Analysis Procedures for Detecting Falsification, Fabrication, and Plagiarism in Research Images

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Step 1
The respondent's computer is forensically imaged.

Step 2
Data are then identified and organized by figure and panel.

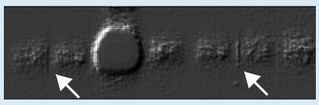
Step 3
Raw image files of western blots, microscopy and histology are identified.

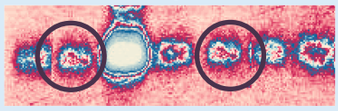
Proprietary imaging and analysis software is used as needed to open and export the files.

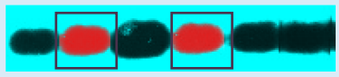
Step 4
Published images are located and saved via direct download from the journal, PDF, or screenshot.

Step 5
Image and experimental methodology is reviewed.

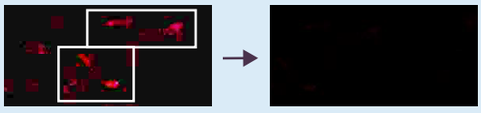
Step 6
After data have been organized and compiled, the following forensic analysis tools are used to compare raw images to published images to detect innapropriate image manipulations or duplications.

Embossing[1]

Splice lines

Gradient maps[1]

Potentially duplicated bands

Overlays[1]

Potentially duplicated bands

Embossing, gradient maps, and overlays are generated in Photoshop. These tools can detect innapropriate duplications and manipulation techniques like cloning, painting, erasing, or splicing.

Image reproduction[2]

Cells were hidden by photo editing

Metadata review

Date Modified	Date Created
Today, 2:56 PM	Jan 30, 2024, 9:09 AM
Jan 29, 2024, 3:37 PM	Jan 29, 2024, 3:37 PM

Can capture discrepencies in methodology

Review of metadata and image reproduction can help determine if the methodology used in the paper matches the published images or misrepresents data.

AI Generated Images
AI generated images pose a concern to research image integrity. Some of these generated images can be difficult to detect via the forensic procedures outlined above, especially if original raw images are not available. Procedures for detecting AI generated images are currently being tested by forensic groups.

Image Integrity Software for Researchers
Software like Imagetwin and Proofig are based on AI algorithms and can help research groups detect duplications or inappropriate manipulations in their figures. Proofig and Imagetwin can detect duplications and manipulations within a manuscript. Imagetwin additionally checks for plagiarism from a database of more than 51 million images.

Free options like FigCheck and Forensically are less user friendly, but still may be useful resources for researchers.

Image Citations

1. The featured western blot is from Figure 1 panel A of the below paper from the Dana-Farber Cancer Institute. Iwakoshi, N., Lee, AH., Vallabhajosyula, P. et al. Plasma cell differentiation and the unfolded protein response intersect at the transcription factor XBP-1. Nat Immunol 4, 321–329 (2003). https://doi.org/10.1038/ni907
2. The image reproduction example is taken from the Office of Research Integrity. https://ori.hhs.gov/samples

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