POINTS OF VIEW

Salience to relevance

In science communication, it is critical that visual information be interpreted efficiently and correctly. The discordance between components of an image that are most noticeable and those that are most relevant or important can compromise the effectiveness of a presentation. This discrepancy can cause viewers to mistakenly pay attention to regions of the image that are not relevant. Ultimately, the misdirected attention can negatively impact comprehension.

Salience is the physical property that sets an object apart from its surroundings. It is particularly important to ensure that salience aligns with relevance in visuals used for slide presentations. In these situations, information transmission needs to be efficient because the audience member is expected to simultaneously listen and read. By highlighting relevant information on a slide, we can direct a viewer's attention to the right information. For example, coloring a row or column of a table will preferentially direct attention to the selected material (**Fig. 1a**). As information presented as tables typically appears homogenous, it is especially helpful to define what is most important. The same approach can be applied to plots and graphs to delineate segments of data (**Fig. 1b**). Whereas these techniques are not appropriate for all journal publications, annotating information presented in slides can be an effective mechanism to enable the audience to better grasp what is being said and shown.

Human vision is highly selective. When multiple stimuli are in a scene they compete for our visual attention. We make sense of the visual field by selecting, in turn, one or few objects for detailed analysis at the expense of all others. Cognitive scientists create 'salience maps' to describe the relative visibility of objects in an image that explain what we might look at first, second and so on[1].

Using the concept of a salience map, we can rely on relative visibility to order content on the page and help us design better graphics. There are several graphical variables—including color, shape, size and position—we can use to create salience (see October 2010 column)[2]. Salience is a relative property that depends on the relationship of one object to other objects on the page. Information that is presented physically larger is usually easier to see and is likely to be read first. In a composition where most of the parts are oriented vertically and horizontally, elements placed at a diagonal stand out. On a backdrop of predominantly black-and-white elements, colored information is highly conspicuous (**Fig. 1**).

a

Color name	RGB (1–255)
Black	0, 0, 0
Orange	230, 159, 0
Sky blue	86, 180, 233
Bluish green	0, 158, 115
Blue	0, 114, 178
Vermillion	213, 94, 0

b

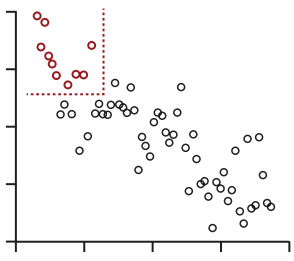

Figure 1 | Matching salience to relevance draws visual attention to important information. (**a**) Table with a row highlighted. (**b**) Segments of data in a plot emphasized with color.

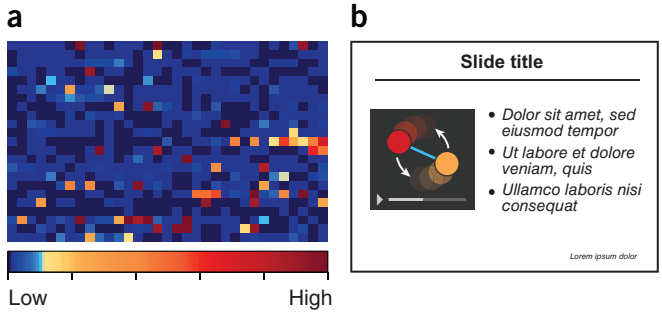

Figure 2 | Discordances between salience and relevance can be harmful. (**a**) The relative visibility of hues in the color scale is asymmetric, making higher values (represented by deep red) less apparent. (**b**) Continuously moving images can be distracting and can compromise the viewer's ability to concentrate on other content.

In contrast, unintentional and inadvertent assignment of salience can be harmful to the communicative potential of images. In the sample heatmap shown in **Figure 2**, the authors chose a color scale that makes common sense, using deep red to represent high values. But in this case lower values are actually more salient than higher ones because deep red is hard to see against the deep blue background of the lowest values.

What stands out is often taken as most important or relevant. In one study, researchers assessed the effects of salience on the ability of test subjects to accurately answer questions that required interpreting weather maps. By alternating the relative visibility of task-relevant and task-irrelevant information (in this case, information about pressure and temperature, respectively) they found that display factors such as salience had large effects on task performance[3]. For example, a question about wind direction was supposed to elicit an answer about air pressure, but when data on temperature were made most apparent, subjects incorrectly responded with a reference to temperature, having been influenced by the salience of the temperature data presented.

In presentations, a potential source of misalignment between salience and relevance is in the use of moving images. Presenters may include short movies (for example, a rotating three-dimensional structure). When these movies are allowed to loop continuously, this powerful competing stimulus makes it nearly impossible to concentrate on other content, as motion is one of the most potent mechanisms for attracting attention. For this reason, animation in PowerPoint slides should be used judiciously. The element being animated should direct our attention to the most relevant content that supports the primary message of the slide. An oscillating arrow will draw more of our attention than the objects it is intended to highlight.

It is well recognized that how the same information is presented can dramatically affect comprehension. Making relevant information visually obvious will ensure that viewers notice the right content. To get a sense of what is most salient on the screen, stand back and squint.

Next month, I will conclude this segment of 'design principles' by discussing the value of 'design' itself.

Bang Wong

1. Fecteau, J. & Munoz, D. *Trends Cogn. Sci.* **10**, 382–390 (2006).
2. Wong, B. *Nat. Methods* **7**, 773 (2010).
3. Hegarty, M. *et al. J. Exp. Psychol. Learn. Mem. Cogn.* **36**, 37–53 (2010).

Bang Wong is the creative director of the Broad Institute of the Massachusetts Institute of Technology & Harvard and an adjunct assistant professor in the Department of Art as Applied to Medicine at The Johns Hopkins University School of Medicine.