

Digital Image Ethics: Guidelines and Best Practices

Douglas W. Cromey, M.S., Assistant Scientific Investigator
Dept. Cellular & Molecular Medicine, University of Arizona, Tucson, AZ 85724-5044
Voice: 520-626-2824 Email: Cromey@arizona.edu

The instructions to authors in professional journals like Nature and the Journal of Cell Biology are now detailing exactly what can and cannot be done with digital images that are submitted as figures. At the other extreme there are many journals that still say very little about what should or shouldn't be done with digital images. Which one is right, and what's all the fuss about?

The scientific press has reported a number of cases of digital image fraud in the last 10-15 years. In some instances very prominent scientists have had their reputations put in jeopardy because they, a coworker, or a coauthor, stepped "over the line" and committed fraud. Journal editors have also expressed a growing uneasiness that while, in the past, it was difficult to manipulate film images, it has now become almost too easy to manipulate digital images in programs like Adobe Photoshop.

Rules and guidelines are useful so that everyone understands exactly what constitutes inappropriate behavior. Unfortunately the creators of the "rules" often don't explain why the rules are scientifically important. The goal of this presentation is to introduce the guidelines that I have been developing over the last 10+ years and try to explain at least some of the "why". We don't have to agree on every point, but if I've started you thinking about what is appropriate and what isn't, then I think I've accomplished something valuable.

Lessons learned from Photojournalism and Historians (*example images*)^{A,B}

Manipulated images lead to an inaccurate historical record. The historical records in science are lab books, electronic data archives, and journal articles. If these are misleading, scientists could use the altered image information found in these sources to guide the direction of their research, possibly embarking on fruitless studies, wasting time and money. What is our responsibility to our coworkers and professional colleagues?

The failure, intentional or not, to capture a representative sampling of images of the subject being studied could lead others to misinterpret the data. Selectively presenting images that only tell one side of "the story" may be an engrained part of politics, but the expectation for scientists is that we will be unbiased and truthful. If we only show other people the pictures we want them to see, then the viewers will most likely reach the interpretation that we want them to have. What if our interpretation is wrong? It may be a poorly kept secret that most published images are somewhat less than "representative", but is this right? What would happen to the quality of science if we only showed our most compelling images to our project leaders, lab group, or collaborators?

"Artistic" changes to an image can unintentionally alter the factual content and/or a viewer's interpretation of the image. We need to be very cautious about manipulating an image so that it will better convey the message that we want to present. How should we make clear to readers that the manipulations performed on digital images are appropriate and scientific?

Photo-illustrations that "look" real are misleading. The public "rolls their eyes" at manipulated images in tabloid newspapers and celebrity magazines, but they have higher expectations for scientists. Are composite images with disclaimers appropriate in science?

Should scientists have a code of ethics for their digital image data? What responsibilities do principal investigators have to discuss these issues with their students and staff?

Ethical guidelines for the appropriate use and manipulation of scientific digital images^{C, D, E, F}

1. Scientific digital images are data that can be compromised by inappropriate manipulations.
2. Manipulation of digital images should only be performed on a copy of the unprocessed image data file (Always keep the original data file safe and unchanged!).
3. Simple adjustments to the entire image are usually acceptable.
4. Cropping an image is usually acceptable.
5. Digital images that will be compared to one another should be acquired under identical conditions, and any post-acquisition image processing should also be identical.
6. Manipulations that are specific to one area of an image and are not performed on other areas are questionable.
7. Use of software filters to improve image quality is usually not recommended for biological images.
8. Cloning or copying objects into a digital image, from other parts of the same image or from a different image, is very questionable.
9. Intensity measurements should be performed on uniformly processed image data, and the data should be calibrated to a known standard.
10. Avoid the use of lossy compression.
11. Magnification and resolution are important.
12. Be careful when changing the size (in pixels) of a digital image.

Bonus: Beware of “self-plagiarism”

Resources & references

Introduction to the Responsible Conduct of Research, Nicholas H. Steneck, with illustrations by David

Zinn, HHS Office of Research Integrity, http://ori.hhs.gov/publications/ori_intro_text.shtml

HHS Office of Research Integrity - Forensic Droplets (J. Krueger) - <http://ori.hhs.gov/droplets>

Science Image Integrity - <http://scienceimageintegrity.org/>

Emory University, Office of Research Compliance - <http://www.orc.emory.edu/>

Assoc. VP for Research and Director, ORC – Kris West, JD, MS

Policy on Research Misconduct - <http://policies.emory.edu/7.8>

IRB (Human Subjects) – <http://www.irb.emory.edu/>

IACUC (Animal Care & Use) – <http://www.iacuc.emory.edu/>

TRUST Line – 1-888-550-8850

^A Pictures that Lie, C|Net, <http://www.news.com/2300-1026-6033210.html>

^B Photo Tampering throughout History, Fourandsix Technologies, <http://www.fourandsix.com/photo-tampering-history/>

^C Digital Imaging: Ethics, (online 2001-2012), D. W. Cromey, http://swehsc.pharmacy.arizona.edu/exppath/micro/digimage_ethics.html

^D Online Learning Tool for Research Integrity in Image Processing (2008), S.H. Vollmer (with D.W. Cromey, contributing author), University of Alabama – Birmingham, <http://www.uab.edu/researchintegrityandimages>

^E Avoiding Twisted Pixels: Ethical guidelines for the appropriate use and manipulation of scientific digital images (2010) Cromey, D.W., *Journal of Science & Engineering Ethics* 16:639–667. DOI: 10.1007/s11948-010-9201-y

^F Digital Images are Data – and should be treated as such: Image ethics in science (2012) D. W. Cromey, in *Cell Imaging Techniques: Methods and Protocols*, 2nd Edition. Taajedes and Roth, eds. Humana Press (Forthcoming)