts arise in other professions, such as law and medicine. In law, the ideal of *pro bono publico* encourages attorneys to donate their time to those who need

their services but cannot pay the full professional fee. Physicians and other health professionals incur similar moral obligations.

This recommendation is more moderate than Care's because it suggests shared-fate individualism as a moral ideal for the profession of scientists, not as a moral rule. Care claims that for competent individuals, heavy sacrifice is morally required. This requirement is unrealistic for scientists for several reasons. First, the reality of the profession is that self-realization, individual career development, is essential. Scientists who focus only on service to others may not be able to maintain sufficient research profiles to obtain funding and other resources to do any kind of meaningful research, thus limiting their ability to do anything useful. Such a scientist would cease to be a competent person in Care's sense. Second, as Dyson notes, not all research aimed at ''toys for the rich'' is morally questionable. For example, although the explosion in computer technology is primarily a boon to the affluent, with its personal computers, cell phones, and the like, it has had unexpected benefits for less affluent societies. Drugs that are developed for one disease sometimes are found to be effective in new circumstances. Science and technology are full of surprises and serendipitous discoveries. Third, the kinds of problems that scientists can effectively work on are limited by their training; not every scientist has the background and skill to study the most pressing societal problems. As a result, shared-fate individualism is more reasonable as a moral ideal for Pasteur's and Edison's quadrants. As they work in use-inspired basic research or applied research, scientists should put service to humanity and the amelioration of the serious problems of today's world above self-realization whenever and wherever possible as they plan and develop their careers. Many scientists working in Edison's quadrant do not have the flexibility to choose their projects because they work in industry, but scientists who work in universities or government laboratories often have freedom to choose the research they do, so I propose that the moral ideal of shared-fate individualism should apply to them. Finally, for any scientist deciding where and how to build a career, shared-fate individualism should be a guide. As Care suggests, for a competent individual, in today's world, a career of service should be chosen even if it requires personal sacrifice.

A scientist may legitimately work in three quadrants. Many occupy more than one in the course of their careers. Each has its moral ideals: the habit of truth, the gift economy, and shared-fate individualism. As with all moral principles, these ideals require elaboration and interpretation in individual circumstances. Together they provide the basis for a humane ethics of science.

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