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EDITORIAL

Five Common Pitfalls to Avoid while Composing Scientific Figures

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"I included so much data, and yet my paper got rejected after review." This is a common reaction when one receives a rejection letter from an Editor. In fact, a significant fraction of submitted papers is rejected at *ACS Energy Letters* because of confusing or incomprehensible data presentation or non-scientific representation of figures. Authors can easily avoid such rejections if they take extra care while composing figures. It is not the quantity but rather the quality of data presentation that makes a paper stand out. The graphics included in the manuscript should be essential to the research being reported. Inclusion of excessive, nonessential data in oversized multiple panel figures in the main text simply dilutes the key findings. The question to ask while composing a figure is, "*Can a general reader understand the scientific message emerging from the figure that I just composed?*"

Graphics are a great way to present a large amount of information without having to use a lot of words (Figure 1). A well-composed figure is worth a thousand words.

The brief discussion presented in this Editorial can serve as a reference to avoid common pitfalls while composing figures for your next scientific publication. Figure 2 provides a general outline to follow. For additional details on graphical presentation, please refer to earlier Editorials (see Related Readings 1−5) and the *ACS Guide to Scholarly Communication*.[6] We will now focus here on five common pitfalls in figure presentation in scientific articles.

1. Unreadable Multiple Data Panels in a Single Figure. Inclusion of excessive data panels to pad the experimental results is not an effective strategy. A while ago, an Editorial in *Chemistry of Materials*, by Prof. Jillian Buriak, discussed the need for clarity in figures.[1] Yet, we continue to see an excessive number of data panels included in a single figure, with each panel presenting multiple data sets. The miniature-sized data presentation often not only is difficult to read but also makes it difficult to verify the scientific merit. This practice of a "data dump" is ineffective since it does not impress the reader, reviewer, or Editor. If someone cannot clearly see something, they will eventually stop trying.

Ask yourself two questions: (1) Are the panels included in a single figure closely related in terms of measurements or analysis? (2) Will the data presented in each panel be discussed in greater detail in the article? If you answer "No" to either of these questions, then those extra data panels do not belong in main text and should be moved to the Supporting Information. If the authors focus on key findings with 2−4 panels per figure, the key finding will draw the attention of the reader.

Figure 1. A careful design of the graphics leads to an impactful and succinct way of conveying key information. (Source: GoodIdeas/Shutterstock.com)

See the Editorial, "Figure Size: Please Be Kind to Your Reader" (https://pubs.acs.org/doi/10.1021/acs.chemmater.7b04002).

2. Incorrect Labeling of Panels in Figures. We frequently encounter incorrectly labeled figure panels and their descriptions in the text. The intent to include more panels in a single figure also increases the probability of the wrong labeling of panels. In many instances, the misidentification is revealed during the review process. The burden of accuracy, however, lies on the shoulders of the authors. Note: Wrong labeling can sometimes be difficult to catch and, therefore, can slip through the review process and production check. Such mistakes, when discovered after publication, require a separate correction. A mistake in a published article will forever remain in the published article despite any Addition/Correction being published.

3. Wrong Choices of Graphs and Axis Titles. The author should look at the data before deciding the best way to present them. X-Y and X-Y-Y plots should display a causality between the measured property (Y-axis) and the variable (X-axis). If there is no causality, consider using a bar diagram. The axis units should be evenly divided with tick marks. Alternately, the axis can be marked as broken to accommodate small and larger values.

The axis title should contain the proper scientific variable name followed by the units. Use of symbols in the axis title

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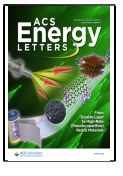

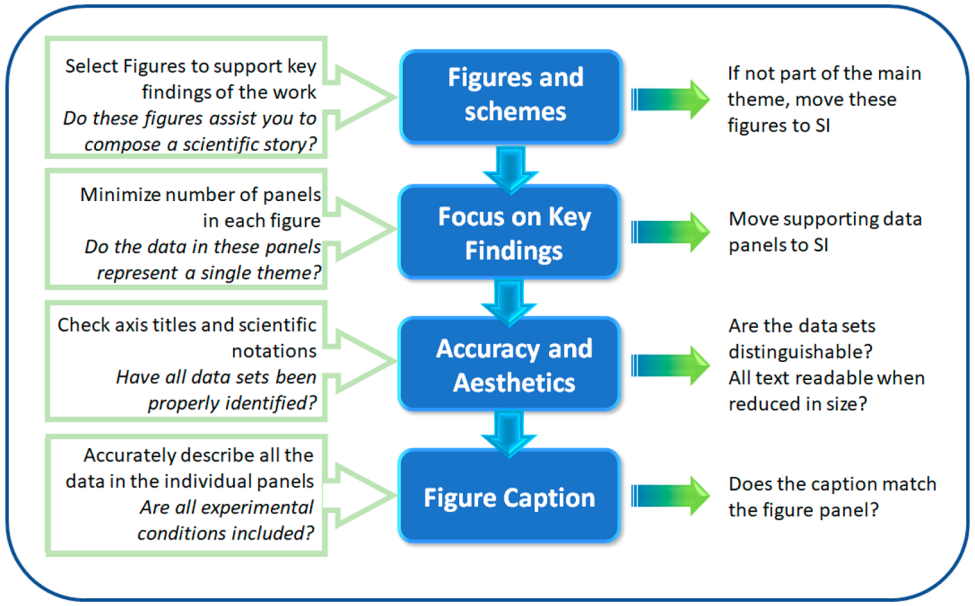

Figure 2. General guidelines to avoid pitfalls and compose effective figures in a scientific publication.

should be avoided to avoid any ambiguity in their meaning. (For example, *A* can stand for amplitude or absorbance.) As discussed in an earlier Editorial,[3] one should exercise care when defining the units on the scale. Note that absolute measurements such as pH and absorbance have no units, so including "a.u." on the axis is incorrect. Measured values, whether they have a unit, no unit, or an arbitrary unit, need to be quantified; i.e., a scale should be included on the corresponding axis. Simply writing "Intensity (a.u.)" on the *y*-axis without a scale is inadequate. Lastly, a measured property not having units (e.g., absorbance), when expressed as a.u., loses its quantitative information.

See the Editorial, "Absolute, Arbitrary, Relative, or Normalized Scale? How to Get the Scale Right" (https://pubs.acs.org/doi/10.1021/acsenergylett.9b01571).

4. Unlabeled Traces. Data plots and lines in the figure need to be identified with a legend or label within the figure. Alternatively, one can use different symbols and a key to identify individual sets of data. Unlabeled data in a figure make it difficult for reviewers and readers to identify. It is not a good practice to identify data plots solely with colors since they are likely to appear differently on different screens and to the eyes of people with color impairedness.

See the Editorial, "Three Simple Ways to Identify Data Sets in a Figure" (https://pubs.acs.org/doi/10.1021/acsenergylett.1c00415).

5. Poorly Composed Captions. The description of data in the figure caption should provide a complete account of the major findings of the experiment/theory being discussed in the text. Hence, care should be taken to identify each data set/panel with detailed information. Inclusion of experimental conditions or parameters used in the calculations will make the figure stand alone. A figure caption with cryptic or short general statements is not going to provide sufficient information for reviewers or readers to assess the data.

See the Editorial, "Ten Tips for Capturing Figures with Captions" (https://pubs.acs.org/doi/10.1021/acsenergylett.9b00253).

This list of five common pitfalls is a simple overview based on our experiences in examining thousands of submitted articles. Before an Editor returns a manuscript for revision, each figure in the manuscript is carefully examined and compared to its caption. The suggested changes/corrections are then forwarded as editorial comments to be addressed during the revision process. We kindly urge our authors to take extra care while preparing their manuscripts and go through the figures and captions carefully before submission.

In closing, one last reminder is to call-out (refer to) all figures and individual panels in the main text and to discuss the presented data in detail. If you have trouble finding a place in your article to discuss a figure, it may be a clue that the information is peripheral to your results and would be better left out or moved to the Supporting Information.

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https://pubs.acs.org/10.1021/acsenergylett.1c02401

Notes

Views expressed in this editorial are those of the authors and not necessarily the views of the ACS.

RELATED READINGS

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(3) Kamat, P. V. Absolute, Arbitrary, Relative, or Normalized Scale? How to Get the Scale Right. *ACS Energy Lett.* **2019**, *4*, 2005−2006.
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(5) Biegel, C. M.; Kamat, P. V. Ten Tips for Capturing Figures with Captions. *ACS Energy Lett.* **2019**, *4*, 637−638.
(6) *ACS Guide to Scholarly Communication*; American Chemical Society, 2020; Part 4.1, Graphics & Multimedia. DOI: 10.1021/acsguide.40101