Visual Presentations · 3
Why many graphs don't work

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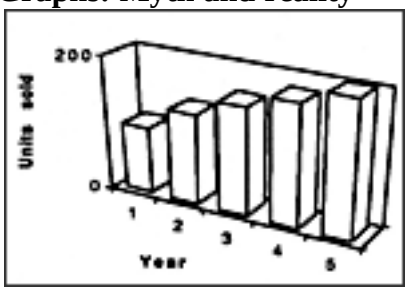
Graphs: Myth and reality



Some of us believe that anything presented in a pictorial format is easy to understand. Not so. The information contained in many graphs is completely obscured by the noise that accompanies it. Look at the graph on the left. This is based on an actual graph that appeared in a Canadian daily financial paper. The graph was supposed to convey *something* very exciting, according to the article that accompanied it. If a picture is worth a thousand words, the graph should convey something. See if you can identify the basic information that the graph is trying to convey.

In my view, this graph fails to communicate effectively. The exciting point that the writer wants to convey is that computer sales have doubled in the past five years. Is it really obvious from the graph? For most people it won't be. To understand why this graph doesn't work the way the writer intended it to, we need to understand the components of graphics.

Components of a graph

Horton* points out that any graph has four components:

1. Message is what you want to convey. If, in the above graph, your message is that computer sales are growing steadily, then that is your message.

2. Redundancy is the reinforcement of the message. For instance, if you are producing a bar chart, you can show losses as red bars and profits as green bars. This is redundancy. It reinforces the message and makes it easy for the reader to understand. In general, redundancy is good.

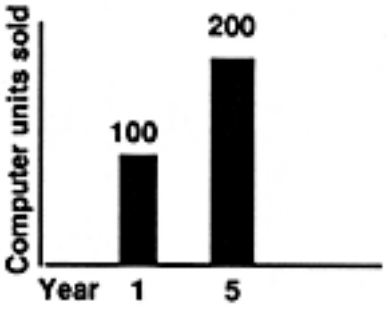
3. Decoration is what you do to a graph to make it look attractive. It has no purpose other than to get the attention of the reader. When we use colour in our graphics (when it is not strictly necessary to convey our message effectively), we are using it for decorative purposes. But when we use colours to mean something (as described in the previous paragraph), we are using it for redundancy.

4. Noise is something that obscures the message you want to convey. Graphs that fulfil the grammar and syntax often fail because of the noise that accompanies the message.

The biggest problem arises when we start producing a graph without first being clear about the point we want the reader to grasp. Because redundancy is the reinforcement of the message, if we are not clear about the message, we cannot use redundancy effectively. A problem can be made much worse when we use the decorative features that many software packages offer. Very often such features can create noise and completely obscure the message. If we start with no clear idea of the message, then we cannot tell if the message is obscured.

Let us now return to the graph above. Why doesn't it work? Because the basic message is drowned out by unnecessary data and irrelevant decorations that obscure the basic message.

Pseudo-3D charts

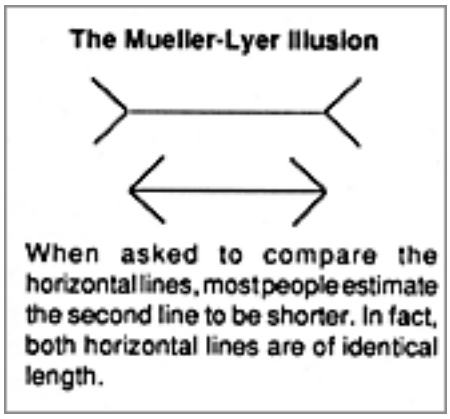


Consider the graph on the left. It re-presents the information contained in the graph on the previous page:

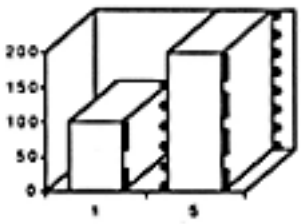
- the pseudo-3D bars are replaced by simple bars;
- unnecessary information (sales in intervening years) is eliminated; and
- numbers are included to add redundancy.

It is very hard to miss the point - that sales have doubled in the past 5 year - in the second graph.

The first problem with the original graph is that although the data is two-dimensional, a pseudo-three-dimensional format is used. This creates a visual illusion and introduces noise.



The use of inappropriate pseudo-three-dimensional charts is so common, it is worth considering them in some detail. The main attraction of these graphs is that they look visually pleasing. However, anybody who is interested in communicating the message will realize that this comes with a hefty price tag-no less than the meaning of the graph itself. Why does this pseudo-three-dimensional chart create so much noise? Pseudo-3D charts are subject to a well-known illusion known as the Mueller-Lyer illusion. Consider the two arrow-head lines on the left. Which centre line is longer? Most people who see these figures for the first time will perceive the first line to be longer, although both lines are of identical length. Although we know that we are supposed to compare only the central line, our brain takes into account the picture as whole (Remember, the eye is NOT a camera; it is not a faithful recorder; it interprets what it sees).

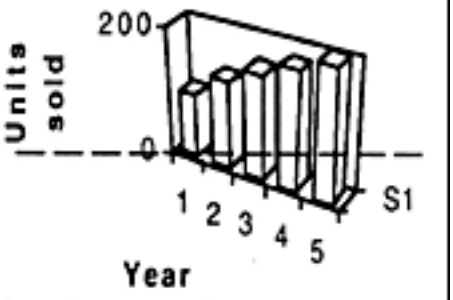


We need to compare the height of the rectangles (indicated by dashed lines). Instead, our eyes compare the total height indicated by the dotted line (as in the Mueller-Lyer illusion). This distorts the relative sizes of the two bars. Compare this to the chart at the top.

In pseudo-3D graphs a constant projection is added to the height of the bar or an extra area is added to some part of a pie chart. These additions, which are there purely for decorative purposes, introduce noise in our charts and obscure the message.

Now we know why the graph we began with fails to convey the writer's message : Computer sales have doubled in the past 5 years. The noise created by the inappropriate graph overwhelms the message. As we discussed, here is why the graph doesn't work:

- Instead of just presenting the two simple bars, the writer presents data for all five years. (Maybe that's how the data were laid out in his/her spreadsheet.) This minimizes the impact of the central message.
- By using a pseudo-3D layout, the impact of difference is further diminished. A pseudo-3D graph add a constant height to all bars. This makes it even more difficult to see the real relationships among the bars.
- The graphic package tries to add further decoration by adding perspective to the chart. If you look at the bottom of the bars, you will note that they are not on a horizontal plane. This means that your eye is trying to compare bars that do not start on the same level. Each year's bar is placed on a lower level than the bar of the preceding year.

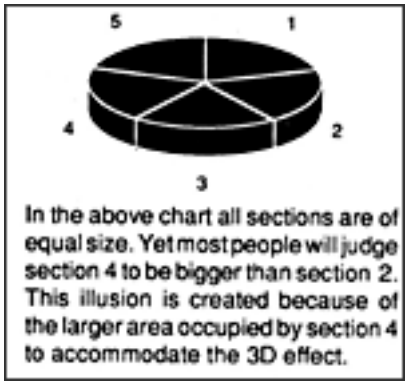


Note that each column starts at a level that is lower than that of the previous column. Since the data are not 3-dimensional, this creates additional problems when we attempt to compare the size of the columns.

If the author was highly conscious of the message he or she was trying to convey, such distortions would have been easily spotted. Compare once again the fancy pseudo-3D chart with the simple bar chart (with numbers added for redundancy). This chart lacks decoration, but it is hard to miss the message of the writer.

Distortions are common whenever pseudo-3D representations are used. The pie chart on the right exaggerates the share of section 4, because of the added area required to represent depth and perspective.

'Geological' (area) charts
Look at the chart on the right. If I were to say that as sales go up, so does total profit, most people would probably agree. Some experienced observers might say that profits have been steady, irrespective of sales. Except that it is not so. In fact, profits have been steadily declining over the years, even in years when sales have gone up. The baseline for profits in this chart is the sales. Because of this, as sales go up or down, it appears that profits are also going up or down in the same way. Let us redraw this as a line chart (see panel on the next page). It is now obvious that profits are steadily going down, irrespective of sales!



In the above chart all sections are of equal size. Yet most people will judge section 4 to be bigger than section 2. This illusion is created because of the larger area occupied by section 4 to accommodate the 3D effect.

This leads us to the first rule of graphic representations:
Always start a graph with a clear idea as to what you want the graph to say. Watch for noise that might obscure your message. Add decorations only when they don't create noise. The main purpose of a graph is to provide effective visual support to your ideas, not to make your report look pretty-especially if this is achieved at the expense of effective communication. Compare once again the area chart and our simple line chart. Which chart clearly conveys to the reader that profits have been steadily declining?

The 'need not to know' distortion
Information that is communicated falls into three categories:

- **Need to know:** Information that must be conveyed.
- **Need not know:** Information that may or may not be conveyed.
- **Need not to know:** Information, if conveyed, will distort the message or confuse the reader.

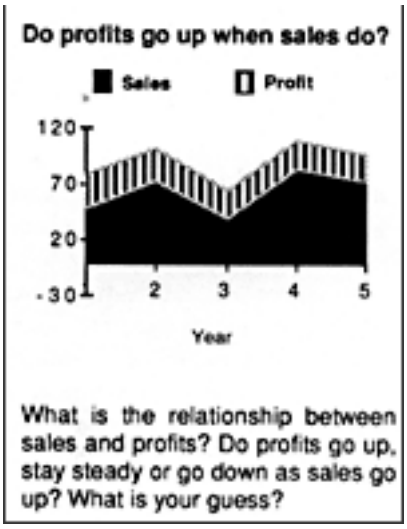
3 types of information

- Need to know
- Need not know
- Need not to know

An effective communicator will not only emphasize 'the need to know' information but will also make sure that no 'need not to know' information is presented.

Four basic ideas

1. If you use a graph, have something definite to say.
2. Make sure to exclude 'need not to know' information.
3. Use numbers.
4. Graphs are good for communicating magnitude, quantitative not qualitative.



What is the relationship between sales and profits? Do profits go up, stay steady or go down as sales go up? What is your guess?

Of these three, 'need not to know' is the least understood type. Most people seem to assume that 'need not know' information is the same as the 'need not to know' information. In the original graph, the author's purpose was to show that computer sales have doubled in 5 years. It was NOT to show how the industry has grown over the intervening period. By presenting the year by year growth information in the graph, the writer sacrificed the core of the message: the sales doubled over the past 5 years. The annual growth information in this case falls into the category 'need not to know'.

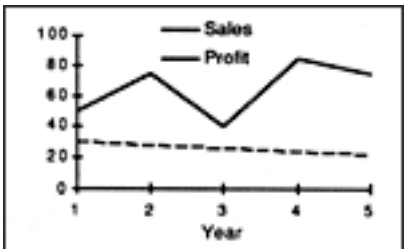
In presenting graphs-as well as in any communication-it is at least as important to pay attention to the information readers 'need not to know' as to the information they 'need to know'.

The second principle of graphic presentation **don't present 'need not to know' information.** Graphs that contain information that the reader does not care about or cannot interpret can only diminish the impact of the main message.

Redundancy can be the message

Very often graphs are presented without numbers accompanying them. The assumption is that it is easy for the reader to understand the graph without the numbers. Research carried out by A. Ehrenberg and myself several years ago has shown that this is an erroneous assumption.

Contrary to the popular belief that people can estimate numbers from charts, people simply cannot estimate areas, lengths etc. from graphs except in a very gross way. If we want to convey numerical information, we need to present numbers in addition to a graphical representation.



This is a line graph of the same data shown in the previous page. Profit has been steadily declining irrespective of sales. This is impossible to detect in the area (geological) chart.

The area chart may look attractive but in this case it hides a very crucial piece of information. It illustrates how charting without thinking about the meaning, can result in gross misinterpretation of data.

The third principle of graphic presentation, then, is i**n most graphs numbers do not just represent redundant information; rather they are essential if the basic message is to be understood.**

Use graphs to convey qualitative ideas

The conventional wisdom seems to be that graphs are good substitutes for numbers. The practice of showing graphs without numbers is widespread. But research that's now available shows that graphs in and of themselves cannot convey quantitative information. Graphs are good at conveying 'A is much is bigger than B' rather than 'A is 75% bigger than B'. The fourth principle of graphic presentation is that **graphs (without numbers) do not convey quantitative information well. Graphs without numbers are good at conveying qualitative information only.**

Dr Chuck Chakrapani is the President of Standard Research Systems Inc. and co-author of Marketing Research: Methods and Canadian Practice.