Every day, researchers make judgments about what data to include and what to leave out, balancing a desire to be forthcoming with the need to make a clear and simple argument. The case of the engineer shows just how difficult navigating such decisions can be for early-career researchers. And decisions about data aren't the only hazardous situations; judgments with ethical implications pervade scientific practice. "There are some situations that are very clear-cut, and that's when we talk about real misconduct. ... Everything else, every scientist needs to use their best judgment," says Kathleen Flint of the U.S. National Postdoctoral Association in Washington, D.C., which has been pushing to fill in a gap in training postdocs in the responsible conduct of research. Fortunately, sound ethical practice in science is very close to sound scientific practice: the key is to know what you're doing and to do it meticulously.

Acquiring sound data

Ways to be sloppy in the lab are limitless, and all can compromise your data. Sloppiness can take the form of not quite following the protocols for storing your samples, collecting just about (but perhaps not quite) enough data, or not running simultaneous controls. "Historical data are allowed, but it depends on what kind of historical data you have," says Adil Shamoo, a biochemistry professor at the University of Maryland School of Medicine in Baltimore who focuses on the responsible conduct of research.
- Conflict of Interest and Commitment
- Human Subjects
- Animal Welfare
- Research Misconduct
- Publication Practices and Responsible Authorship
- Mentor / Trainee Responsibilities
- Peer Review
- Collaborative Science

"People are adding things all the time when they come up with their internal list for their institutions," says Daniel Vasgird, director of the Research Integrity and Compliance Office (http://oric.research.wvu.edu/) of West Virginia University in Morgantown. Some argue for adding financial responsibility and environmental health and safety, for example, he adds.

We are continuing to discuss these and other issues on Science Careers as part of our rolling feature (http://sciencecareers.sciencemag.org.gate1.inist.fr/career_magazine/previous_issues/articles/2010_11_05/caredit.a1000108) on research integrity.

The pressure to cut corners can be high; in a 2002 national survey

(ftp://www.nature.com.gate1.inist.fr/nature/journal/v435/n7043/full/435737a.html) of National Institutes of Health (NIH)-funded scientists, 23% admitted (http://caliber.ucpress.net/doi/pdf/10.1525/jer.2006.1.1.43) to "cutting corners in a hurry to complete a project." But cutting corners can be risky, says Melissa Anderson, a research-ethics researcher at the University of Minnesota (http://www1.umn.edu/twincities/index.php), Twin Cities, and a co-author of that survey. Researchers who leave those last few essential tests until later "may forget that they skipped some steps, and then they present results as though they did them, or they may never have time to go back and make the changes." Or, once the project is funded, they get caught up in the moment and "they don't realize that their preliminary results weren't on quite as solid ground as they thought they were."

Record everything

One cornerstone of science is the necessity to keep thorough records so that you and others can go back and redo the work. Yet 27.5% of the respondents to Anderson's 2002 survey admitted to inadequate record keeping.
Good record keeping starts with the lab notebook. So what constitutes a good lab notebook? It may be a traditional, bound-and-numbered paper book, or it may be a manipulation-proof online notation system. But it always provides a comprehensible, well-organized, accurate, complete, day-by-day account of what you do in the lab. Others "should be able to step in and understand everything that happened and pick up the work from that point on," Anderson says. Early-career scientists need to understand the "appropriate standards of record keeping within their particular laboratory, within their institution, within their field," Vasgird says. Also, make sure you store your notebooks securely but accessibly and fully back them up.

Use statistics properly

Another area where carelessness can have serious ethical consequences is in the use of statistics. Often, young scientists do not know enough about preparing their data for statistical analysis, or what test is appropriate under which conditions, Anderson says. "If you don't have a good enough statistical grounding, you'd better get some help from someone who does." Also, make sure you don't lose track of what you've done and what you're trying to achieve, she adds. Many young scientists produce hundreds of statistical runs "and they don't know what variables they've changed, and they don't know which run was supposed to do what, and they get all confused."

Represent your data truthfully

Fifteen point three percent of respondents to Anderson's survey admitted to "dropping observations or data points from analyses based on a gut feeling that they were inaccurate." It's wrong to "throw away information you don't like," Shamoo says. Sometimes it's appropriate to discard outliers but only "if it is, let's say, within 3 to 4 standard deviations of the mean. You say that, and you say what is the statistical reasoning" behind your decision, he continues. Selecting data for publication is a particularly tough problem; you always run the risk of leaving out meaningful data. "You have so much latitude in that selection," Shamoo says, that it's sometimes difficult to assess what is just sloppy or plain unethical. You need to apply your best and most honest judgment, being aware of the standards in your discipline and asking colleagues if necessary. "What would be unethical ... is if the data you didn't include in the paper, for example, has direct bearing on the conclusion of the paper. What would be sloppy is, there are certain pieces of data" that are important "because it gives a different dimension to the outcome. It will not change the conclusion, [but it] was not published," Shamoo adds. "The safest approach is to note parenthetically or in a footnote that further analyses were done and that they are available upon request or on a Web site. The point is to be sure that neither the work nor the findings are misrepresented by omission," Anderson says.

Write with fidelity

When writing up your results, you should make sure that the resulting publication will "represent with veracity, with accuracy, [and] with truthfulness the data you have obtained," Shamoo says. That means providing a complete account of all the steps you took. Nowadays, many journals offer extra space in appendices or on the journal's Web site; that lets you keep the core narrative clean and readable while documenting the work completely and publicly. "There is no excuse in this day and age not to have details of the experiments such that any graduate student anywhere in the world will be able to repeat it," Shamoo says. If you really lack space, "you could say simply, 'The details are not appropriate for this journal, please write to me' or 'Please go to my Web site.' "

Also resist the temptation to over-interpret. Ask for feedback from your supervisor, who may have a broader view of the field and of what exactly can be claimed on the basis of the present findings. Anderson says. Feel free to make some educated guesses or speculations in your discussion, but clearly
- Adil Shamoo and David Resnik's textbook *Responsible Conduct of Research* (http://www.amazon.com/Responsible-Conduct-Research-Adil-Shamoo/dp/019536824X)

- Online course (http://ori.dhhs.gov/education/products/columbia_wbt/index.html) on responsible conduct of research produced by Columbia University (with input from Daniel Vasgird)

- *Teaching the Responsible Conduct of Research in Humans* (http://ori.hhs.gov/education/products/ucla/default.htm) by Stanley Korenman


- 'Guidelines for Responsible Data Management in Scientific Research' (http://ori.hhs.gov/education/products/clinicaltools/data.pdf) by Clinical Tools Inc.

- Tufts University's Do's and Don'ts for Keeping Lab Notebooks (http://techtransfer.tufts.edu/?pid=20&c=37) and Do's and Don'ts for e-Lab Notebooks (http://techtransfer.tufts.edu/?pid=21&c=38)

- 'Plagiarism and self-plagiarism: What every author should know' (http://www.biochemia-medica.com/content/plagiarism-and-self-plagiarism-what-every-author-should-know) by Miguel Roig

- 'What's in a picture? The temptation of image manipulation' (http://www.ncbi.nlm.nih.gov.gate1.inist.fr/pmc/articles/PMC2172141/?tool=pubmed) by Journal of Cell Biology editors Mike Rossner and Kenneth Yamada

- 'Stop Misbehaving' (http://www.jci.org/articles/view/28824/version/1) by Ushma Neill, executive editor of The Journal of Clinical Investigation

Photo: (top) John Haslam (http://www.flickr.com/people/foxypar4/) on Flickr (Creative Commons License)

Elisabeth Pain is contributing editor for South Europe.

10.1126/science.caredit.a1000111