

When the Image Is the Evidence, Verify It

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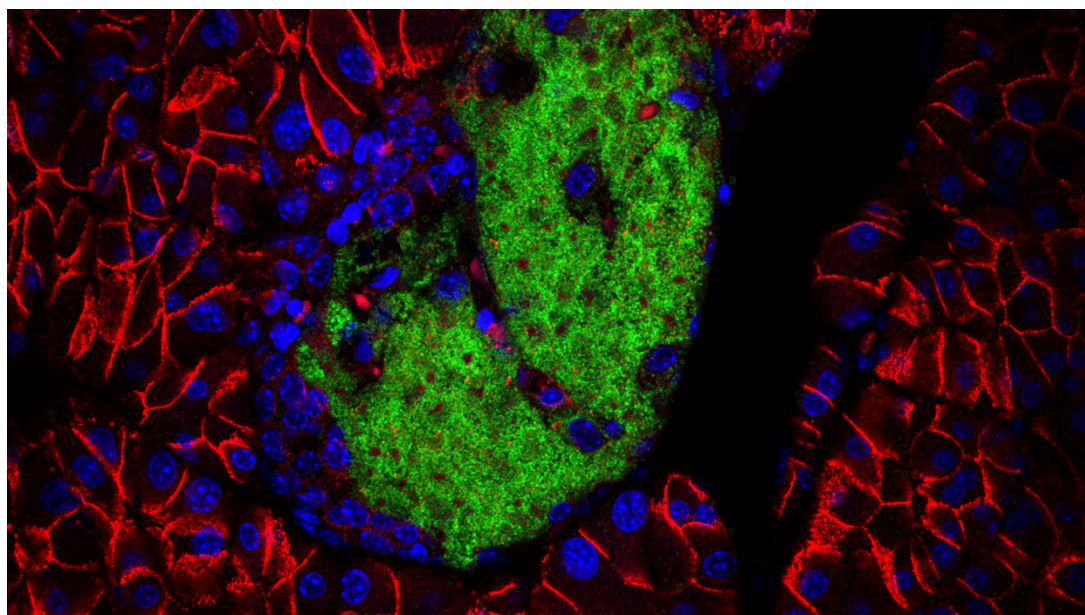
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Graphical Abstract



A fluorescence micrograph of pancreatic tissue. In much of biology, an image like this is not an illustration of the evidence. It is the evidence.

Keywords: image integrity; research integrity; image duplication; scientific publishing; automated image screening; peer review; publication ethics; western blot

Purpose, Rationale, and Limitations

This Technical Note introduces Prooffig AI, a tool designed to identify image-related errors, duplications, and possible manipulations in research figures. It supports everyone involved in preparing, reviewing, and publishing manuscripts, including co-authors, principal investigators, and editors.

Introduction

When a figure carries the proof and the unaided eye cannot confirm it, verifying it is a control you run before publication, not a correction you make after. In many scientific disciplines, the figure serves as the core of the argument. Whether confirming an effect, verifying a material's behavior, or validating a treatment's efficacy, the evidence often depends on what can be observed in the figure rather than

solely on textual claims. In fields like cell biology, materials science, and clinical research, images—micrographs, gels, blots, scans, or data plots—often serve as the primary evidence. Therefore, when the proof is presented through a figure, it must be trustworthy and clear.

Discussion

An image is data

When an image is the proof, the unaided eye alone often cannot confirm it because of the large number of unknown patterns; you must verify it before publication, not try to correct it afterward. An image is data encoded in a particular way, and a figure is a claim built from that data. If a value in a table looks wrong, we recheck the calculation. Why hold a figure to a lower standard of verification than a number?

Confirming that the panels in a figure are what we believe them to be, that nothing has been duplicated by accident, and that processing has not crossed from clarification into misrepresentation are part of doing the work well.

The difficulty is that the human eye cannot make this comparison (Fig. 1). We cannot hold hundreds of images in working memory and compare them in pairs. We cannot reliably notice that a region of one image recurs, altered,

in another (Fig. 2). Many scientific images give the eye little to hold onto in the first place: a microscopy field, a gel lane, or a set of similar features can look much like the next, with few distinctive landmarks for a reader to focus on. The very qualities that make an image good evidence are often the same qualities that make a problem with it hard to catch with the eye alone.

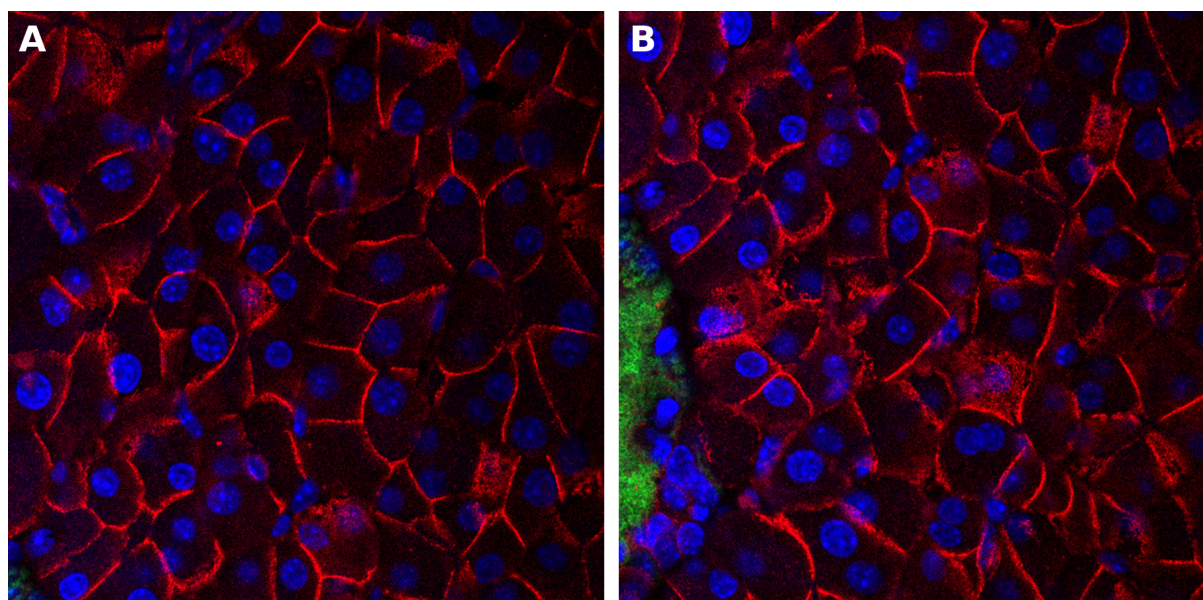


Figure 1. Can you spot the duplication? Two fluorescence micrographs of pancreatic tissue are shown as apparently different fields. A partially overlapping region is present in both panels, creating an inappropriate duplication that is difficult to detect by visual inspection alone. See if you can identify it before checking the answer in Figure 3.

Errors are more frequent than cheats

Deliberate manipulation exists and does real harm. But in any field that produces this much imagery and involves this much handling, most figure problems are not the work of anyone trying to deceive. Among the journals where one image-integrity analyst screened manuscripts at the point of acceptance, 20-35% of manuscripts were flagged for image-related problems¹. That is not a rare failure at the fringe of the literature. It is the ordinary friction of doing image-heavy science on a deadline.

Scrutiny should not be read as an accusation because a manuscript is rarely the work of a single researcher. Figures pass among collaborators, students, and co-authors across laboratories and institutions, and a problem can enter at any point along the way: a panel duplicated by accident, an image mislabeled in a shared folder, a figure processed beyond the point of honest enhancement, or, on occasion, something deliberate introduced by someone other

than the corresponding author. Even the most thorough researcher cannot personally vouch for every image in a paper with many names. An integrity check is not a statement of distrust. It protects the people whose names are on the work.

Treating every flagged figure as a moral failing is unfair. Some of the earliest careful guidance on image handling in the life sciences began with a more useful premise: that authors needed clear rules for acceptable processing because the line between honest enhancement and misrepresentation is not always obvious to a busy researcher.² Two decades later, that premise still holds. Most people do not need to be policed. They need help spotting what they cannot see.

A second set of eyes

This is the kind of comparison that software handles well, and people handle poorly,³ which is why automated image screening has moved over the past decade from a curiosity to a

planned step in editorial review at a growing number of journals. The point of such screening is not to catch villains.

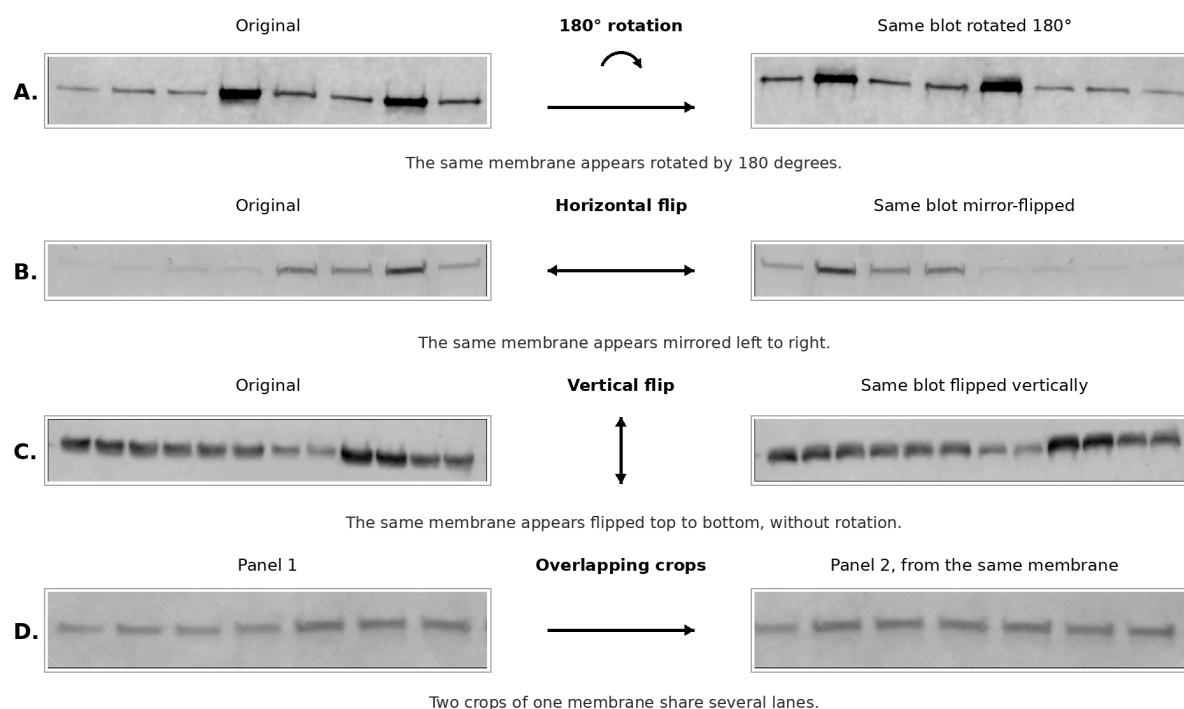


Figure 2. Four ways one western blot can enter a manuscript twice without anyone intending it: rotated 180 degrees, mirrored left to right, flipped top to bottom, or cropped twice so that the two crops share lanes. In every pair, the two panels are the same membrane. None of these changes the underlying data, which is what makes them easy to introduce and hard to notice.

It is to give authors and editors a second set of eyes on a type of error the human eye largely cannot detect. Automated tools can flag that two regions are suspiciously alike. They can surface a probable duplication, a likely manipulation, or a sign that an image was generated rather than captured. What they cannot do is tell you why. They cannot read intent, and they

should not pretend to. A flag is the start of a conversation, not a verdict. The judgment about whether a similarity is a copy-and-paste error, a defensible reuse, or something worse belongs to the people who understand the samples and the instruments. The right model is not a lie detector. It is a smoke alarm that sounds before anyone has decided whether there is a fire (Fig. 3).

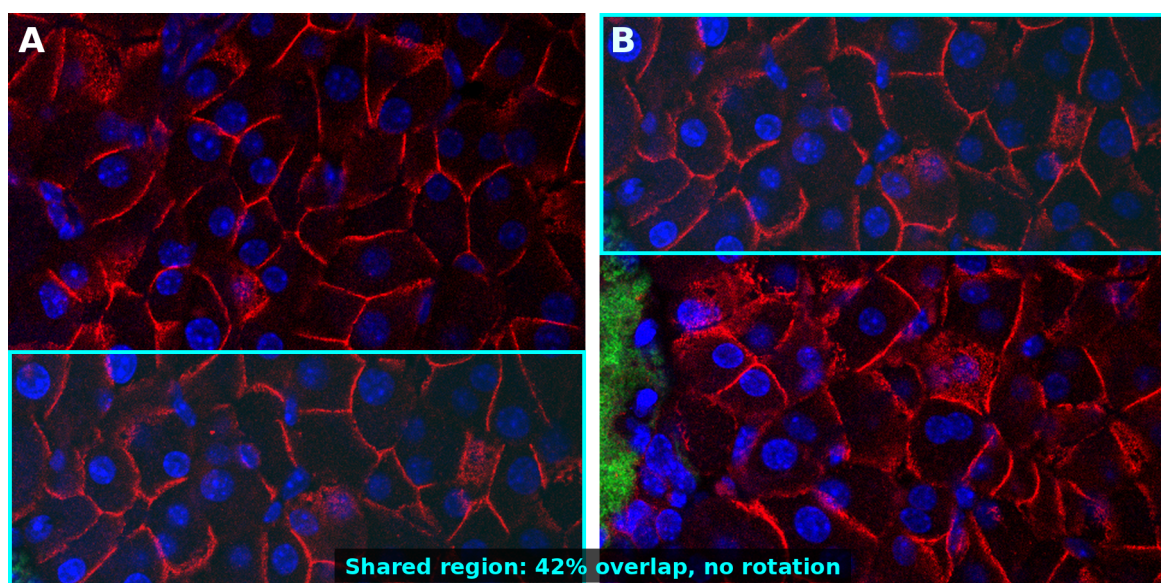


Figure 3. The answer to Figure 1. The overlapping region is outlined in both panels. The two panels are overlapping crops of a single micrograph, equivalent to the overlapping fields a microscope captures when imaging a single specimen. No pixels were altered. Reusing a single source field across two panels is a common cause of unintentional duplication, and an overlap in featureless tissue is among the hardest to detect by visual inspection.

The stakes rise downstream

As a finding moves from an early result toward application, the chain of evidence it rests on gets longer. An image in one paper becomes a citation in a review, which becomes an assumption in a grant, which becomes a premise in the next study or a trial design and may lead to a clinical trial in human patients. An error at the foundation does not stay at the foundation.

When industry groups set out to reproduce influential preclinical studies, they validated roughly a quarter in one analysis and roughly one in ten in another^{4,5}. A large independent

replication effort a decade later reached a similar conclusion, finding that the results of high-impact preclinical studies were often weaker than or inconsistent with the originals⁶. Figure problems are not the cause of that gap, and these studies did not set out to measure them. But they are among its avoidable contributors, and they are the contributors most amenable to a systematic check before publication rather than a painful correction afterward. The cost of a flawed figure is seldom the retraction that lands years later. It is all the research quietly built on it in the meantime.

Conclusion

The figures we publish now are the foundation on which later work will stand. Because the eye alone cannot vouch for them, the choice is a simple one: make verification a habit rather than a reaction, beginning with the next manuscript. Researchers who wish to screen their figures before submission can learn more at <https://proofig.com>.

Conflicts of Interest: The author is co-founder and CEO of a company that provides image-integrity screening software. The views expressed are his own.

AI statement: Claude was used for research support and editing, including support for the selection of sources/citations. Every reference was then checked against the primary source before submission.

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