

Ethics in Scientific Research: Principles, Violations, and Oversight

Scientific research is increasingly shaping public policy, medical treatment and technology, making the ethical integrity of research more important than ever. Data fraud, unauthorized human testing and conflicts of interest have eroded public trust and raised urgent questions about how science polices itself. In the present paper, we review the major ethical principles, typical breaches and supervision mechanisms in the modern scientific research. We argue that these issues need to be understood to preserve the credibility of scientific research and society's license to trust and finance scientific research.

Responsible research has an ethical backbone with four main pillars. The first is honesty and integrity, meaning that researchers must present proposals, data, methods, and results honestly, and prohibits fabrication (making up data), falsification (manipulating existing data), and misrepresentation of findings. The second principle is objectivity that requires that bias should be minimized at all stages from experimental design to data collection, analysis, interpretation and even peer review. The third principle is the respect for human and animal subjects. This includes obtaining informed consent from participants, ensuring their privacy through data anonymization, avoiding any physical or psychological harm, and adhering to the "3Rs" (Replacement, Reduction, Refinement) when using animal subjects to minimize suffering. Finally, accountability also means not stealing intellectual property, and proper citation.

Ethical dilemmas are common in the day-to-day practice of research even with the best of intentions. In data management, it is important to collect data correctly, store it securely and share it responsibly and problems arise when data are lost, deleted selectively or shared without permission and it is a standard obligation to keep raw data for a minimum of five to ten years. Disputes frequently erupt over who is an author and who is not; authentic authorship involves a significant intellectual contribution. Ghost authorship (failure to acknowledge a genuine contributor) and guest or gift authorship (crediting an influential but uninvolved person) distort accountability and breach ethical standards. Plagiarism, whether of another person's words, ideas or figures, without attribution, or of self-plagiarism (reuse of one's own previous work without citation), continues to be a serious violation that misleads readers as to the novelty of findings. Also, subconscious biases can arise from conflicts of interest, such as financial ties, institutional pressures or personal biases, hence the need for full disclosure.

Two general types of research misconduct exist. The first category is called FFP and is for fabrication, falsification and plagiarism. Fabrication is when a researcher makes up survey responses from people who don't exist, falsification is when a researcher deletes outliers to get statistical significance, and plagiarism is when a researcher copies a published paragraph on methodology without quotation marks or proper citation. The second category involves questionable research practices. These are not outright fraud but still violate the spirit of integrity. Examples include p-hacking (running multiple statistical tests and only reporting those with p-values less than 0.05), HARKing (Hypothesizing After the Results are Known), where a post-hoc finding is presented as a prior hypothesis, and poor statistical reporting (e.g., not reporting non-significant results, or not reporting effect sizes). The consequences of misconduct are serious, including retractions of published papers, loss of research

funding, damage to the reputations of individuals and institutions, and real harm to patients who may be treated with ineffective therapies based on fraudulent clinical trials.

There are several oversight mechanisms to prevent and to correct these violations. In the US, Institutional Review Boards and in other countries, Research Ethics Committees are independent committees that review all research involving human subjects before it begins, considering the risk-benefit ratio and the adequacy of the processes of informed consent. Research integrity offices, such as the United States Office of Research Integrity, investigate allegations of fabrication, falsification and plagiarism in publicly funded research. Most universities have their own research integrity officers. Whistleblowers, usually laboratory technicians or junior co-authors, are vital in exposing misconduct but risk retaliation for doing so. Institutions need anonymous reporting hotlines, legal protections such as those provided by the Whistleblower Protection Act, and most importantly, a culture that encourages people to speak up, not one that encourages them to fear doing so.

Ultimately, science is an intensely human endeavor, and with human frailty comes the need for ethical vigilance. The key duties are clear: be honest in reporting, be objective in analysis, respect human and animal subjects, be transparent in declaring conflict of interest, and be accountable in authorship and data management. To translate principle into practice, the scientific community must commit to ongoing ethics education throughout all stages of career development, preregistration of studies to minimize p-hacking, open data policies to enable independent verification, and above all, a culture of integrity in which ethical conduct is celebrated as the very foundation of discovery, not a secondary consideration. It is only through these means that scientific research can gain the trust of the public and fulfill the promise of advancing knowledge for the common good of humanity.