

Image Ethics: To Adjust or Not to Adjust

Norris D. Flagler¹, Eli Ney¹, Beth W. Mahler² and Robert R. Maronpot¹

¹Laboratory of Experimental Pathology, National Institute of Environmental Health Sciences, Research Triangle Park, North Carolina 27709, and ²Experimental Pathology Laboratories Inc., Research Triangle Park, North Carolina 27709

Abstract

With the widespread access to and availability of digital imaging equipment and image manipulation software, it is relatively easy to alter images that document scientific findings. With a focus on photomicrographs, we will examine the ethics of digital image manipulations. Some changes, including cropping or intensity adjustments to the entire image, are usually acceptable. However use of software "filters", color adjustments, interpolation and cloning are generally inappropriate and/or unethical. Generic guidelines for acceptable image adjustments and suggested documentation for these photomicrographs will be presented.

Guidelines

There are two logical places in a submitted manuscript where the author should consider documenting the methods and types of adjustments to photomicrographs to be used in a scientific publication. In the *first* instance, the image adjustment program used (e.g., Adobe Photoshop®, CorelDRAW®, Microsoft® Digital Image Suite and Image Composer) and the basic types of image adjustments should be clearly stated in the *Material and Methods* section, perhaps even using a subsection specifically for that purpose. The *second* place where it is appropriate to indicate image adjustments used is in the legend of the specific photomicrograph or figure.

A typical statement in the *Material and Methods* section might be:

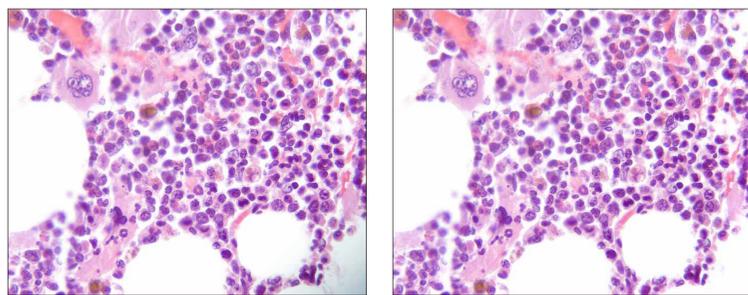
"Copies of some original photomicrographs were cropped, globally adjusted for white balance and color saturation to match the original stained histologic slide, and globally sharpened using Adobe Photoshop®."

If that is all that was done, no further statement should be necessary.

To be absolutely certain that image adjustments do not conflict with journal policy, it is recommended that the authors *indicate to the Editor* in the cover letter accompanying manuscript submission that images were adjusted as defined in the *Materials and Methods* and that original unadjusted images are available for comparison. This underscores the importance of always retaining the originally captured image and making any adjustments on a copy of the original.

To Remove Or Not To Remove Background Shading

The original photomicrograph of a mouse bone marrow smear had an area of shading in one corner. This was removed using the dodge tool in Adobe Photoshop®. The dodging was restricted to highlights and, therefore, little if any change occurred in the actual tissue.



ETHICAL: provided a statement is made in the figure legend

Legend Example: Bone marrow smear from a normal B6C3F1 mouse showing a variety of hematopoietic cells. Background shading in one corner was dodged out without affecting the hematopoietic cells using Adobe Photoshop®.

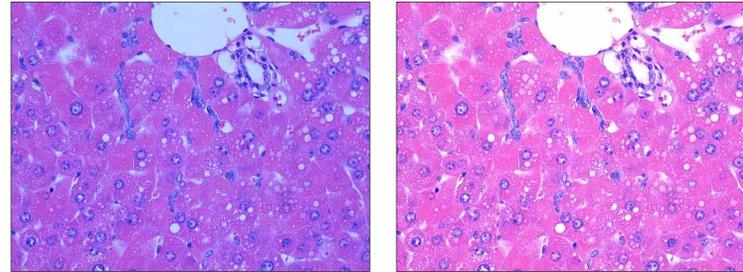
Additional Resource Material

Digital Imaging: Ethics (2001, revised 2005) D. Cromey, SWEHSC Cellular Imaging Core newsletter.

The Ethics of Digital Manipulation in Scientific Images (2000) J. Hayden, JBC 27-1: 11-19.

To Balance Or Not To Balance

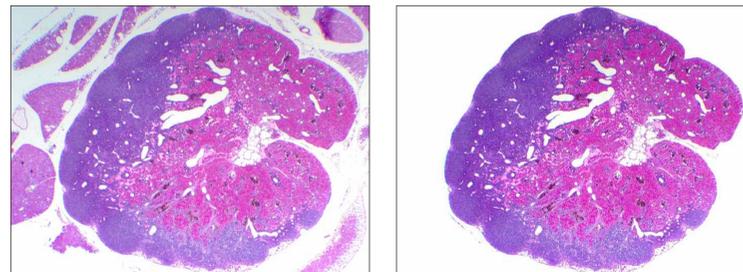
The degree of bluish background in the original photomicrograph suggests that the pathologist should adjust the lighting on the microscope before capturing the image. Using Adobe Photoshop®, a global adjustment of white balance was applied. Global adjustment of white balance is considered ethical.



ETHICAL

To Erase Or Not To Erase

Using Adobe Photoshop®, the entire background including uneven illumination and brown fat has been erased.

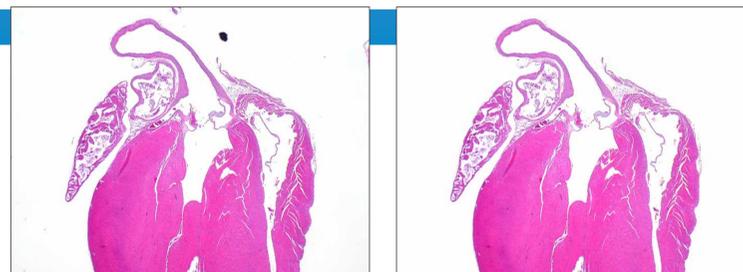


UNETHICAL

While this change has not been applied to the point of interest in the image (i.e. the lymph node), the large degree of background alteration is considered unethical, even with a statement in the figure legend explaining what was done. This would not be an appropriate adjustment were this image to be submitted to the journal.

To Crop/Clean Or Not To Crop/Clean

The original photomicrograph has tissue fragments in the background that can easily be removed by cropping except for the black spot that is near the tissue. After cropping, the black spot was erased using Adobe Photoshop®. Since this was done on the background to remove a distracting artifact, it is considered ethical if a statement indicating what was done is in the figure legend. The alternative is to clean the slide and retake the photomicrograph.

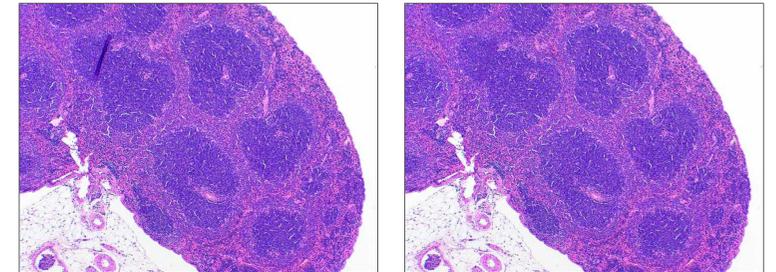


ETHICAL: provided there is an explanation in the legend

Legend Example: This low power photomicrograph is from a control mouse in the present study. A large dust particle in the background was removed using Adobe Photoshop®.

To Clone Or Not To Clone - 1

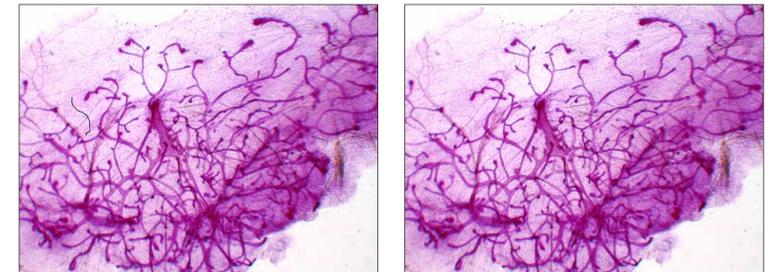
The tissue fold in the white pulp area was removed using the cloning tool in Adobe Photoshop®. This type of alteration of the actual tissue image is **UNETHICAL**. There are three alternatives: 1) live with it since it isn't too bad; 2) crop it out; or 3) resection the block and take a new photomicrograph without the tissue fold.



UNETHICAL: cloning of a tissue fold

To Clone Or Not To Clone - 2

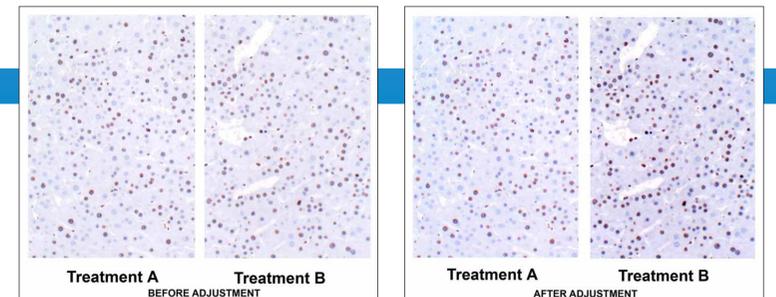
A large dark fiber present in this image of a mammary fat pad has been cloned out (replaced with surrounding parenchyma using the cloning tool in Adobe Photoshop®). This is a localized manipulation rather than a global change, and it involves altering the original tissue structure. This is considered unethical.



UNETHICAL

To Adjust Or Not To Adjust

Before adjustment both treatments were of similar stain intensity. Unequal global image density adjustment between the two treatments makes treatment B look more pronounced than treatment A.



UNETHICAL: unequal image density adjustment