A picture worth a thousand words (of explanation)

While the dust slowly settles over a staggering case of scientific fraud, a bitter aftertaste lingers with scientists and editors alike—that of having been deceived by grossly manufactured evidence. It is clear that fraud is a shameful exception, but this climate may be conducive to a little reflection on some less extreme practices of figure manipulation, which—if seemingly more innocuous—are largely more common. With current processing software, a few clicks of the mouse make possible a spectrum of image manipulations, from innocent embellishment to scientific misconduct. *Nature* journals have prepared new guidelines in an attempt to clarify boundaries of acceptability in preparing images for publication (http://www.nature.com/nmeth/about/ed_policies/index.html).

We do believe that in the vast majority of cases intentions are good: authors seek to present data more clearly. But good intent does not make all practices acceptable, and the few numbers available to quantify the unacceptable are surprisingly high.

Particularly informative are the statistics gathered by the *Journal of Cell Biology*, which for almost 4 years has been applying a systematic search for image manipulation in its accepted papers before publication (*The Scientist* **20**, 24; 2006). This scrutiny led to 1% of accepted papers to be revoked on the grounds that image manipulation affected the interpretation of data. Surprisingly, 25% of accepted manuscripts contained at least one inappropriately manipulated figure for which a satisfactory replacement could be obtained from the authors upon further investigation. These rates have not declined since the policy was implemented. Such numbers together with anecdotal evidence suggest that a large proportion of authors are not aware of what does and does not constitute inappropriate image manipulation.

The new *Nature* journal guidelines are an attempt to clarify these limits. Their principle is that no modification can be made that selectively affects only a portion of the image, removes information or adds information obtained in a different experiment. Even without affecting the paper's conclusion, such modifications may have consequences. For example, hiking up the contrast of a western blot image to decrease the appearance of background will provide the community with a false idea of the antibody quality. Moreover, some observations that do not appear to make sense in the context of the current body of knowledge may turn out to be logical once the biology of the system is understood. Removing such peripheral information from images today will lead to contradictions tomorrow.

Thanks to electronic submission and publication processes, much more information may be presented to editors, reviewers and ultimately readers. When modifications are unavoidable, authors should provide a clear description of the manipulation in the figure legend and are encouraged to provide original images as supplementary information.

Distortion of data can also occur before the figures are prepared, that is, at the time of image acquisition. This is particularly true for fluorescence microscopy (*Nat. Methods* **2**, 889; 2005). Unless properly trained, many researchers may not fully understand the consequences of adjusting instrument settings. To allow readers to fully comprehend the context of an experiment, we request that the parameters affecting image acquisition be recorded in the paper. Additionally, *Nature Methods* has recently published a special focus issue (http://www.nature.com/nmeth/focus/fluorescence/index.html) with the goal of providing a reference of best practices for new users of fluorescence microscopy.

Several documented cases of published papers containing manipulated images, whether intentionally deceptive or not, have reflected a disconnect between the people who acquire the results and those who report them (*Nature* **434**, 952; 2005). When even a single person distorts evidence unbeknownst to their coauthors, the reputation of honest, unsuspecting scientists is at stake. To avoid such damaging situations, corresponding authors need to acknowledge their responsibility to be accountable for the scientific veracity of the work.

From now on, *Nature Methods* will also be requesting, upon conditional acceptance of a paper, a statement by the corresponding author assuring that the figures provided for publication accurately represent the original data in agreement with our guidelines. This will be viewed as bureaucratic nonsense by some, but nevertheless, we hope it will promote a dialog within research groups and improve awareness of the acceptable limits of image modification.

We encourage you to read these guidelines, discuss them with your peers and perhaps reconsider some practices that you have been applying without contemplating their consequences. We hope that this is a solid step forward in dismantling the myth that more-than-perfect images are needed to gain the approval of reviewers and editors.