

Aspects of Design in Computer Graphics: Some Notes

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December 1992

Introduction

It is often thought by the general public that the primary aim of good design is to make things pleasing to the eye. This is a misconception for which designers themselves are partly to blame. By showing pictures of their work and talking endlessly of aesthetics they seem to ask to be judged simply by the appearance of things. Certainly one of the aims of a designer might be to make things pleasant to look at -- but this is a consequence of the process of design rather than its purpose. Indeed it could, and in my view, should be argued that aesthetics has always had a more functional role than that of 'entertainment'.

What, then, *is* the primary purpose of design? It is to give things meaning. Good design enhances our understanding of an artefact. Thus when looking at a designed work we should ask ourselves, 'Do I understand what this artefact means?' rather than, 'Do I like the look of it?' If we take this view of design we can see immediately why we need good design in presentation graphics. By designing our output well we can improve the way it communicates.

Enhancing meaning

Good design, then should provide 'affordance'. This is a useful word coined by the great American experimental psychologist, James J Gibson (1904-79) to indicate the way in which the environment gives out perceptual mechanisms support of 'affordance' for understanding what we see (Gibson 1979). Thus, ground texture -- which, as it recedes into the distance, gets smaller in scale both as a whole and in detail -- is an example of something in nature that provides affordance to our judgment of distance. In contrast, a pull handle fixed to a door that is meant to be pushed does not provide affordance. What the handle appears to say is 'Pull' The action required is 'Push'. Thus, in this instance, a plain unadorned push plate would be better design because it provides more affordance than a pull handle -- however beautiful the handle itself appears to be.

When we design, then, we should try to enhance meaning by affordance. The appearance of our designs should reinforce what they have to say and the skill of good designers lies in their ability to match what artefacts actually say with what they appear to say. (Exceptions to this arise when the aim is to create a mood rather than convey an explicit meaning. When we want to affect and

emotion, we may well want to create a significant tension between appearance and meaning, introducing ambiguity and even confusion in the process. This may take us across the somewhat fuzzy boundaries between design and art.)

Context and affordance

It is essential to remember, though, that the meaning of an artefact does not just lie in the artefact itself. Context plays a vital role in our understanding of what things mean. But two forms of context are significant to designing:

1. what might be called 'explicit context', which is the context of the artefact in relationship to its surroundings and to other artefacts; and
2. what might be called 'implicit context', which is the context of the artefact in relationship to the experience of its beholder.

In many cases the first of these is at least partially within the designer's control. The second rarely is. But if we do not appreciate that some peoples' implicit contexts might differ markedly from our own, we are liable to fail to convey the meaning we intend. In presentation graphics, for example, we often see such misunderstandings occur in the use of colour.

Colour and form Over the years, colours have acquired special meanings in certain circumstances: for example red generally means, 'stop' or 'danger' and, in UK accountancy, is used to indicate negative amounts. Frequently, though, we see computer graphics images where these elementary understandings are ignored and we often see cases where red has been given the opposite meanings, for example, on video control screens and on slides of financial bar charts and numbers. In addition, a high percentage of the male population (about 8%) and a much smaller percentage of females (0.4%), have defective colour vision -- the most frequent problem being an inability to distinguish well between red and green. But we often see information displays where understanding crucially depends on being able to distinguish these colours. Cultural differences in meanings given to colours should also be noted -- although other cultural differences might have more general significance in image understanding.

However certain aspects of colour relationships are not completely dependent on external contexts so that it is possible at least to give some general rules for guidance on the use of colour. For example:

- Unless specially trained or gifted, human beings have poor absolute judgement for colour -- although most of us can distinguish quite minute differences in colours when samples are seen together. We can, in fact, only distinguish about six colours if we have to rely on our memories. Thus, if important information is to be carried by colour, we should either limit the number of colours involved to less than seven or provide a key to meaning that can be seen with the colour bearing information.
- Adjacent patches of colour that have the same brightness or lightness -- even if different hues are involved -- should be avoided as the boundaries between them will not appear sharp (unless the boundaries are edged in contrast). For sharpness generally, contrasting brightness or lightness is essential.

- Partly for the foregoing reason, blue lines on black backgrounds or vice versa and yellow lines on white backgrounds or vice versa do not show up well. Hence these combinations should be avoided.
- White or yellow lines on blue are very clear.
- Neutral grey backgrounds help to set off colours.
- Colours near in hue are restful; complementary colours are more dynamic and, sometimes, harsher.

Another area in which appearance and meaning frequently clash is where extra graphical information is added to, or omitted from, raw data in the mistaken belief that this improves the situation. An example of the former is where essentially two-dimensional information, say number against time, is converted into three dimensions by making one of the elements into a solid (Figure 1).

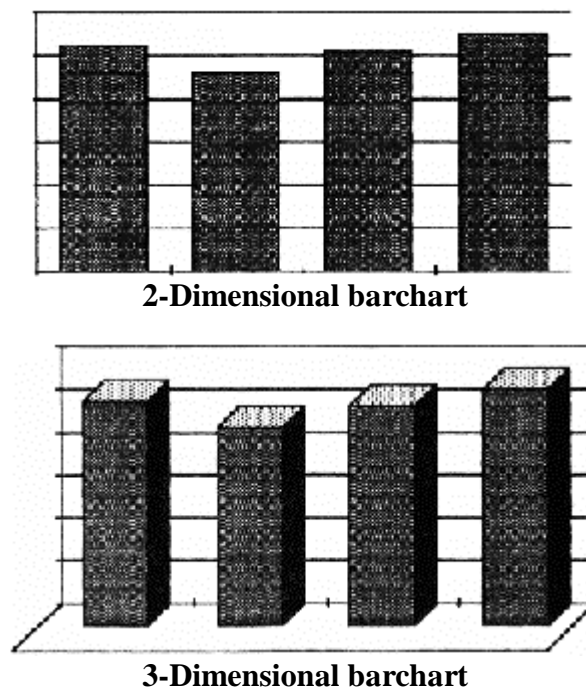


Figure 1

Showing data added but no gain in information -- perhaps even a loss.

An example of the latter is where the zero line is not included in a chart. This has the (possibly intended but nonetheless misleading) effect of exaggerating small differences (Figure 2).

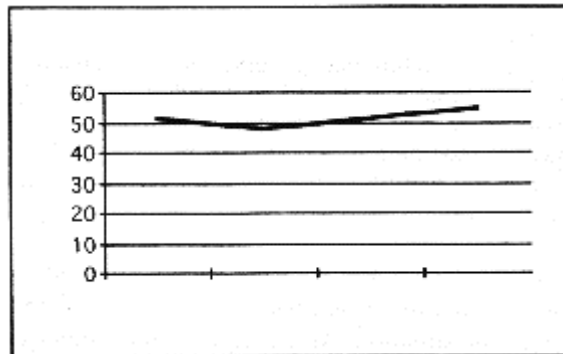


Chart showing zero line: apparently minor differences between values.

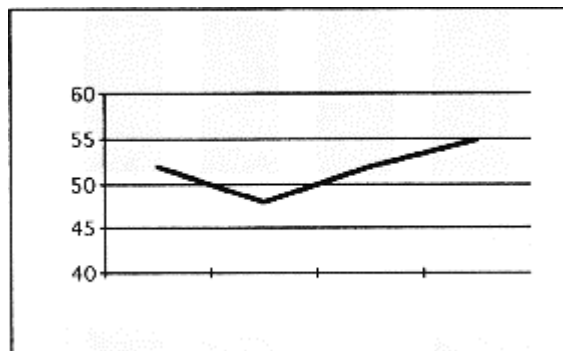


Chart omitting zero line: apparently major differences in values.

Figure 2

Illustrating how omitting data can distort information: The picture would be even further falsified if the dimensions on the left were omitted.

When put as baldly as in Figures 1 and 2 it might be thought that such trivial and obvious design faults would not need to be drawn to anyone's attention. But examples of just these faults abound: on TV, in scientific presentation, in company accounts -- just about anywhere where numbers are felt to need illustrating. Invariably such images distort the underlying data, sometimes disgracefully. Unfortunately, making distorted images like turning 2-D data into 3-D chart is very easy nowadays. Virtually any presentation package will do it at the touch of a button. thus for Figure 1, no more effort was needed to produce the 2-D chart than the 3-D one. Both were automatically generated from the numbers the computer had to hand. Tufte(1983) is very good at identifying such worrying examples of 'chartjunk' and is compulsory reading for all who wish to make images that have some meaning.

We can draw some obvious rules from these examples:

- Never add more dimensions to the presentation than are in the data.
- Never omit anything that is relevant. (This is what Einstein meant when he said that things 'should be as simple as possible but no simpler').
- Only emphasise that which needs to be emphasised.

- That the medium or system will allow something to happen -- or even make it easy for it to happen -- is not sufficient excuse for making it happen.

Concluding remarks

Designing is a skill that has to be learned. It is best learned by practice and by looking at well-designed examples. In the area of information design, a well-designed example is one which conveys its information directly and with minimum ambiguity. It also uses its medium appropriately, that is to say, it tries not use the techniques and methods of some other medium. Hence, say in computer-based wordprocessing, a good example pretends to be neither conventional typesetting nor manual typewriting. For this reason a well-designed wordprocessed document will not use right- and left-hand justification unless the system can properly cope with it (and usually it can't); nor will it use underlining when **boldening** or *italicising* are possible. (Underlining in wordprocessing is almost always unsuccessful. The underline appears to cut through the descenders of letters like y, j, and g and makes reading difficult. Remember that we read more by appreciating the general form of words than by looking carefully at each letter -- this is the reason proof-reading is so difficult. Typographical tricks, like underlining or putting everything in capital, interfere with the general form of words: underlining, by makes it hard to appreciate the pattern of descenders; and capitalising, by reducing all letters and hence words to a rectangular form.) But, by learning and applying a few basic principles, almost anyone can design well. Designing is not a magical process however much professional designers would like us to believe that it might be. The aim of the non-professional designer is not to break new ground but to present information in a coherent and acceptable way. We can do that by remembering that the aim of designing is to make sense of things.

References

Gibson JJ (1979) *The Ecological Approach to Visual Perception*, Houghton Mifflin, New York.
Tufte ER (1983) *The Visual Display of Quantitative Information*, Graphic Press, Cheshire, Conn.