Background

With increased awareness of data manipulation in scientific publications, whether sloppy science or outright fraud, and because scientific journals seem to be receiving evermore allegations of falsified data in figures, we decided to follow the example set by several other journals and add a quality control step before accepting papers containing images that are prone to manipulation.

Methods and implementation

As an important step before implementing the project, we invited an expert in image integrity to conduct a seminar for the office staff and editors. Thereafter we set up a procedure (Fig. 1) whereby all papers were screened before final acceptance when they contained gels and blots, microscopic images, or others (e.g., graphs) both in the main part of the paper and supplementary material. Such figures were examined using the forensic tools and routines provided by the ORI\(^1\) and recommended by the experts\(^2\). For our screening, we use Adobe Photoshop version CS6 but have determined that GIMP software is also suitable for investigating such images.

To monitor the process, we created an Excel sheet and from 18 July 2016 to 18 May 2017 recorded data concerning the manuscript, time needed for checking, person who checked the figures, the number and kinds of images checked, percentage of papers with problems, and the ultimate fate of the paper. We also recorded other manuscript-related information for internal office use, such as editor responsible and category of manuscript.

Recording time/image (a) for individual papers by continuous time and (b) for papers checked by month. Training time to achieve a routine is around 3-4 months.

Discussion and perspective

In our project, images needed to be checked in nearly 25% of papers ready for acceptance at our cancer research journal, requiring a time commitment of about 80 h for the initial checking during our study period of ~10 months (Table 1). Of these papers, 35.5% were found to have issues and the authors were contacted (Table 2). After the papers were returned, the images needed to be checked again to determine whether problems were resolved and, if not, returned to the authors. We did not track those times in our project but, clearly, additional hours were needed, possibly even more time than for initial checking.

Ultimately, though, almost all the issues could be resolved, which largely comprised copy-paste errors and/or magnification problems (Fig. 2). Only 3 manuscripts were not accepted: 1 was rejected, 1 was given the opportunity to resubmit, and 1 was withdrawn upon author request. Importantly, too, our authors seemed sincerely grateful for the guidance and quality control. Among the papers checked, problems with images were found in nearly 40% of papers from Asia as compared to roughly 32% and 31% of those from Europe and North America, respectively (Table 1).

In our office, it took 3-4 months to become proficient in checking images (Fig. 3). Our project has been highly worthwhile. We can with a good degree of certainty claim that figures in our papers meet high standards. Though quality control comes at a relatively high cost in terms of both workload and staff resources, it was worth opening Pandora’s box. By keeping up with present technology, we feel we will be better prepared to understand and keep pace with future developments, such as machine learning and artificial intelligence, which will presumably take the issue of image integrity to new levels and pose new challenges in scientific publication.

Table 1. Summary of image integrity checking by geographic region. Results for Europe, Asia and North America are also reported as percentage in the background pie charts.

Table 2. Outcome summary of image integrity recording.

References

1. https://ori.hhs.gov/forensic-tools
3. World map background in Table 2 from Wikipedia (http://en.wikipedia.org/wiki/File:World_map_blank_without_borders.svg)

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