# 10 Composition

Composition concerns making careful decisions about the physical attributes of, and relationships between, every visual property to ensure the optimum readability and meaning of the overall, cohesive project.

Composition is the final layer of your design anatomy, but this should not imply that it is the least important part of your design workflow. Far from it. It is simply that now is the most logical time to think about this, because only at this point will you have established clarity about what content to include in your work. As I explained, this final layer of design thinking, along with colour, is no longer about *what* elements will be included but *how* they will appear. Composition is a critical component of any design discipline. The care and attention afforded in the precision of your composition thinking will continue until the final dot or pixel has been considered.

Visual assets such as your chart(s), interactive controls and annotations all occupy space. In this chapter you will be judging what is the best way to use space in terms of the position, size and shape of every visible property. In many respects these individual dimensions of thought are inseparable and so, similar to the discussion about annotation, the division in thinking is separated between project- and chart-level composition options:

- Project composition: defining the layout and hierarchy of the entire visualisation project.
- Chart composition: defining the shape, size and layout choices for all components within your charts.

## 10.1 Features of Composition: Project Composition

This first aspect of composition design concerns how you might lay out and size all the visual content in your project to establish a meaningful hierarchy and sequence. Content, in this case, means all of your charts, interactive operations and elements of annotation.

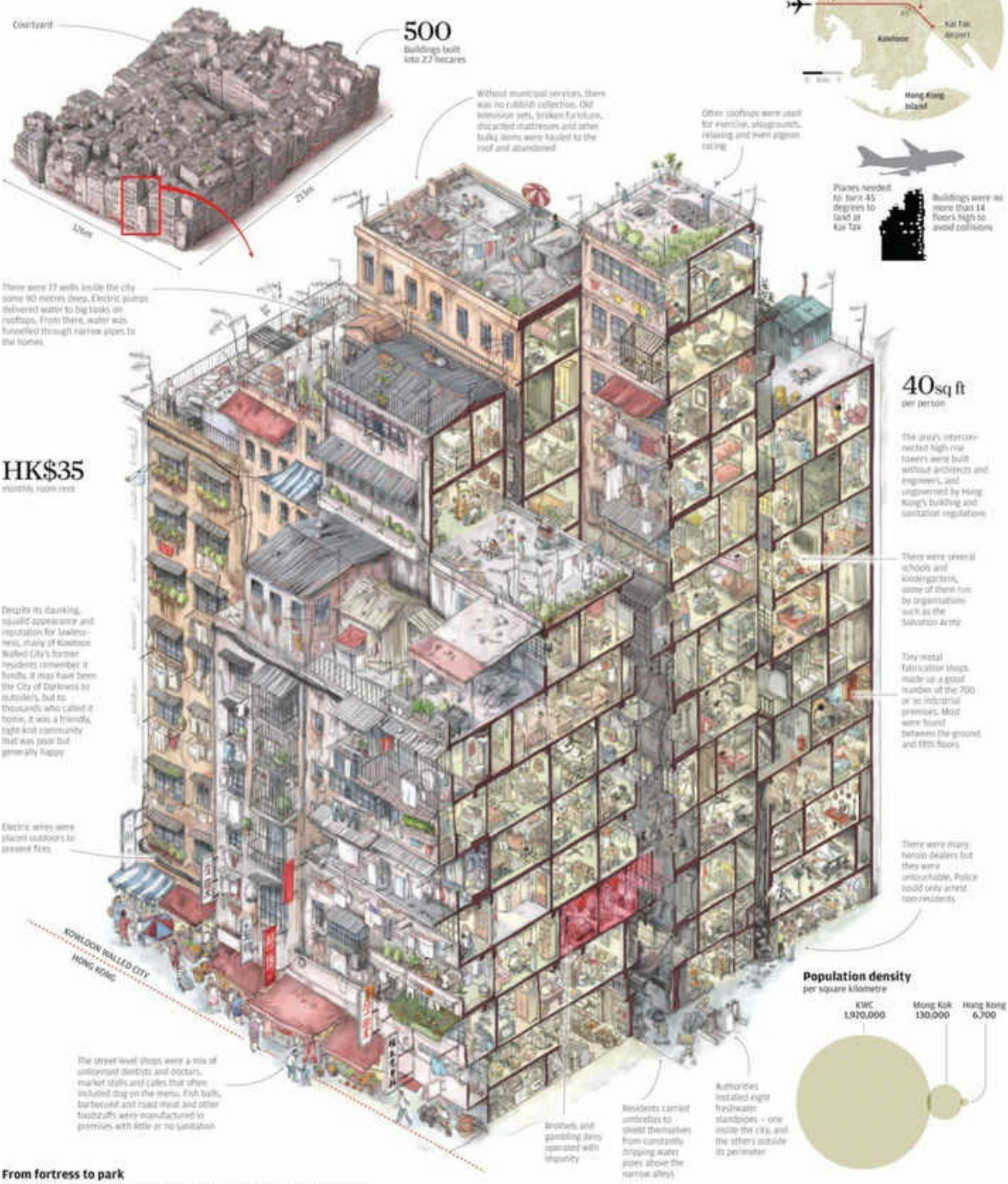
Where will you put all of this, what size will it be and why? How will the hierarchy (across views) and sequencing (within a view) best fit the space you have to work in? How will you convey the relative importance and provide a connected narrative where necessary?

I will shortly run through all the key factors that will influence your decisions, but it is worth emphasising that so much about composition thinking is rooted in common sense and involves a process of iteration towards what *feels* like an optimum layout. Of course, there are certain established conventions, such as the positioning of titles first or at the top (usually left or centrally aligned). Introductions are inevitably useful to offer early, whereas footnotes detailing data sources and credits might be of least importance, relatively speaking. You might choose to show the main features first, exploiting the initial attention afforded by your audience, or you may wish to build up to this, starting off with contextual content before the big 'reveal'.

Figure 10.1 City of Anarchy

# City of anarchy

Kowloon Walled City, located not far from the former Kai Tak Airport, was a remarkable high-rise squatter camp that by the 1980s had 50,000 residents. A historical accident of colonial Hong Kong, it existed in a lawless vacuum until it became an embarrassment for Britain. This month marks the 20th anniversary of its demolition.

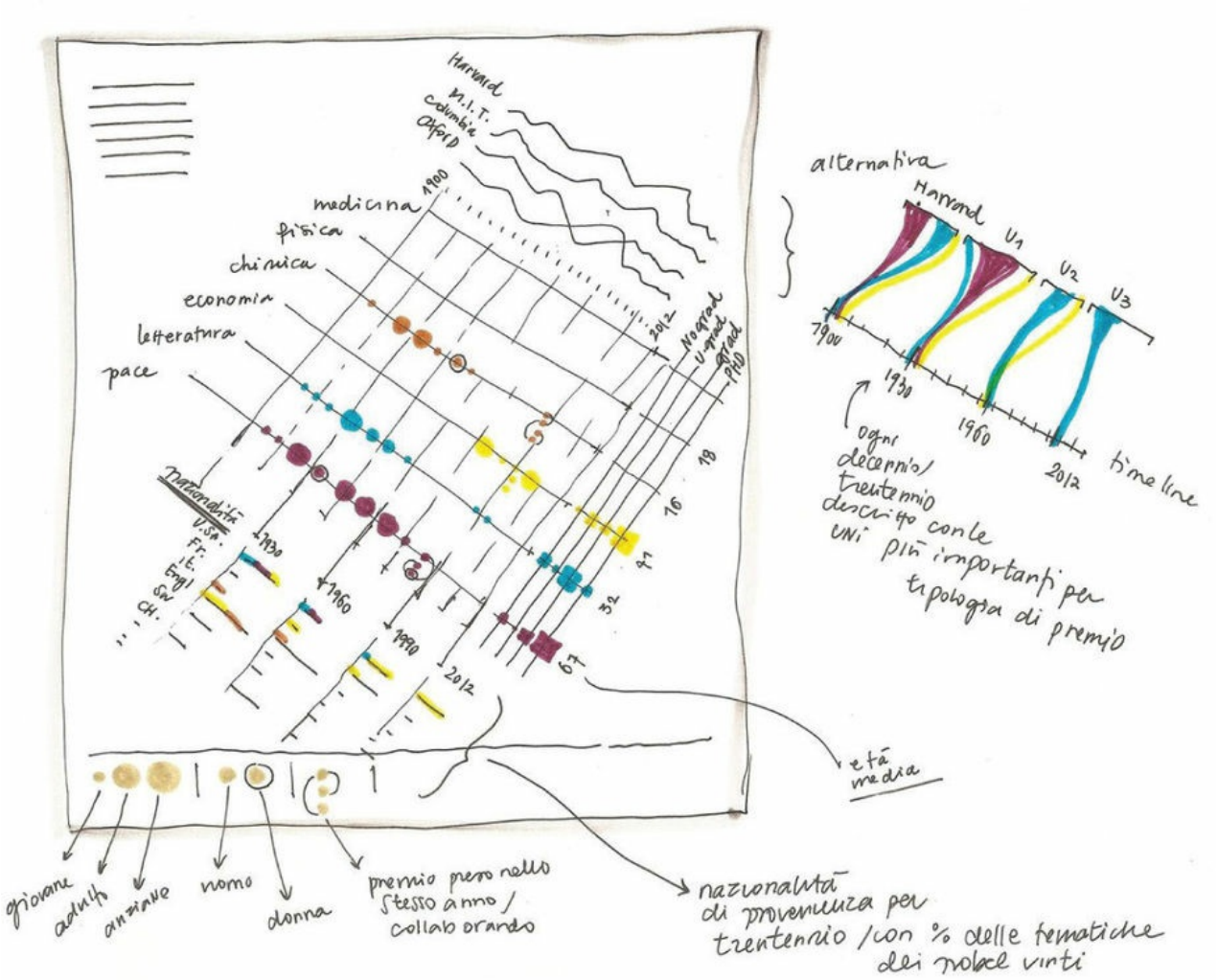


The hierarchy of content is not just a function of relative position through layout design, it can also be achieved through the relative variation in size of the contents. Just as variation in colour implies significance, so too does variation in size: a chart that is larger than another chart will imply that the analysis it is displaying carries greater importance.

The 'City of anarchy' infographic demonstrates a clear visual hierarchy across its design. There is a primary focal point of the main subject 'cutaway' illustration in the centre with a small thumbnail image above it for orientation. At the bottom there are small supplementary illustrations to provide further information. It is clear through their relative placement at the bottom of the page and their more diminutive stature that they are of somewhat incidental import compared with the main detail in the centre.

There are generally two approaches for shaping your ideas about this project-level composition activity, depending on your entry-point perspective: wireframing and storyboarding. I profiled these at the start of this part of the book, but it is worth reinforcing their role now you are focusing on this section of design thinking.

> *Wireframing* involves sketching the potential layout and size of all the major contents of your design thinking across a single-page view. This might be the approach you take when working on an infographic or any digital project where all the interactive functions are contained within a single-screen view rather than navigating users elsewhere. Any interactive controls included would have a description within the wireframe sketch to explain the functions they would trigger.
> Figure 10.2 is an early wireframe drawn by Giorgia Lupi when shaping up her early thoughts about the potential layout of a graphic exploring various characteristics of Nobel prizes and laureates between 1901 and 2012.
>
> Figure 10.2 Wireframe Sketch




*Storyboarding* is something you would undertake *with* wireframing if you have a project that will entail multiple pages or many different views and you want to establish a high-level feel for the overall architecture of content, its navigation and sequencing. This would be an approach relevant for linear outputs like discrete sequences in reports, presentation slides or video graphics, or for non-linear navigation around different pages of a multi-faceted interactive. The individual page views included as cells in this big-picture hierarchy will each merit more detailed wireframing versions to determine how their within-page content will be sized and arranged, and how the navigation between views would operate.

With both wireframing and storyboarding activities all you are working towards, at this stage, are low-fidelity sketched concepts. Whether this sketching is on paper or using a quick layout tool does not matter; it just needs to capture with moderate precision the essence of your early thinking about the spatial consequence of bringing all your design choices together. Gradually, through further iteration, the precision and finality of your solution will emerge.

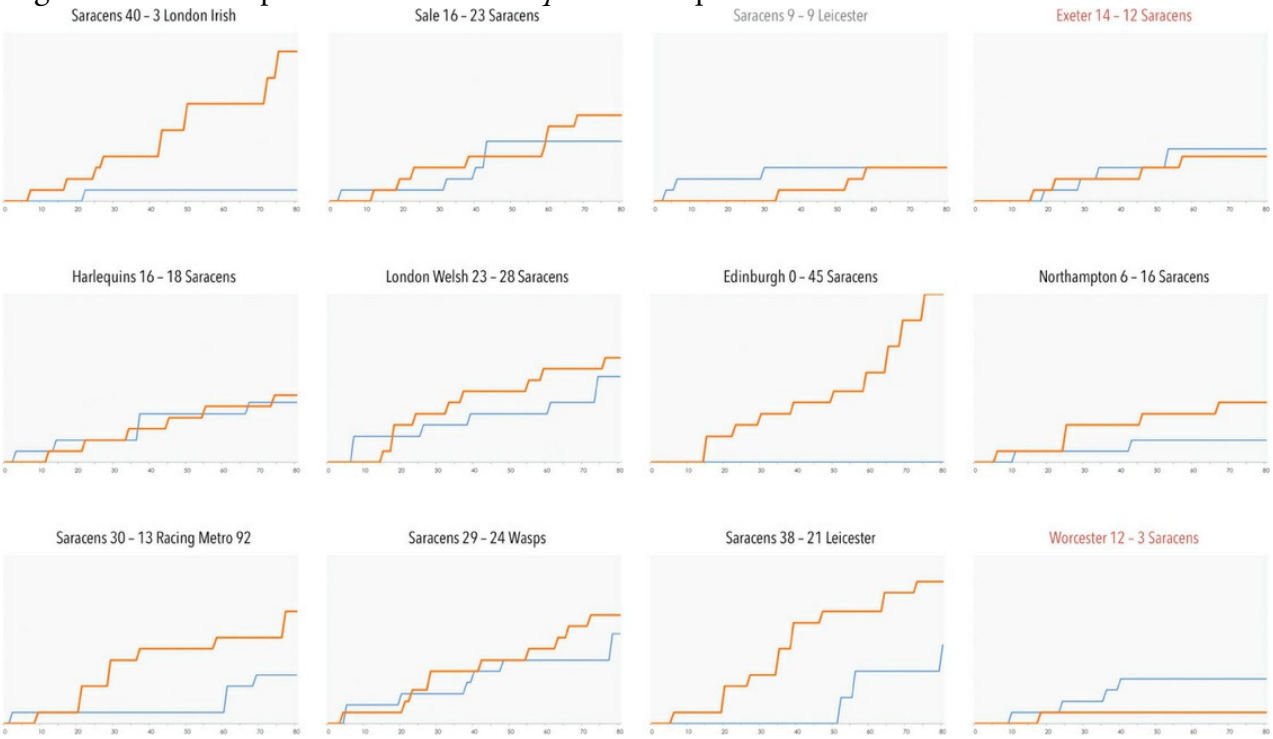
## 10.2 Features of Composition: Chart Composition

After establishing your thoughts about the overall layout, you will now need to go deeper in your composition thinking and contemplate the detailed spatial matters local to each chart, to optimise its legibility and meaning. There are many different components to consider.

Chart size: Do not be afraid to shrink your charts. The eye can still detect at quite small resolution and with great efficiency chart attributes such as variation in size, position, colour, shape and pattern.

This supports the potential value of the small-multiples technique, an approach that tends to be universally loved in data visualisation. As I explained earlier, this technique offers an ideal solution for when you are trying to display the same analysis for multiple categories or multiple points in time. Providing all the information in a simultaneous view means that viewers can efficiently observe overall patterns as well as perform a more detailed inspection. Figure 10.3 provides a single view of a rugby team's match patterns across the first 12 matches of a season. Each line chart panel portrays the cumulative scoring for the competing teams across the 80 minutes of a match. The 12 match panels are arranged in chronological order, from top left to bottom right, based on the date of the match.

Figure 10.3 Example of the *Small Multiples* Technique




The main obstacle to shrinking chart displays is the impact on text. The eye will not cope too well with small fonts for value or category labels, so there has to be a trade-off, as always, between the amount of detail you show and the size you show it.

Chart scales: When considering your chart-scales try to think about how you might use these to tell the viewer something meaningful. This can be achieved through astute choices around the maximum value ranges and also in the choice of suitable intervals for labelling and gridline guides.

The maximum values that you assign to your chart scales, informed by decisions around editorial framing, can be quite impactful in surfacing key insights. You may recall the chart from earlier that looked at the disproportionality of women CEO's amongst the S&P 1500 companies. Figure 10.4 is another graphic on a similar subject, which contextualises the relative progress in the rise of women CEOs amongst the Fortune 500 companies. By setting the maximum y-axis value range to reflect the level at which equality would exist, the resulting empty space emphasises the significant gap that still persists.

Figure 10.4 Reworking of 'The Glass Ceiling Persists'

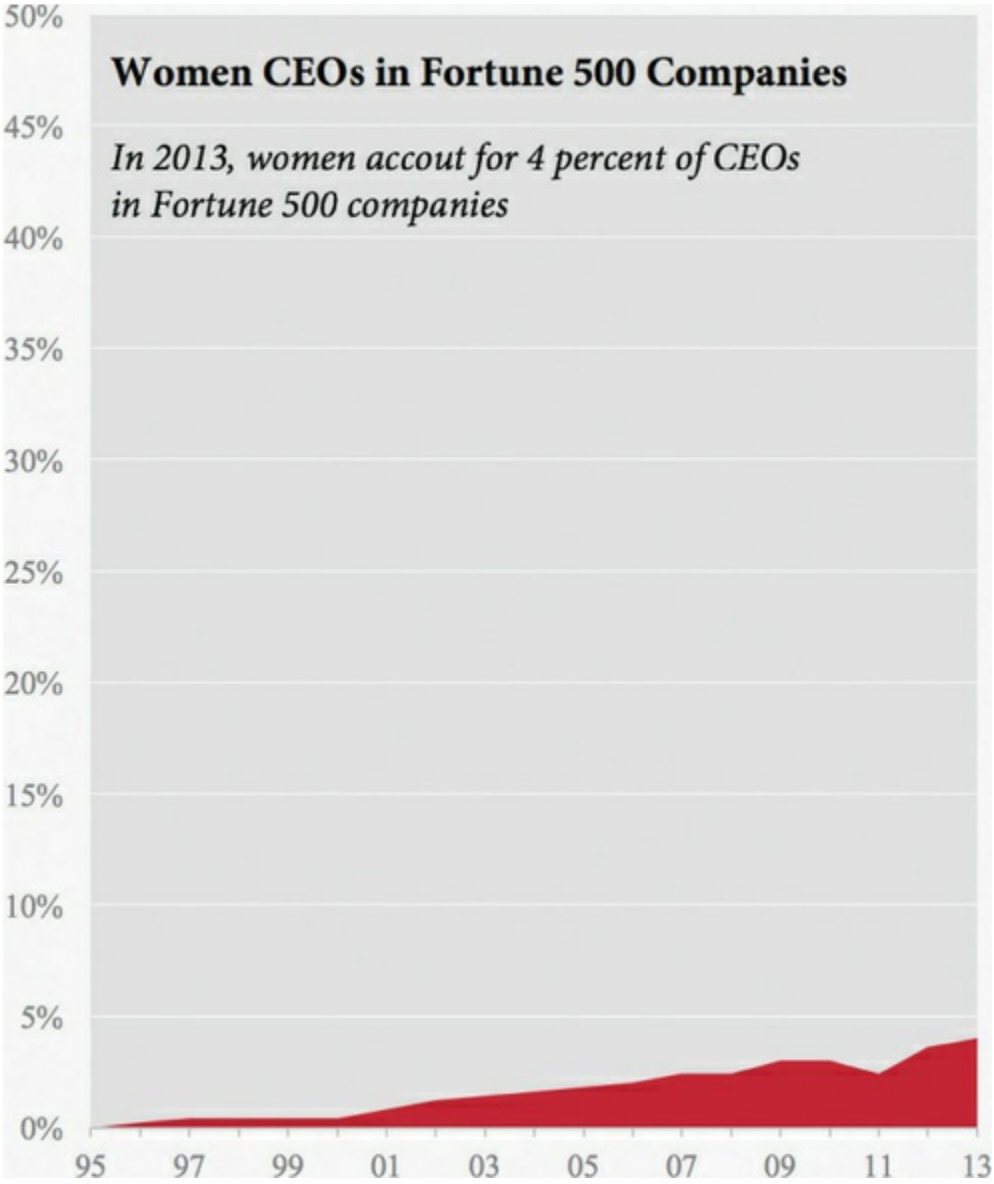



Figure 10.5 Fast-food Purchasers Report More Demands on Their Time

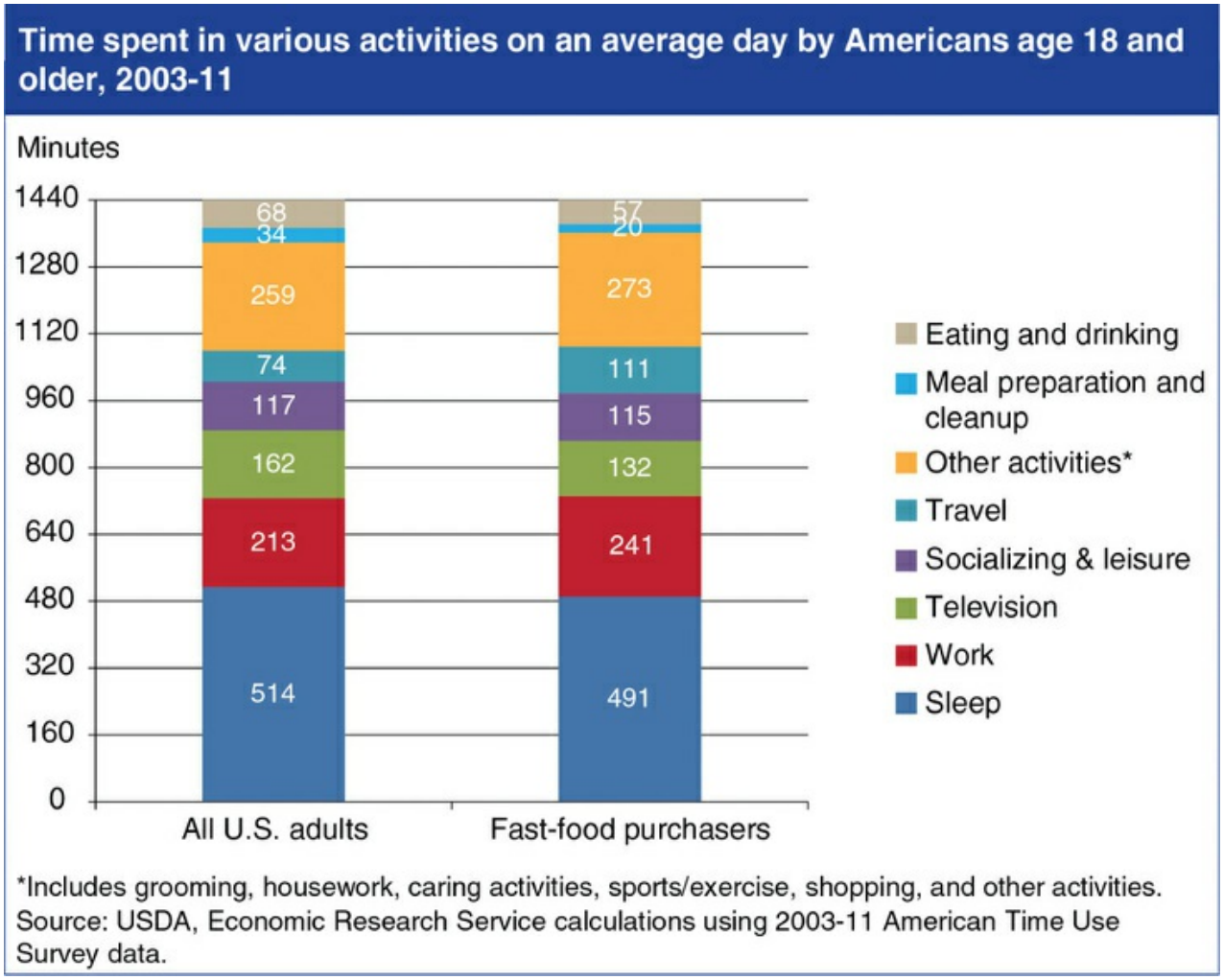
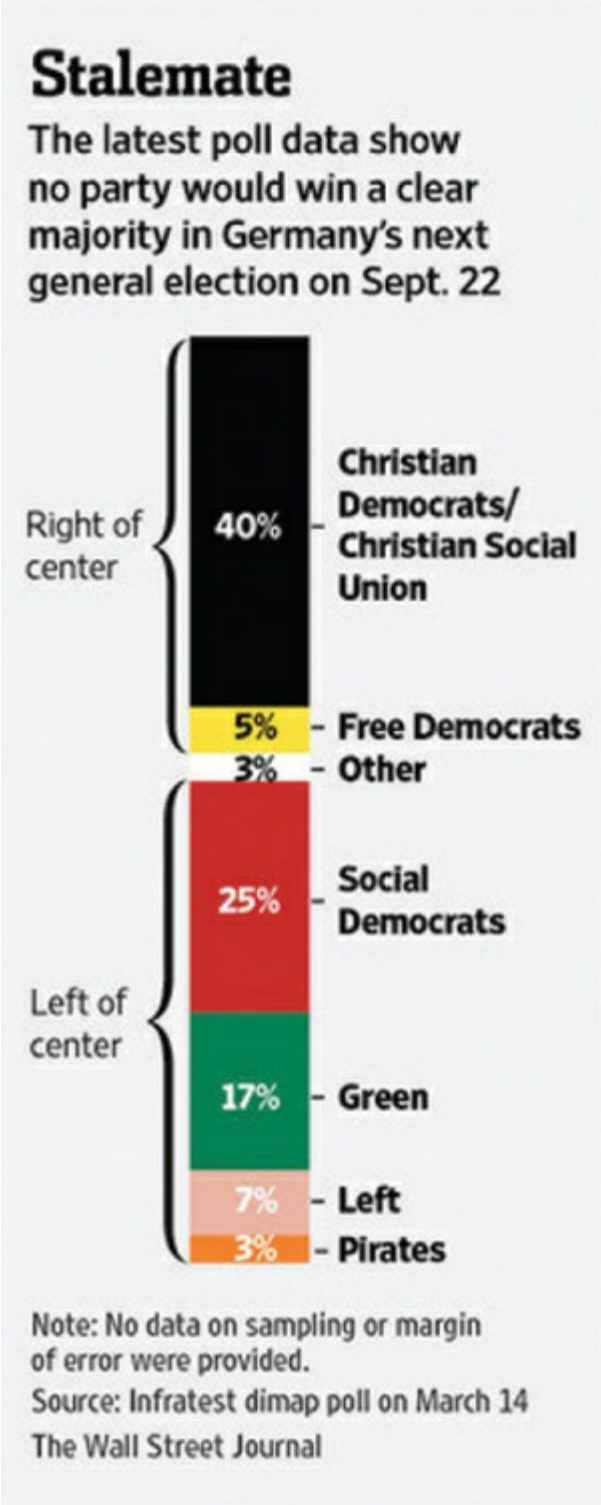



Figure 10.5 shows how the lack of careful thought about your scales can undermine the ease of readability. This chart shows how American adults spend their time on different activities. The analysis is broken down into minutes and so the maximum is set at 1440 minutes in a day. For some reason, the y-axis labels and the associated horizontal gridlines are displayed at intervals of 160 minutes. This is an entirely meaningless quantity of time so why divide the day up into nine intervals? To help viewers perceive the significance and size of the different stacked activities it would have been far more logical to use 60-minute time intervals as that is how we tend to think when dividing our daily schedule.

Chart orientation: Decisions about the orientation of your chart and its contents can sometimes help squeeze out an extra degree of readability and meaning from your display.

Figure 10.6 Illustrating the Effect of Chart orientation Decisions




The primary concern about chart orientation is towards the legibility of labels along the axis. A vertical bar chart, with multiple categories along the x-axis, will present a challenge of making the labels legible and avoiding them overlapping. Ideally you would want to preserve label reading in line with the eye, but you might need to adjust their orientation to either 45° or 90°. My preference for handling this with bar charts is to switch the orientation of the chart and to then have much more compatible horizontal space to accommodate the labels.

The meaning of your subject's data may also influence your choice. While there may have been constraints on the dimension of space in its native setting, Figure 10.6, portraying the split of political parties in Germany, feels like a missed opportunity to display a political axis of the Left and the Right through using a landscape rather than portrait layout.

As you saw earlier, the graphic about 'Iraq's bloody toll' (Figure 1.11) uses an inverted bar chart to

create a potent display of data that effectively conveys the subject matter, but importantly does so without introducing any unnecessary obstacles in readability.

In the previous section I presented a wireframe sketch of a graphic about Nobel prize winners. Figure 10.7 shows the final design. Notice how the original concept of the novel diagonal orientation was accomplished in the final composition, exploiting the greater room that this dimension of space offers within the page. It feels quite audacious to do this in a newspaper setting.

Figure 10.7 Nobels no Degrees

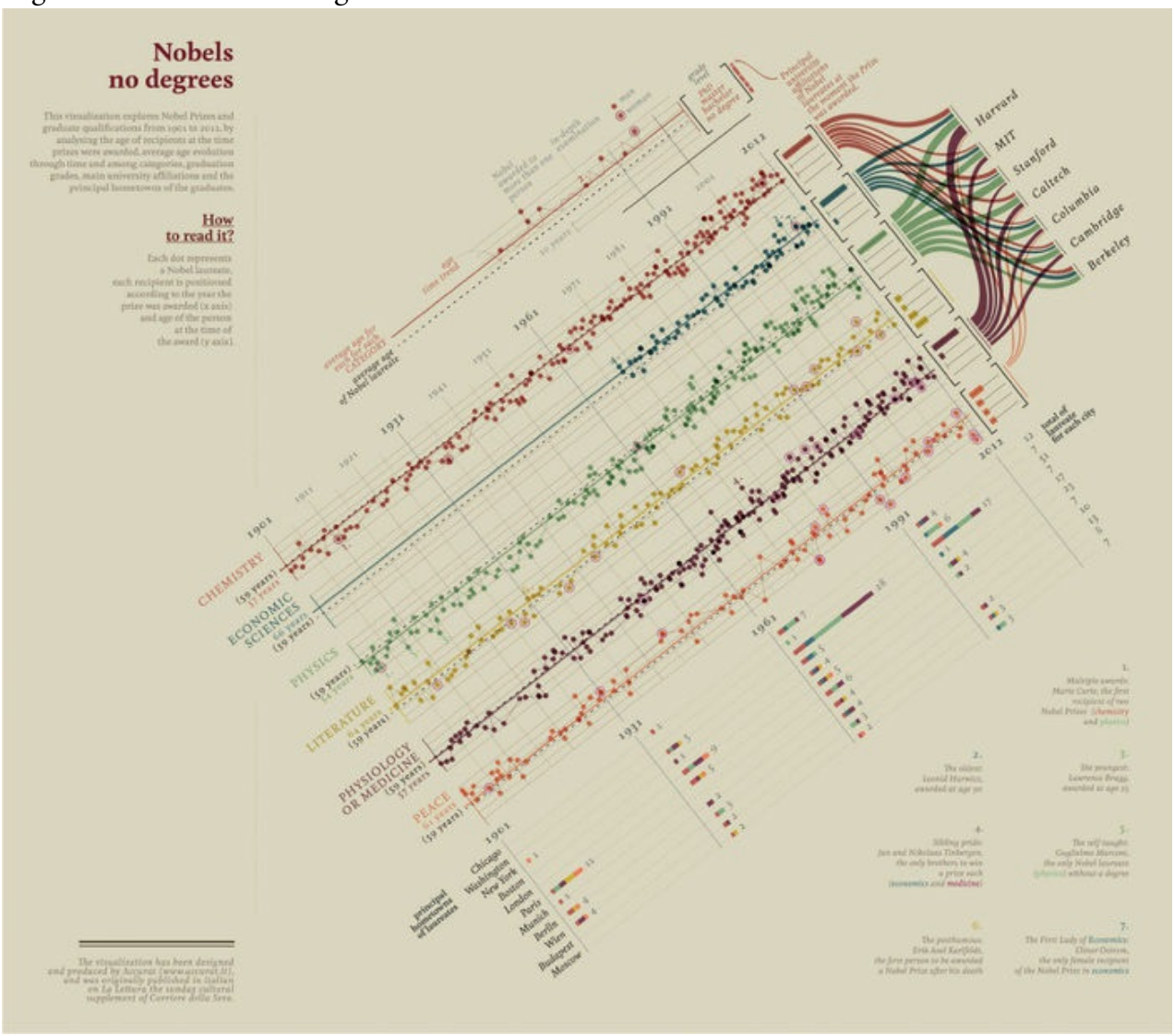



Figure 10.8 Kasich Could Be The GOP's Moderate Backstop

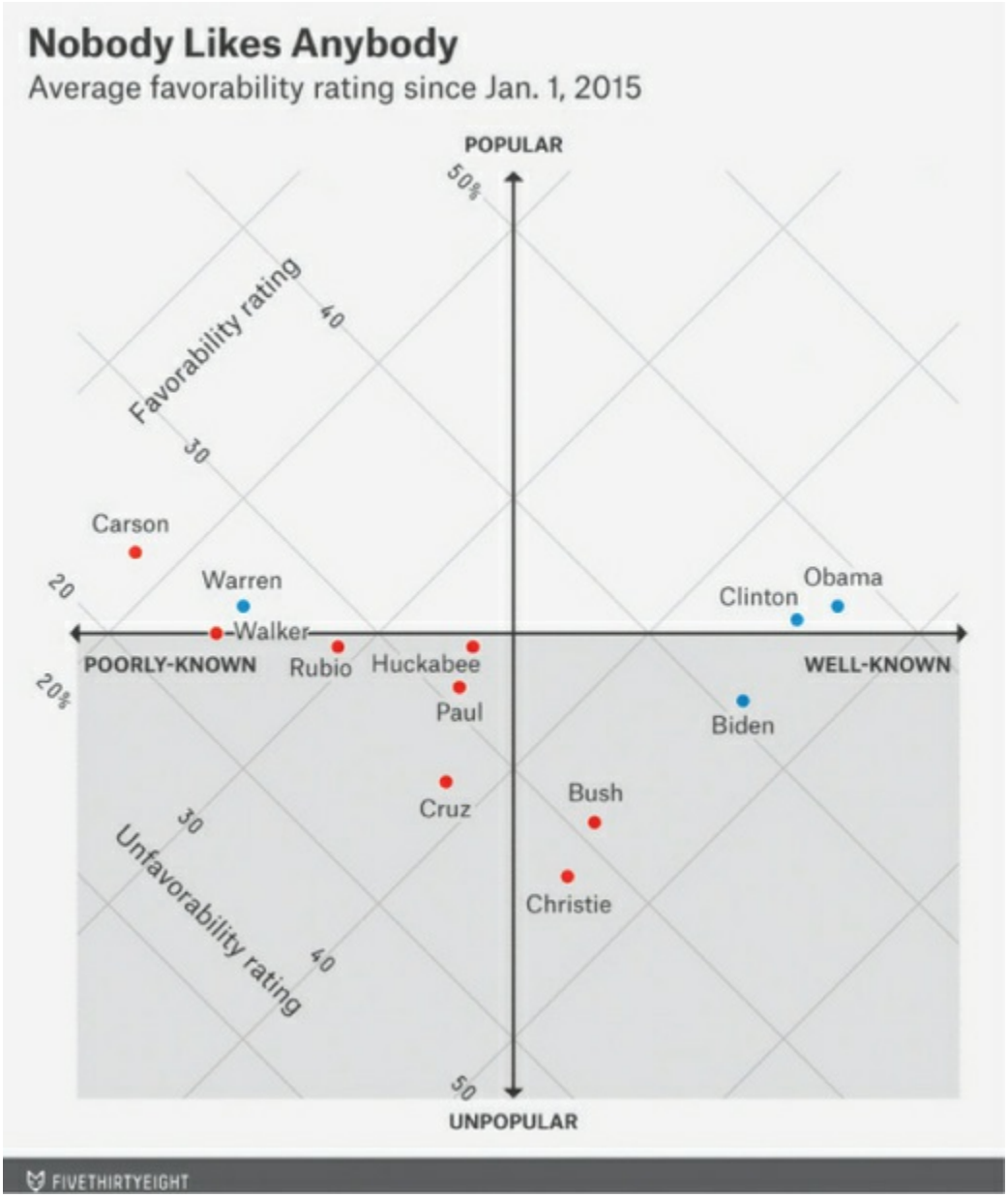



Figure 10.8, from FiveThirtyEight, rotates the scatter plot by 45° and then overlays a 2 × 2 grid which helps to guide the viewer's interpretation by making it easier to observe which values are located in each quadrant. It is also used to emphasise the distinction between location in the top and bottom halves of the chart along the axis of popularity, essentially the primary focus of the analysis.

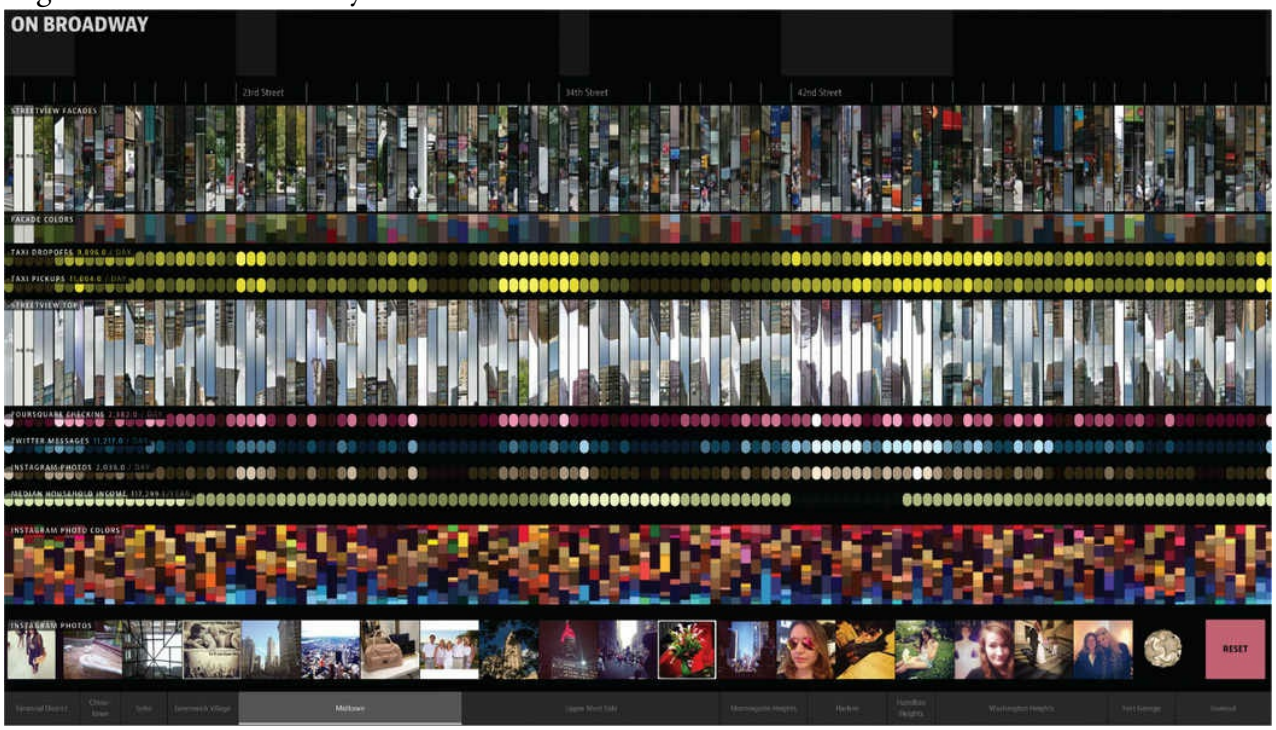
Although the LATCH and CHRTS acronyms share some similarities, the application of each concerns entirely different aspects of your design thinking. They are independent of one another. A bar chart, which belongs to the categorical (C) family of charts, could have its data potentially sorted by location, alphabet, time, category or hierarchy.

Chart value sorting: Sorting content within a chart is important for helping viewers to find and compare quickly the most relevant content. One of the best ways to consider the options for value sorting comes from using the LATCH acronym, devised by Richard Saul Wurman, which stands for the five ways of organising displays of data: Location, Alphabet, Time, Category or Hierarchy.

*Location* sorting involves sequencing content according to the order of a spatial dimension. This does not refer to sorting data on a map locations are fixed, rather it could be sorting data by geographical spatial relationships (such as presenting data for all the stops along a subway route) or a non-geographical spatial relationship (like a sequence based on the position of major parts of the body from head to toe).

You should order by location only when you believe it offers the most logical sequence for the readability of the display or if there is likely to be interest or significance in the comparison of neighbouring values. An example of location sorting is displayed in 'On Broadway' (Figure 10.9) on the following page, an interactive installation that stitches together a sequenced compilation of data and media related to 30 metre intervals of life along the 13 miles (21 km) of Broadway that stretches across the length of Manhattan. This continuous narrative offers compelling views of the fluctuating characteristics as you transport yourself down the spine of the city.

Figure 10.9 On Broadway




*Alphabetical* sorting is a cataloguing approach that facilitates efficient lookup and reference. Only on rare occasions, when you are especially keen to offer convenient ordering for looking up categorical values, will you find that alphabetical sorting alone offers the best sequence. In Figure 10.10, investigating different measures of waiting times in emergency rooms across the United States, the bar charts are presented based on the alphabetical sorting of each state. This is the default setting but users can also choose to reorder the table hierarchically based on the increasing/decreasing values across the four columns.

Data representation techniques that display overlapping connections, like Sankey diagrams, slope graphs and chord diagrams, also introduce the need to contemplate value sorting in the z-dimension: that is, which of these connections will be above and which will be below, and why.

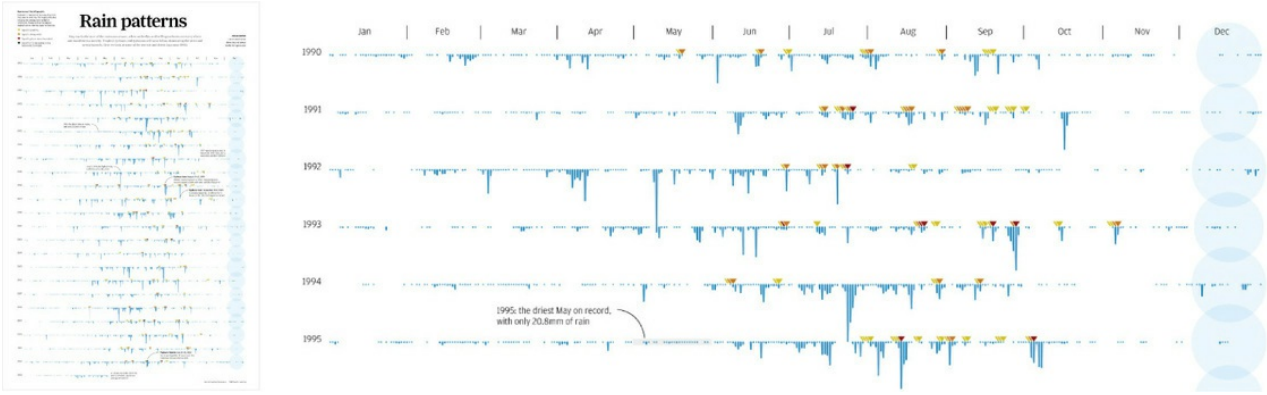
Alphabetical sorting might be seen as a suitably diplomatic option should you not wish to imply any ranking significance that would be displayed when sorting by any other dimension. Additionally, there is a lot of sense in employing alphabetical ordering for values listed in dropdown menus as this offers the most immediate way for viewers to quickly find the options they are interested in selecting.

Figure 10.10 ER Wait Watcher: Which Emergency Room Will See You the Fastest?

| State | Waiting Time | Time Until Sent Home | Broken Bone | Transfer Time |
|---|---|---|---|---|
| | Average time patients spent in the emergency room before being seen by a doctor | Average time patients spent in the emergency room before being sent home | Average time patients with broken bones had to wait before receiving pain meds | Among patients admitted, additional time spent waiting before being taken to their room |
| Nat Avg. | 24 min | 135 min | 54 min | 96 min |
| Alaska | 24 | 132 | 53 | 124 |
| Alabama | 30 | 127 | 66 | 73 |
| Arkansas | 26 | 121 | 64 | 64 |
| Arizona | 26 | 166 | 54 | 96 |
| California | 26 | 161 | 60 | 126 |
| Colorado | 17 | 139 | 45 | 93 |
| Connecticut | 27 | 139 | 54 | 153 |
| Dist. of Columbia | 54 | 187 | 69 | 223 |
| Delaware | 35 | 165 | 67 | 200 |
| Florida | 23 | 145 | 54 | 108 |
| Georgia | 30 | N/A | 59 | 94 |
| Hawaii | 20 | 128 | 52 | 114 |
| Iowa | 20 | 111 | 45 | 62 |
| Idaho | 20 | 125 | 46 | 76 |
| Illinois | 25 | 141 | 50 | 88 |
| Indiana | 18 | 121 | 49 | 79 |
| Kansas | 17 | 105 | 44 | 55 |
| Kentucky | 22 | 129 | 53 | 78 |
| Louisiana | 25 | 125 | 55 | 87 |
| Massachusetts | 35 | 161 | 57 | 122 |
| Maryland | 46 | 191 | 67 | 134 |
| Maine | 27 | 127 | 48 | 109 |
| Michigan | 21 | 132 | 52 | 99 |
| Minnesota | 25 | 123 | 42 | 62 |
| Missouri | 23 | 136 | 49 | 80 |
| Mississippi | 27 | 112 | 65 | 62 |

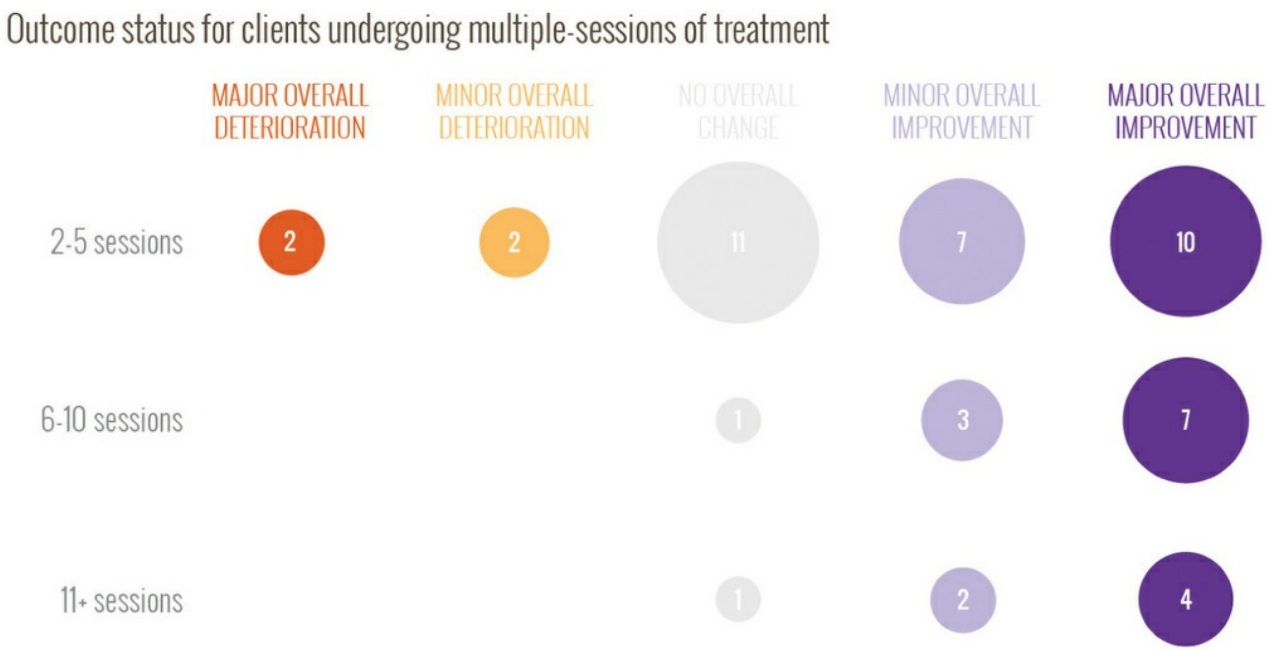
*Time-based* sorting is used when the data has a relevant chronological sequence and you wish to display and compare how changes have progressed over time. In Figure 10.11, you can see a snapshot of a graphic that portrays the rain patterns in Hong Kong since 1990. Each row of data represents a full year of 365/366 daily readings running from left to right. The subject matter and likely interest in the seasonality of patterns make chronological ordering a common-sense choice.

Figure 10.11 Rain Patterns




*Categorical* sorting can be usefully applied to a sequence of categories that have a logical hierarchy implied by their values or unique to the subject matter. For example, if you were presenting analysis about football players you might organise a chart based on the general order of their typical positions in a team (goalkeeper > defenders > midfielders > forwards) or use seniority levels as a way to present analysis about staff numbers. Alternatively, if you have ordinal data you can logically sort the values according to their inherent hierarchy. In Figure 10.12, that you saw earlier in the profile of ordinal colours, the columns are sequenced left to right in order from 'major deterioration' to 'major improvement', to help reveal the balance of treatment outcomes from a sample of psychotherapy clients.

Figure 10.12 Excerpt from 'Pyschotherapy in The Arctic'




*Hierarchical* sorting organises data by increasing or decreasing quantities so a viewer can efficiently perceive the size, distribution and underlying ranking of values. In Figure 10.13, showing the highest typical salaries for women in the US, based on analysis of data from the US Bureau of Labour Statistics, the sorting arrangement presents the values by descending quantity to reveal the highest rankings values.

Figure 10.13 Excerpt from 'Gender Pay Gap US'


In Figure 10.12 the bubbles in each column do not need to be coloured as their position already provides a visual association with the 'deterioration' through to 'improvement' ordinal categories. The attribute of colour, specifically, can therefore be considered *redundant encoding*. However, you might still choose to include this redundancy if you believed it aided the immediacy of association and distinction. In this case, the chart was part of a larger graphic that employed the same colour associations across several different charts and therefore it made sense to preserve this association.

## 10.3 Influencing Factors and Considerations

You are now familiar with the array of various aspects of composition thinking. At this point you will need to weigh up your decisions on how you might employ these in your own work. Here are some of the specific factors to bear in mind.

## Formulating Your Brief

Format: Naturally, as composition is about spatial arrangement, the nature and dimensions of the canvas you have to work with will have a fundamental bearing on the decisions you make. There are two concerns here: what will be the shape and size of the primary format and how transferable will your solution be across the different platforms on which it might be used or consumed?

Another factor surrounding format concerns the mobility of viewing the work. If the form of your output enables viewers to easily move a display or move *around* a display in a circular plane (such as looking at a printout or work on a tablet) this means that issues such as label orientation can be largely cast aside. If your output is going to be consumed in a relatively fixed setting (desktop/laptop or via a presentation) the flexibility of viewing positions will be restricted.

## Working With Data

Data examination: Not surprisingly, the shape and size of your data will directly influence your chart composition decisions. When discussing physical properties in Chapter 4, I described the influence of quantitative values with legitimate outliers distorting ideal scale choices. One solution for dealing with this is to use a non-linear logarithmic (often just known as a 'log') scale. Essentially, each major interval along a log scale increases the value at that marked position by a factor of 10 (or by one order of magnitude) rather than by equal increments. In Figure 10.14, looking at ratings for thousands of different board games, the x-axis is presented on a log scale in order to accommodate the wide range of values for the 'Number of ratings' measure and to help fit the analysis into a square-chart layout. Had the x-axis remained as a linear scale, to preserve a square layout would have meant squashing values below 1000 into such a tightly packed space that you would hardly see the patterns. Alternatively, a wide rectangular chart would have been necessary but impractical given the limitations of the space this chart would occupy.

I have great sympathy for the challenges faced by designers like Zimbabwe-based Graham van de Ruit, when working on typesetting a book titled *Millions, Billions, Trillions: Letters from Zimbabwe, 2005–2009* in 2014. The book was all text, apart from one or two tables. One of the tables of data supplied to Graham showed Zimbabwe's historical monthly inflation rates, which, as you can see (Figure 10.15), included some incredibly diverse values.

I love the subtle audacity of Graham's solution. Even though it is presented in tabular form there is a strong visual impact created by allowing the sheer spatial consequence of the exceptional mid-2008 numbers to cause the awkward widening of the final column. I think this makes the point much more effectively than a chart might, in this case.

Figure 10.14 The Worst Board Games Ever Invented

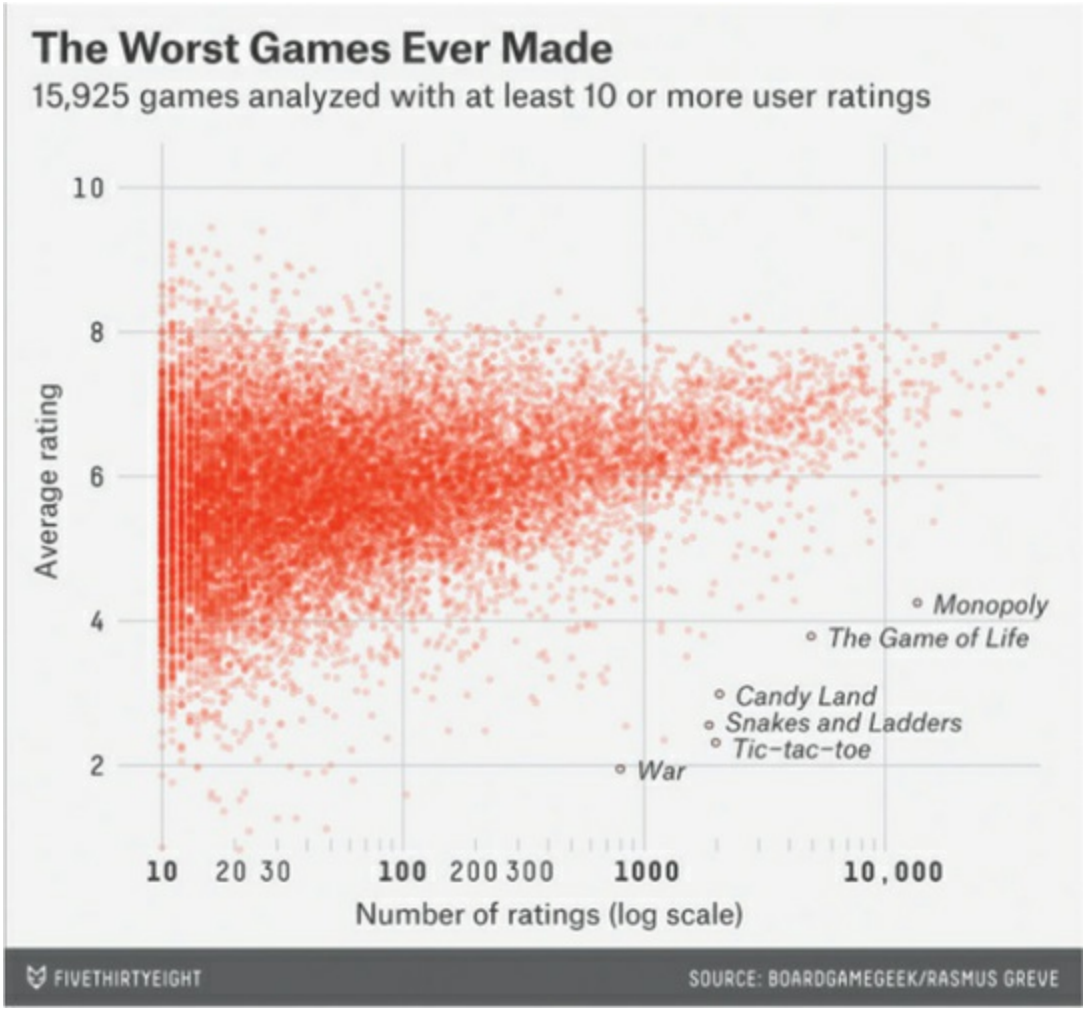



Figure 10.15 From *Millions, Billions, Trillions: Letters from Zimbabwe, 2005–2009*

*Month on month inflation % 2000–2008*

| | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 |
|---|---|---|---|---|---|---|---|---|---|
| **Jan** | 55 | 57 | 116 | 208 | 628 | 133 | 613 | 1593 | 100,580 |
| **Feb** | 48 | 57 | 116 | 220 | 602 | 127 | 782 | 1729 | 165,000 |
| **Mar** | 50 | 55 | 113 | 228 | 583 | 123 | 913 | 2200 | 355,000 |
| **Apr** | 53 | 56 | 114 | 269 | 505 | 129 | 1092 | 3714 | 736,604 |
| **May** | 58 | 55 | 122 | 300 | 448 | 144 | 1193 | 4530 | 1,800,000 |
| **Jun** | 59 | 64 | 114 | 364 | 394 | 164 | 1184 | 7251 | |
| **Jul** | 53 | 70 | 123 | 399 | 362 | 254 | 993 | 7634 | 220,000,000 |
| **Aug** | 53 | 76 | 135 | 426 | 314 | 265 | 1204 | 6592 | 231,000,000 |
| **Sept** | 62 | 86 | 139 | 455 | 251 | 359 | 1023 | 7892 | |
| **Oct** | 60 | 97 | 144 | 525 | 209 | 411 | 1070 | 14840 | |
| **Nov** | 56 | 103 | 175 | 619 | 149 | 502 | 1098 | 26470 | |
| **Dec** | 55 | 112 | 198 | 598 | 132 | 585 | 1281 | 66000 | |

'I thought that a graph might be more effective, but I quickly realised that the scale would be a big challenge… The whole point of graphing would have been to show the huge leap in 2008, something that I felt the log scale would detract from and was impractical with the space constraints. I also felt that a log scale might not be intuitive to the target audience.' Graham van de Ruit, Editorial and Information Designer

## Establishing Your Editorial Thinking

Angles: The greater the number of different angles of analysis you wish to cover in your work, the greater the challenge will be to seamlessly accommodate the resulting chart displays in one view. The more content you include increases the need to contemplate reductions in the size of charts or a non-simultaneous arrangement, perhaps through multi-page sequences with interactive navigation.

In defining your editorial perspectives, you will have likely established some sense of hierarchy that might inform which angles should be more prominent (regarding layout position and size) and which less so. There might also be some inherent narrative binding each slice of analysis that lends itself to being presented in a deliberate sequence.

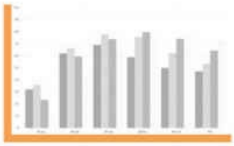
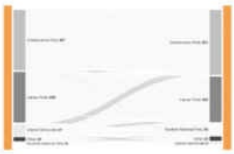
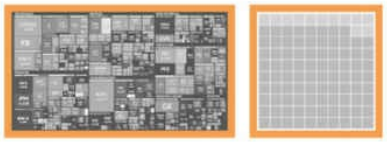
## Data Representation

Chart type choice: Different charts have different spatial consequences. A treemap generally occupies far more space than a pie chart simply because there are many more 'parts' being shown. A polar chart is circular in shape, whereas a waffle chart is squared. With each chart you include you will

have a uniquely shaped piece that will form part of the overall jigsaw puzzle. Inevitably there will be some shuffling of content to find the right size and placement balance.

The table in Figure 10.16 summarises the main chart structures and the typical shapes they occupy. This list is based only on the charts included in the Chapter 6 gallery but still offers a reasonable compilation of the main structures. These are ordered in descending frequency as per the distribution of the different structures of charts in the gallery.

Figure 10.16 List of chart structures

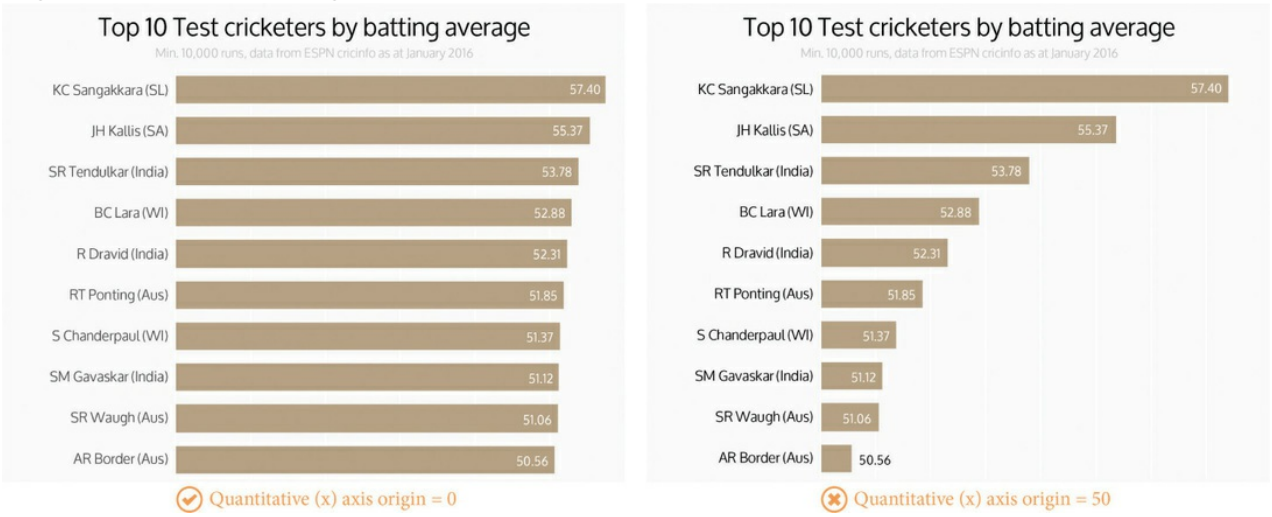
| Structure | Description | Shape |
|---|---|---|
| Cartesian | These are effectively rectangular structures based on a coordinate system with magnitudes or positions along an x (horizontal) and y (vertical) dimension. The bar and line charts use this structure. |  |
| Spatial | These are mapping projections used to display thematic mapping, where values are plotted according to longitude–latitude or associated with the polygonal shapes of geographic units. |  |
| Radial | Radial structures are characterised by a central or circular layout usually based on the division of angular parts or axes radiating outwards. They are used for polar and pie charts. Certain hierarchical and relational charts also demonstrate a similar graphical structure, whereby concentric layers or nodes and edges emanate from a natural centre. For example, node–link diagrams use this structure. |  |
| Columnar | These structures are associated with table-like layouts based on associated x and y cell positions (like the heat map) or layouts that have different tiers or states (such as the Sankey diagram or the linear dendrogram). |  |
| Enclosure | Enclosure charts are based around a fixed shaped container within which data is arranged optimally. This would be seen in the treemap and the waffle chart. |  |

## Trustworthy Design

Chart-scale optimisation: Decisions about chart scales concern the maximum, minimum and interval choices that ensure integrity through the representation as well as optimise readability.

Firstly, let's look at decisions around minimum values used on the quantitative value axis, known as the origin, and the reasons why it is not OK for you to truncate the axis in methods like the bar chart. Any data representation where the attribute of *size* is used to encode a quantitative value needs to show the full, true size, nothing more and nothing less. The origin needs to be zero. When you truncate a bar chart's quantitative value axis you distort the perceived length or height of the bar. Visualisers are often tempted to crop axis scales when values are large and the differences between categories are small. However, as you can see in Figure 10.17, the consequence is that it creates the impression of highly noticeable relative difference between values when the absolute values do not support this.

Figure 10.17 Illustrating the Effect of Truncated Bar Axis Scales




The single instance in which it is remotely reasonable to truncate an axis would be if you had a main graphic which effectively offered a thumbnail view of the whole chart for orientation positioned alongside a separate associated chart (similar to that on the right). This separate chart might have a truncated axis that would provide a magnified view of the main chart, showing just the tips of the bar, to help viewers see the differences close up.

In contrast to the bar chart, a line chart does not necessarily need always to have a zero origin for the value axis (normally the y-axis). A line chart's encoding involves a series of connected lines (marks) joining up continuous values based on their absolute position along a scale (attribute). It therefore does not encode quantitative values through size, like the bar chart does, so the truncation of a value axis will not unduly impact on perceiving the relative values against the scale and the general trajectory. For some data contexts the notion of a zero quantity might be impossible to achieve. In Figure 10.18, showing 100m sprint record times, no human is ever going to be able to run 100m in anywhere near zero seconds. Times have improved, of course, but there is a physical limit to what can be achieved. To show this analysis with the y-axis starting from zero would be unnecessary and even more so if you plotted similar analysis for longer distance races.

However, if you were to plot the 100m results and the 400m results on the same chart, you would need to start from zero to enable orientation of the scale of comparable values. This sense of comparable scale is missing from the next chart, whereby including the full quantitative value range down to zero would be necessary to perceive the relative scale of attitudes towards same-sex marriage. The chart's y-axis appears to start from an origin of 20 but as we are looking at part-to-whole analysis, the y-axis should really be displayed from an origin of zero. The maximum doesn't need to go up to 100%, the highest observed value is fine in this case, but it could be interesting to set the maximum range to 100% in order to create a similar sense of the gap to be bridged before 100% of respondents are in agreement.

Figure 10.18 Excerpt from 'Doping under the Microscope'

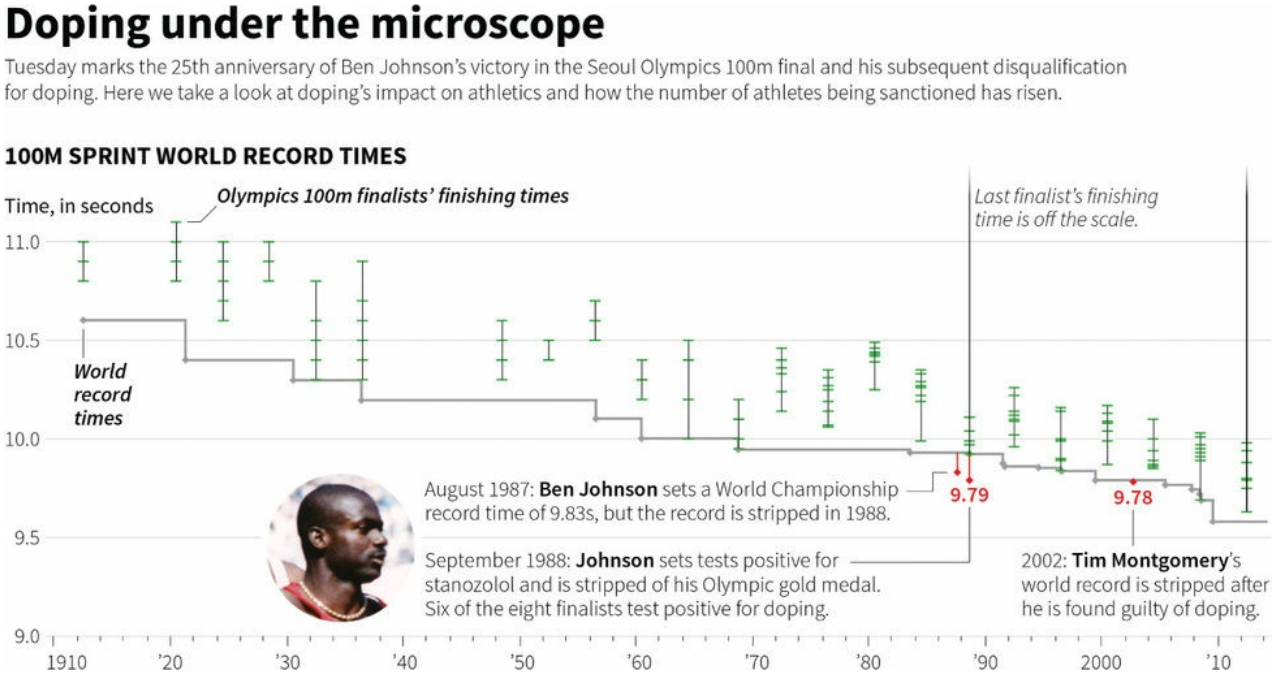
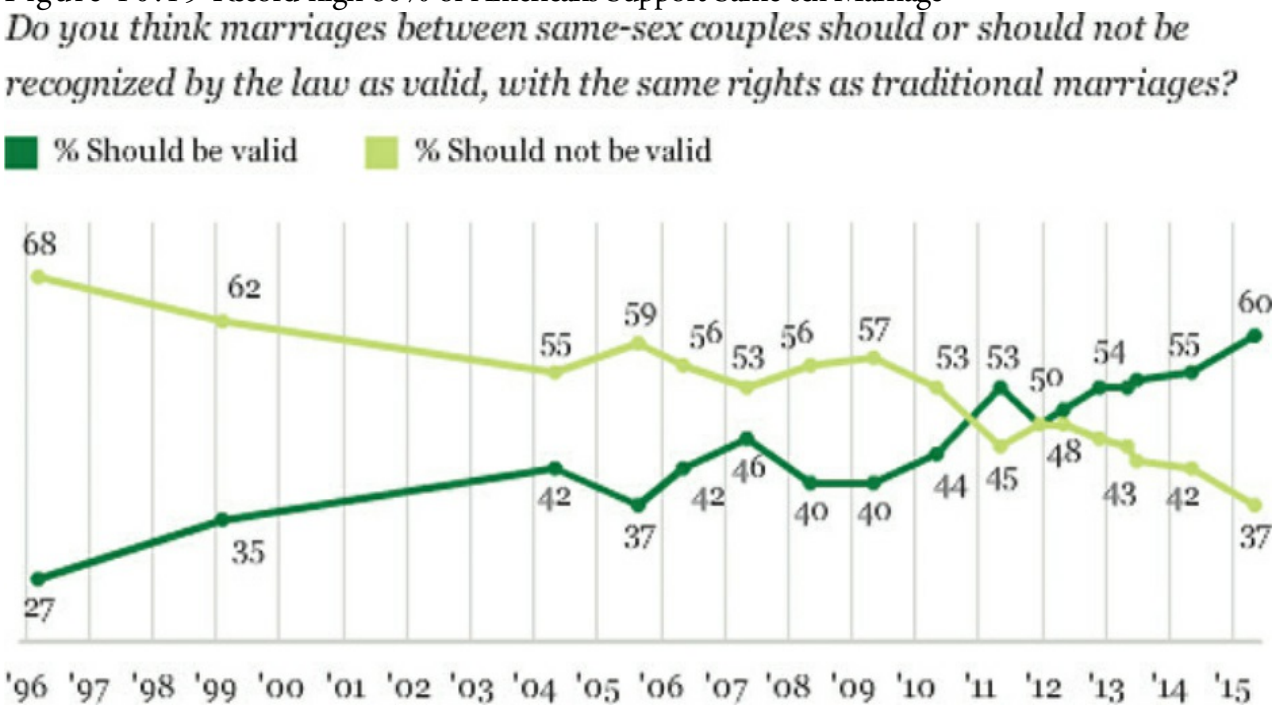



Figure 10.19 Record-high 60% of Americans Support Same-sex Marriage




Aspect ratios: The aspect ratio of a line chart, as derived from the height and width dimensions of the chart area, can have a large impact on the perceived trends presented. If the chart is too narrow, the steepness of connections will be embellished and look more significant; if the chart is stretched out too wide, the steepness of slopes will be much more dampened and key trends may be somewhat disguised. There is no absolutely right or wrong approach here but clearly there is a need for sensitivity to avoid the possibility of unintended deception. A general rule of thumb is to seek a chart area that enables the average slope to be presented at 45°, though this is not something that can be easily and practically applied, especially as there are many other variables at play, such as the range of quantitative and time values and the scales being used. My advice is just to make a pragmatic judgement by eye to find the ratio that you think is faithful to the significance of the trends in your data.

Mapping projections: One of the most contentious matters in the visual representation of data relates to thematic mapping and specifically to the choice of map projection used. The Earth is not flat (hopefully no contention there, otherwise this discussion is rather academic), yet the dominant form

through which maps are presented portrays the Earth as being just that. Features such as size, shape and distance can be measured accurately on Earth but when projected on a flat surface a compromise has to occur. Only some of these qualities can be preserved and represented accurately.

I qualify this with 'dominant' because, increasingly, advances in technology (such as WebGL) mean we can now interact with spherical portrayals of the Earth within a 2D space.

There are lots of exceptionally complicated calculations attached to the variety of spatial projections. The main things you need to know about projection mapping are that:

- every type of map projection has some sort of distortion;
- the larger the area of the Earth portrayed as a flat map, the greater the distortion;
- there is no single right answer – it is often about choosing the least-worst case.

Thematic mapping (as opposed to mapping spatially for navigation or reference purposes) is generally best portrayed using mapping projections based on 'equal-area' calculations (so the sacrifice is more on the shape, not the size). This ensures that the phenomena per unit – the values you are typically plotting – are correctly represented by proportion of regional area. For choosing the best specific projection, in the absence of perfect, damage limitation is often the key: that is, which choice will distort the spatial truth the least given the level of mapping required. There are so many variables at play, however, based on the scope of view (world, continent, or country/sub-region), the potential distance from the equator of your region of focus and whether you are focusing on land, sea or sky (atmosphere), to name but a few. As with many other topics in this field, a discussion about mapping projections requires a dedicated text but let me at least offer a brief outline of five different projections to begin your acquaintance:

Many tools that offer rudimentary mapping options will tend to only come with a default (non-adjustable) projection, often the Mercator (or Web Mercator). The more advanced geospatial analysis tools will offer pre-loaded or add-in options to broaden and customise the range of projections. Hopefully, in time, an increasing range of the more pragmatic desktop tools will enhance projection customisations.

Figure 10.20 A Selection of Commonly Deployed Mapping Projections

| | |
|---|---|
| **Mercator**<br>While the Mercator has been widely discredited in its role as a means of portraying the world (due to the vast distortions at the poles) it is still the most common projection found in mapping tools (where it is often termed Web Mercator). This is largely because of its rectangular dimensions that support seamless zooming. If you are determined to use this projection, you should not use it for a global view; stick to a lower regional level so the distortions are minimised, especially for regions around the equator. |  |
| **Albers Equal-area Conic**<br>This unusual looking conic projection is most highly recommended for presenting maps at a lower regional level, such as a country or subcontinent view. |  |
| **Lambert Azimuthal Equal-area**<br>This spherical projection is most commonly recommended for hemisphere- or continent-level views. The European Environment Agency, for example, recommends its usage for any European mapping purpose. |  |
| **Winkel–Tripel**<br>Most of the important people who are far better informed about mapping projections than I tend to speak in glowing terms about the Winkel–Tripel projection as the best choice for viewing the world. Indeed, as the most ringing endorsement of its credentials, it represents the modern standard world map adopted by *National Geographic*. |  |
| **Mollweide**<br>In contrast to the Winkel–Tripel, the Mollweide (equal-area) projection offers greater emphasis on the accuracy of ocean areas and can be useful for atmospheric mapping (e.g. flight paths). | |

## Accessible Design

Good design is unobtrusive: One of the main obstructions to facilitating understanding through a visualisation design is when viewers are required to rely on their memory to perform comparisons between non-simultaneous views.

When the composition layout requires viewers to flick between pages or interactively generated views, they have to try store one view in their mind and then mentally compare that against the live view that has arrived on the screen. This is too hard and too likely to fail given the relatively weak performance of the brain's working memory. Content that warrants direct comparison should be enabled through proximity to and alignment with related items. I mentioned in the section on animation that if you

want to compare different states over time, rather than see the connected system of change, you will need to have access to the 'moment' views simultaneously and without a reliance on memory.

'Using our eyes to switch between different views that are visible simultaneously has much lower cognitive load than consulting our memory to compare a current view with what was seen before.' Tamara Munzner taken from *Visualization Analysis and Design*

## Elegant Design

'I'm obsessed with alignments. Sloppy label placement on final files causes my confidence in the designer to flag. What other details haven't been given full attention? Has the data been handled sloppily as well? … On the flip side, clean, layered and logically built final files are a thing of beauty and my confidence in the designer, and their attention to detail, soars.' Jen Christiansen, Graphics Editor at *Scientific American*

Unity: As I discussed with colour, composition decisions are always relative: an object's place and its space occupied within a display immediately create a relationship with everything else in the display. Unity in composition provides a similar sense of harmony and balance between all objects on show as was sought with colour. The flow of content should feel logical and meaningful.

The enduring idea that elegance in design is most appreciated when it is absent is just as relevant with composition. Look around and open your eyes to composition that works and does not work, and recognise the solutions that felt effortless as you read them and those that felt punctured and confusing. This is again quite an elusive concept and one that only comes with a mixture of common-sense judgement, experience and exposure to inspiration from elsewhere.

Thoroughness: Precision positioning is the demonstration of thoroughness and care that is so important in the pursuit of elegance. You should aim to achieve pixel-perfect accuracy in the position and size of every single property.

Think of the importance of absolute positioning in the context of detailed architectural plans that outline the position of every fine detail down to power sockets, door handles and the arc of a window's opening manoeuvre. A data visualiser has to commit to ultimate precision and consistency because any shortcomings will be immediately noticeable and will fundamentally impact on the function of the work. If you do not feel a warm glow from every emphatic snap-to-grid resize operation or upon seeing the results of a mass alignment of page objects, you are not doing it right. (Honestly, I am loads of fun to be around.

## Summary: Composition

Project composition defines the layout and hierarchy of the entire visualisation project and may include the following features:

- Visual hierarchy – layout: how to arrange the position of elements?
- Visual hierarchy – size: how to manage the hierarchy of element sizes?
- Absolute positioning: where specifically should certain elements be placed?

Chart composition defines the shape, size and layout choices for all components within your charts and

may include the following features:

- Chart size: don't be afraid to shrink charts, so long as any labels are still readable, and especially embrace the power of small multiple.
- Chart scales: what are the most meaningful range of values given the nature of the data?
- Chart orientation: which way is best?
- Chart value sorting: consider the most meaningful sorting arrangement for your data and editorial focus, based on the LATCH acronym.

## Influencing Factors and Considerations

- Formulating the brief: what space have you got to work within?
- Working with data: what is the shape and size of your data and how might this affect your chart design architecture?
- Establishing your editorial thinking: how many different angles (charts) might you need to include? Is there any specific focus for these angles that might influence a sequence or hierarchy between them?
- Data representation: any chart has a spatial consequence – different charts have different structures that will create different dimensions that will need to be accommodated.
- Trustworthy design: the integrity and meaning of your chart scale, chart dimensions, and (for mapping) your projection choices are paramount.
- Accessible design: remember that good design is unobtrusive – if you want to facilitate comparisons between different chart displays these ideally need to be presented within a simultaneous view.
- Elegant design: unity of arrangement is another of the finger-tip sense judgments but will be something achieved by careful thinking about the relationships between all components of your work.

## Tips and Tactics

- You will find that as you reach the latter stages of your design process, the task of nudging things by fractions of a pixel and realigning features will dominate your attention. As energy and attention start to diminish you will need to maintain a commitment to thoroughness and a pride in precision right through to the end!
- Empty space is like punctuation in visual language: use it to break up content when it needs that momentary pause, just as how a *comma* or *full stop* is needed in a sentence. Do not be afraid to use empty space more extensively across larger regions as a device to create impact. Like the notes not played in jazz, effective visualisation design can also be about the relationship between something and nothing.


## READING

Visit the chapter's library of further reading and references to continue your learning about judging composition in data visualisation

## EXERCISES

Undertake these practical exercises to help refine your skill and understanding about making effective composition decisions

## CASE STUDY

Work through the final instalment of the Filmographics case-study narrative, discussing the decisions made about the project's composition