What Is Responsible Conduct of Research?

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What Is the Responsible Conduct of Research and Why Does It Matter?

The Acoustical Society of America (ASA), like most comparable groups in other disciplines, has developed strong ethical principles for conducting and publishing research (see acousticalsociety.org/ethical-principles). The purpose of this essay is to emphasize the importance of the ASA ethical principles and describe their relevance in a broader context that should be useful for every member of the ASA, no matter the environment in which they work.

Anyone engaged in scientific research today, whether in the academy, government research agency, industry, or not-for-profit setting, has heard about RCR, short for "responsible conduct of research." But what exactly does this mean and why do we need to care more about it?

RCR refers to a set of principles for conducting scientific research with the utmost integrity. Initially focused on classroom instruction of students, it is now clear that everyone engaged in the research endeavor, researchers, staff, and administrators, should be involved. The emergence of specific RCR training requirements from funding agencies has resulted in institutional and organizational policies that represent a fairly focused, homogeneous view of what RCR involves. Most importantly, RCR is about more than just "compliance" with specific policies or regulations; rather, it now entails a full range of ethical research behavior and incentives for research and represents a call to arms to protect the integrity that is the essential basis of unimpeachable scientific investigation (National Academies of Science, Engineering, and Medicine, 2017).

To paraphrase remarks by the Nobel Laureate Richard Feynman (Feynman, 1998) in his address at the California Institute of Technology 1974 commencement,

> *"...scientific integrity can be defined as principle of scientific thought that corresponds to a kind of utter honesty — a kind of leaning over backwards. If you are doing an experiment, you should report everything that you think might make it invalid — not only what you think is right about it... Details that could throw doubt on your interpretation must be given... You must present all of the facts that disagree with it, as well as all that agree with your hypothesis... You must do the best you can — if you know anything at all wrong, or possibly wrong — to explain it..."*

The suite of specific topics in RCR range from those centering on compliance with regulatory requirements accompanying federal funding, such as those addressing research misconduct, the use of human subjects and animals in research, conflicts of interest (COIs), and intellectual property resulting from research, to other more general behaviors and best practices. These other practices might best be described as emerging principles for the ethical conduct of science and do not typically involve entanglements with federal regulations. But they are receiving increased attention from funding agencies, and researchers are increasingly asked to address these elements of scientific integrity in their grant applications: mentoring; authorship; peer review; collaborative research; data acquisition, management, sharing, and ownership; and rigor and reproducibility.

The Big One: Research Misconduct

RCR emerged to prevent problematic behaviors that directly impact the integrity of the research product, the most direct, serious, and damaging of which is research misconduct. Research misconduct is specifically defined as fabrication, falsification, and plagiarism (FFP). The definition also typically includes statements that honest error or differences of opinion do not constitute misconduct and that the misconduct must be committed intentionally, knowingly, or recklessly (e.g., deliberately changing data).

The actual incidence of research misconduct is relatively rare compared with the huge number of scientific publications every year, but it is also increasing (Fang et

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al., 2012). Worse yet, many research administration staff in major universities suspect that research misconduct is probably underreported. A quick Google search would reveal some startling examples of research misconduct in recent years, with some cases leading universities to pay settlements totaling hundreds of millions of dollars.

Decades ago, scientists could reassure the public that science is by its nature self-correcting, so any misconduct is likely to be quickly discovered and corrected. But a spate of misconduct cases in the biomedical sciences in the late 1970s and 1980s involving medical treatments made the public more skeptical, eventually drawing the attention of the US Congress and leading to the creation of the Office of Research Integrity (ORI) in the 1990s. The ORI, within the Department of Health and Human Services, was tasked with oversight of research misconduct matters involving Public Health Service funds (e.g., National Institutes of Health grants). New regulations were issued, requiring research institutions to adopt a policy for addressing misconduct, and institutions began designating research integrity officers to manage the review of allegations and report the results to the ORI. Other federal agencies took note and developed similar requirements. The ORI also offers extensive guidance and tools for promoting RCR and even publishes the results of research misconduct investigations on their website (see ori.hhs.gov).

Still below the radar screen, however, are what is known as "questionable research practices" that undermine the integrity of research and contribute to the problem of irreproducible research (Johns et al., 2012). Such practices as "cherry-picking" data, whether they rise to the level of outright fraud and research misconduct, still clearly run counter to Feynman's "utter honesty" and undermine the trustworthiness of the scientific enterprise.

Emerging Principles of the Responsible Conduct of Research

In contrast to the precise definition of research misconduct as discussed in **The Big One: Research Misconduct**, there are a variety of topics in RCR that are best described as a set of emerging principles for how to behave. We touch on the main ones below. Although some are common sense, all of them warrant careful thought and application and are covered in popular research integrity textbooks (e.g., Macrina, 2014).

Authorship

For instance, it is not appropriate to include someone as an author on a paper who has made no contribution to the work or the drafting of the article, but how to weigh the various kinds of contributions is often quite vague. It is not surprising that most scientific journals now require manuscripts to be signed by all authors and include statements about their relative contributions. There are many good sources of information, some discipline specific, about criteria for authorship (e.g., National Institutes of Health, 2010; American Psychological Association, 2015). Also, unlike research misconduct, authorship criteria can vary more across disciplines and cultures. Today, most journals offer guidelines. Most discussions of the ethics of authorship also include a treatment of the process of peer review, including the criteria for evaluating the merit of the work and the importance of confidentiality and addressing potential COIs when evaluating a manuscript.

Mentorship

It used to be fairly common in academic circles to confuse the word "mentor" with other overlapping roles of faculty members such as sponsors, role models, advisors, and teachers. As many have pointed out (e.g., Institute of Medicine, 1997; Macrina, 2014), mentoring conveys a deeper, more enduring commitment in the relationship than simply sponsoring, advising, or teaching. Recognizing that there are a great variety of personalities and modes of human interaction, there are consequently many successful mentoring styles. Excellent source materials summarize the essential ingredients of a successful mentor-mentee relationship and explain how to nurture and foster those relationships (e.g., NAS, 1997; Gee and Popper, 2017). RCR recognizes that mentors play a key role in instilling good scientific practice both in and out of academia.

Collaboration

Gone are the days when single-authored papers were the norm. Modern science almost demands that scientists work in teams, often across interdisciplinary, institutional, and national boundaries. There is a considerable amount of detail available from a variety of sources describing the components of successful collaborative relationships, both large and small (e.g., National Cancer Institute, 2018). Among the most obvious requirements for successful collaborative relationships are those that

come from plain common sense: trust, communication and accountability, and an upfront, clear agreement on expectations, such as authorship credit.

RCR Topics and the Law: Compliance Committees

Today, state and federal regulatory requirements attached to both funded and nonfunded basic research represent an enormous compliance burden for both researchers and research institution staff. For example, the federal government mandates that institutions accepting federal funding have "assurance" or compliance committees in place, staffed by research administrators and researchers intimately familiar with the research programs and culture of the institution, and fulfill reporting requirements that assure the federal government that its researchers are complying with federal guidelines. The purview of these committees covers data acquisition and management, intellectual property, COIs, human subjects, animal subjects, and biohazards and biosafety. Most universities and many other research institutions have detailed websites explaining the exact scope and role of these compliance activities.

There isn't complete unanimity across the globe on these matters. Although the definition of research misconduct is almost universally accepted, the other aspects of research that require compliance committees can vary somewhat across different cultures and countries. For instance, ownership of intellectual property in the United States is directly tied to wording in the US Constitution, a document not pertinent in other countries. Regulations regarding human subject research are fairly similar across the world, whereas regulations regarding animal research are more varied.

A rising sense of the vulnerability of research integrity has led federal granting agencies to sometimes require applicants and institutions to describe the exact procedures by which data will be collected, managed, and shared with the public, requirements almost unheard of several decades ago. Moreover, journals and funding agencies are increasingly requiring researchers to share the data that underlie publications for public inspection. Although the burden on institutions and researchers is great, the federal government and research institutions routinely work together to try and minimize the burden (e.g., the Council on Governmental Relations [see www.cogr.edu] and the Federal Demonstration Partnership [see thefdp.org]).

The Next Big One: Conflicts of Interest

COIs go right to the core of research integrity and objectivity in the generation of new knowledge. COIs represent a serious threat to research integrity at all types of research institutions. Universities, for instance, are coming under pressure to justify their value, in part, by how many patents and industrial relationships they can claim and how many start-up companies are spun off from university laboratories and academic research every year. Some large companies are seeking dual-employment strategies (e.g., 50% in the university and 50% in the company). It is becoming more common for university researchers to share authorship on publications with scientists at corporate entities that are funding the research, an arrangement demanding considerable scrutiny.

A Google search reveals COI threats that have emerged from foreign entanglements, with instances of students, postdocs, and faculty in research institutions actively working with foreign entities to inappropriately transfer intellectual property. Although universities and other research institutions may have been casual in how they have dealt with COIs in the past, that time has now passed. They must take seriously this increasing threat to research integrity and be aggressive in developing ways to maintain productive collaborative relationships across institutions, countries, and cultures while protecting the core essence of scientific integrity, as described by Richard Feynman.

The Road Forward

For the last 25 years, progress in promoting RCR has been slow but relentless. It is now quite clear that rewarding scientific innovation is important but so too is rewarding reproducibility (e.g., Moher et al., 2017). Universities and other research institutions are now proactively sharing best practices and learned lessons. For instance, research office personnel from members of the Big Ten Academic Alliance, a US consortium of major research universities, participate in monthly meetings on how to promote RCR education and foster an environment of research integrity on their campuses. Common sense principles are beginning to emerge, such as:

(1) RCR is more than about compliance; it encompasses a larger suite of behaviors and attitudes that must be respected and embraced;

(2) Online tutorials, a one-class lecture, or a one-day workshop are not enough in RCR education. Semester-long graduate and undergraduate courses, especially with examples, are necessary to cover RCR topics in depth. This should be the start of a career-long appreciation of RCR, not the end;
(3) RCR courses and workshops must involve senior researchers who have been practicing scientists in the instruction, not just compliance personnel in research offices or lawyers who typically have limited research experience at the "bench";
(4) Senior researchers should set aside time in organizational or departmental meetings to discuss RCR principles and cases that are making the news in their disciplines. There is plenty of material;
(5) Everyone involved in the research endeavor (e.g., researchers, students, postdocs) shares responsibility for the integrity of the research; and
(6) National experts in RCR should be invited for selected RCR topics in institution-wide colloquia.

To bluntly answer the opening question of why does it matter, the scientific method inexorably generates new knowledge and new facts. Lack of research integrity produces fake knowledge and alternative facts, something everyone involved in the scientific enterprise is duty bound to prevent.

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