Commentary

Study highlights ethical ambiguity in physics

Most physicists have heard about the almost mythological fraud performed by Jan Hendrik Schön in the early 2000s.[1] His case and that of 15 Turkish theoretical physicists involved in a 2007 plagiarism scandal[2] represent the most notable, egregious, and unambiguous instances of research misconduct in physics. They are textbook cases of research misconduct as defined by the US Office of Science and Technology Policy: "fabrication, falsification, or plagiarism in proposing, performing, or reviewing research, or in reporting research results."[3] By that definition, approximately 2% of scientists across a range of disciplines admit to ethical violations that would constitute misconduct.[4]

A 2% misconduct rate suggests that unethical behavior is not a big problem in science. In physics, extensive collaborations, access to colleagues' data, and rigorous peer review make it extremely difficult for individual researchers to bend the rules. Furthermore, physics does not harbor the types of ethical minefields characteristic of the biosciences. No thorny questions arise pertaining to human or animal life, nor do physicists commonly grapple with the ethical haze of intellectual property when patents and money are at stake. Things seem to be black and white in physics. But are they?

As part of an NSF-funded study titled "Ethics Among Physicists in Cross-National Context," we talked with 170 physicists at US and UK universities. Our results suggest that ethical issues in physics are not as black and white as many physicists may think. Our data show that although physicists associate misconduct with fabrication, falsification, and plagiarism, they also include more routine and mundane issues in their work when discussing misconduct. Moreover, how scientists perceive the line between ethical and unethical behavior is much more ambiguous than official definitions imply.

The interviewed physicists fell into two broad categories: individuals who narrowly defined unethical conduct as fabrication, falsification, and plagiarism, and others who noticed more subtle ethical issues. We found the latter category was not limited to physicists at elite or non-elite universities, nor did it matter whether the physicist was located in the US or UK. In fact, we often saw that researchers at the same university held differing views.

When asked to define responsibility in science, a physicist at one UK university answered, "Responsibility for what? I wouldn't be able to do any military research. . . . So by definition, a lot of the responsibility that . . . other theoretical physicists might have to consider doesn't actually crop up in my case." Because his work was not linked with weapons development, he did not have to think about its potential for human harm.

In contrast, a second physicist in the same department had a different response: "I don't see anything as black and white. . . . There are gray areas. Much like sometimes you have to do white lies for the greater good." That researcher saw questions of ethics arising in more routine contexts. As a result, the respondent and other like-minded individuals are much more likely to report having observed unethical conduct by a colleague than those who maintain a narrow definition of misconduct. Several other physicists maintained a similarly narrow definition of misconduct and therefore reported few personal observations of ethical violations.

What is most remarkable about the physicists who see questions of ethics arising in more routine contexts, and what is not yet well understood by those who study ethics in science, is the range of practices they deemed "ethically gray." Examples they gave included accepting funding for military research, misusing research funds, abusing the peer-review system, misallocating credit and authorship, practicing cronyism, overhyping research results, and exploiting subordinates. Although such practices may be questionable, physicists we interviewed did not unequivocally regard them as unethical or as instances of misconduct. They also often did not know how to address or resolve problems that arise from those behaviors.

The physicists we interviewed had several ways to legitimize ethically ambiguous behavior. Some viewed it as good for science. For instance, a British physicist explained, "There are gray areas, where people are tempted to . . . exaggerate or hype . . . in order to keep funding going [and] keep the people they're responsible for employed." Similar narratives occurred when scientists discussed using funds from one grant to support a student on an unrelated project and allocating credit to colleagues or students whose contributions were minimal or extremely remote. "In our field," said a US physicist, "the ethos is if you touched the work with a barge pole, you should probably have your name on it."

If altruism leads physicists to occasionally engage in questionable behavior, what we might call the "white lie" narrative allows unethical behavior of others to persist because physicists view the consequences as minimal. When discussing colleagues who failed to acknowledge their work or who stole an idea discussed in confidence, physicists legitimized the poor conduct by allowing it to go uncontested. "At that point [I] wasn't going to do a lot more work with those people," explained one US researcher, while another interviewee, describing a colleague who stole an idea, said, "The most important thing was that I didn't feel my student suffered."

Some interviewees found it difficult to separate competitive behavior from unethical behavior, and that made it difficult to recognize misconduct. More often than not, that situation came up when physicists described circumstances in which they believed a colleague stole an idea or manipulated the peer-review system. Those we

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interviewed make comments like "that's how science works," "this is . . . part of the structure of being scientists," and "part of this . . . is just endemic." Physicists described a desire to be open rather than secretive, but they found that the distinctions between theft and priority of discovery were ambiguous.

Competition seems to be the main driver of those ambiguous practices, according to the physicists we interviewed. They reported seeing physicists get highly competitive as funding and opportunities, especially for basic research, become scarcer. Over the past 20 years, the US has fallen from 2nd to 10th place in R&D investment as a percentage of GDP.[5] Physicists have only limited options for improving funding, but they can still control and minimize gray-area issues that result from it.

The physics community needs to establish a greater dialog on how to teach ethics to students and reaffirm ethical practices for research scientists. Creating a physics-specific curriculum for responsible conduct of research would be beneficial. Materials and case studies from the American Physical Society already exist to help with that task (see http://www.aps.org/programs/education/ethics, and the article by Kate Kirby and Frances Houle, PHYSICS TODAY, November 2004, page 42). In addition, ethics discussions about gray areas should continue in seminars and at conferences so faculty can also participate. By having greater exposure to gray-area problems and their effects, researchers and faculty members will be more likely to reevaluate their own practices in the future.

References

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Letters

Ballistic motion of a Brownian particle

Mark Raizen and Tongcang Li (PHYSICS TODAY, January 2015, page 56) describe a remarkable experimental observation of short-time ballistic motion for a single Brownian particle in an optical trap. Readers of their Quick Study may be surprised to learn that "the measurement Einstein deemed impossible" was accomplished nearly 25 years ago by Jixiang Zhu and coworkers,[1] for an ensemble of untrapped Brownian particles. In that case, the long-time motion is diffusive, which is the actual problem considered by Albert Einstein, instead of bounded, the situation studied by Raizen and Li. In the 1992 work by Zhu and coauthors, dynamics down to the scale of 1 Å and 25 ns were probed by a dynamic light-scattering technique in which particle motions cause infinitesimal Doppler shifts in multiply scattered light that are resolved by intensity interferometry. Zhu and coworkers were thus able to capture both motion deep inside the short-time ballistic regime and the predicted long-time tail in the crossover to diffusion.