Week 5, Day 1

Motivating Design Choices: Making Things More Clear

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Agenda for today

- Last week we tried to think through some actual applied rules for mapping visualizations and when certain things work (or don't).
- Now that we have some ground rules, we want to talk about how to make visualizations even more *user-friendly*.
- These are the important considerations to take your visualizations from decent and readable to helpful and discernible.

Revisiting our directory[1]

Type of Information	Suggested Visualization
Amounts	bars, dots, heatmap
Distributions	histogram, density plot, qq-plot, boxplot, violin plot, strip chart
Proportions	bars, density plot, mosaiac plot, treemap, parallel set
Relations	scatterplot, bubblechart, slopegraph, contour plot, bins, correlogram, line graph

- Each of these suggestions can be further modified to be inclusive of more information, by stacking, grouping, faceting, adding information on uncertainty, or changing coordinate systems.

[1] Adapted from Wilke ch. 5

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- Under what circumstances do we need a **legend** or **labels** for each of these? Is there some sort of uniform need for either?

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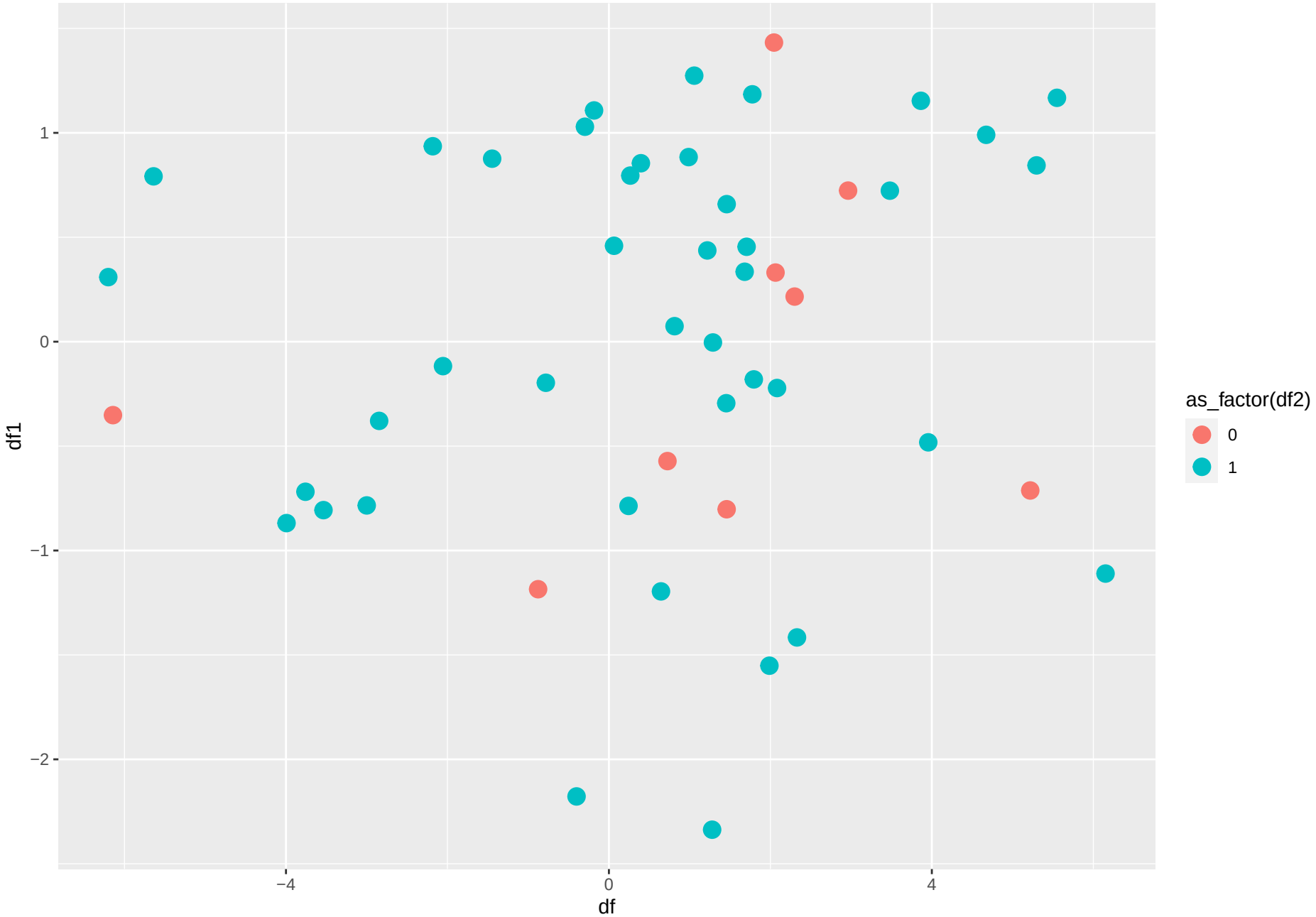
Really the answer is fuzzy

- More than anything whatever we choose, we just need to rely on a technique that is effective and clear.
- One way to ensure that we make things clear is through the concept of **redundant encoding.**
- **Redundant encoding** uses various aesthetic mappings to iterate the information within a visualization.
- This does not mean that we add more information over increased mappings, rather we maximize the opportunities for audience to understand the information being conveyed over different layers.

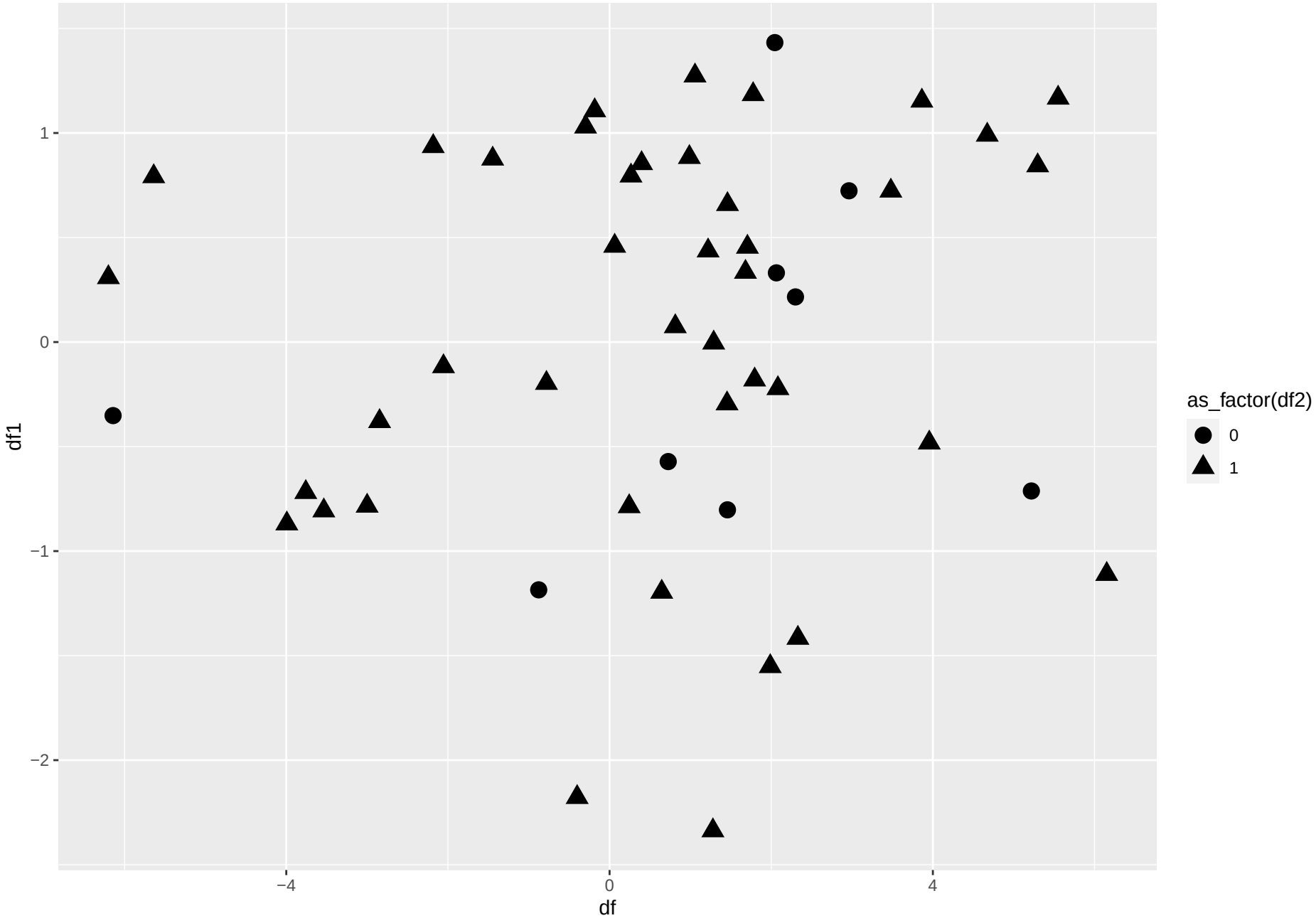
- Therefore, the answer to better understanding isn't always about a **legend** or **labels**. Rather it's whatever solution we have to make something **redundant**.
- Usually in coding (construed broadly), we don't want redundancy. We want *efficiency.*
- **However**, our end goal is not super efficient code for visualization... It's an efficient and precise visualization task.
- Repetition is good for pattern finding, so if a pattern can be iterated multiple ways– our audience benefits.

Toy example of redundant coding

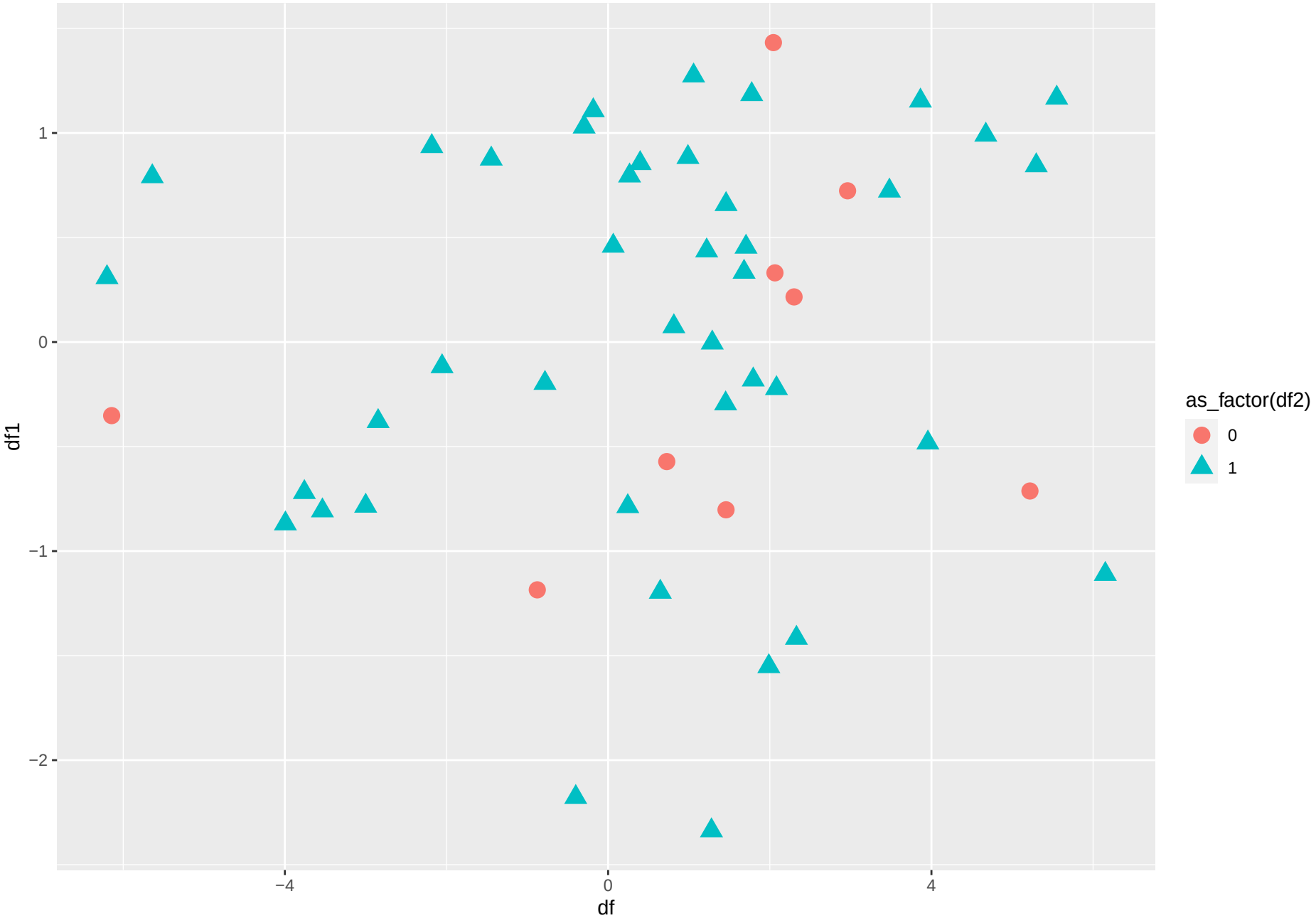
Color



Shape



Redundant



Some takeaways from an experimental study on redundant encoding

Nothelfer, Gleicher, Franconeri (2017).

1) Visual selection is *more accurate* (i.e. better) with a redundant display.
2) Visual selection is *faster* with a redundant display.
3) The benefits of redundant coding extend to more nuanced tasks of visualization apart from accuracy and quickness of judgment.
4) Grouping is stronger if redundant across multiple mappings (in this study, luminance and shape).
5) The benefits of redundancy are not dependent on any single attentional mode.

Iterating the importance of color-blind safe palettes + redundancy

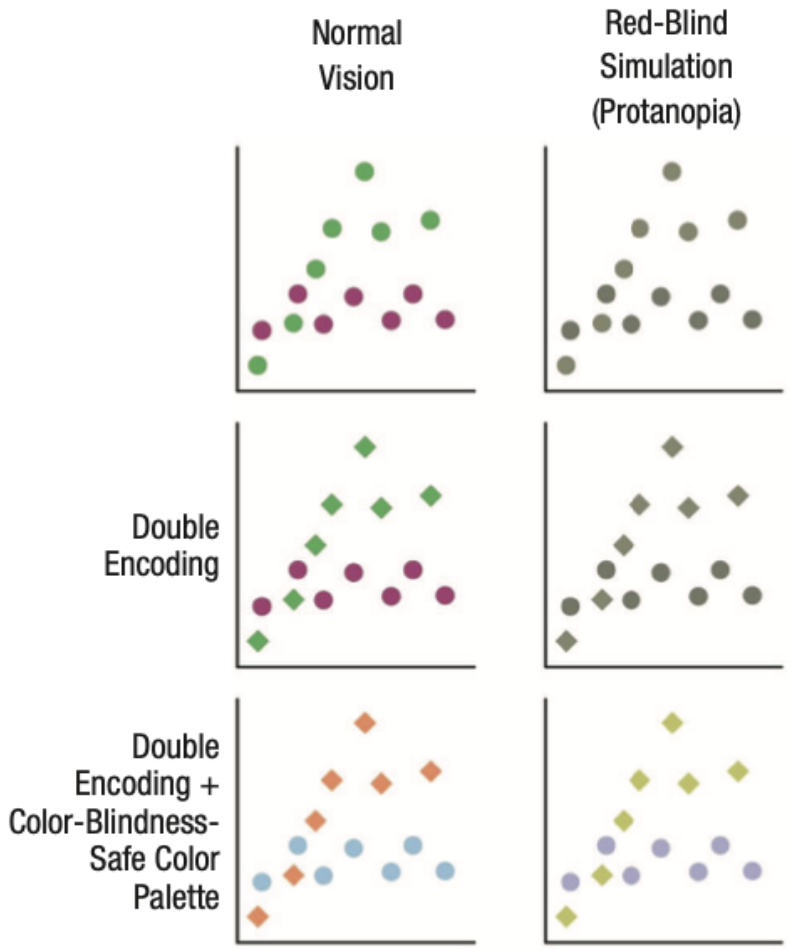


Fig. 5. Three ways to encode data for two groups in a scatterplot, as seen by observers with typical color perception and those with protanopia, a form of color blindness.

Applied Ways to Achieve Redundant Coding

With a Legend?

Somewhat self-explanatory. . .

Without a Legend?

Sometimes, legends will actually add to the burden of the audience. This means that we need to provide design elements that immediately clue in the audience about the represented elements.

a. `Direct Labeling`
b. `Enclosures with labeling`

Illustrating the Point

https://www.cnothelfer.com/redundant-encoding

Using multiples

- We talked last week about combining figures together either via faceting (*small multiples*) or by arranging different visualizations in a grid (*compound figures*).
- We can also do this via animation or, thinking even a bit further ahead, via interactive visualizations.
- But when does this work?

Small Multiples

- "Slice the data" according to some dimension or additional grouping variable and place into a grid.
- We call this `faceting` and use `facet_wrap()` or `facet_grid()` in `ggplot2`.
- Previously, we have done this in only the single dimension case. But we can use this technique if we have higher dimensionality to our data.
- Especially useful for hierarchically grouped data!

An example from Wilke with multi-dimensional faceting

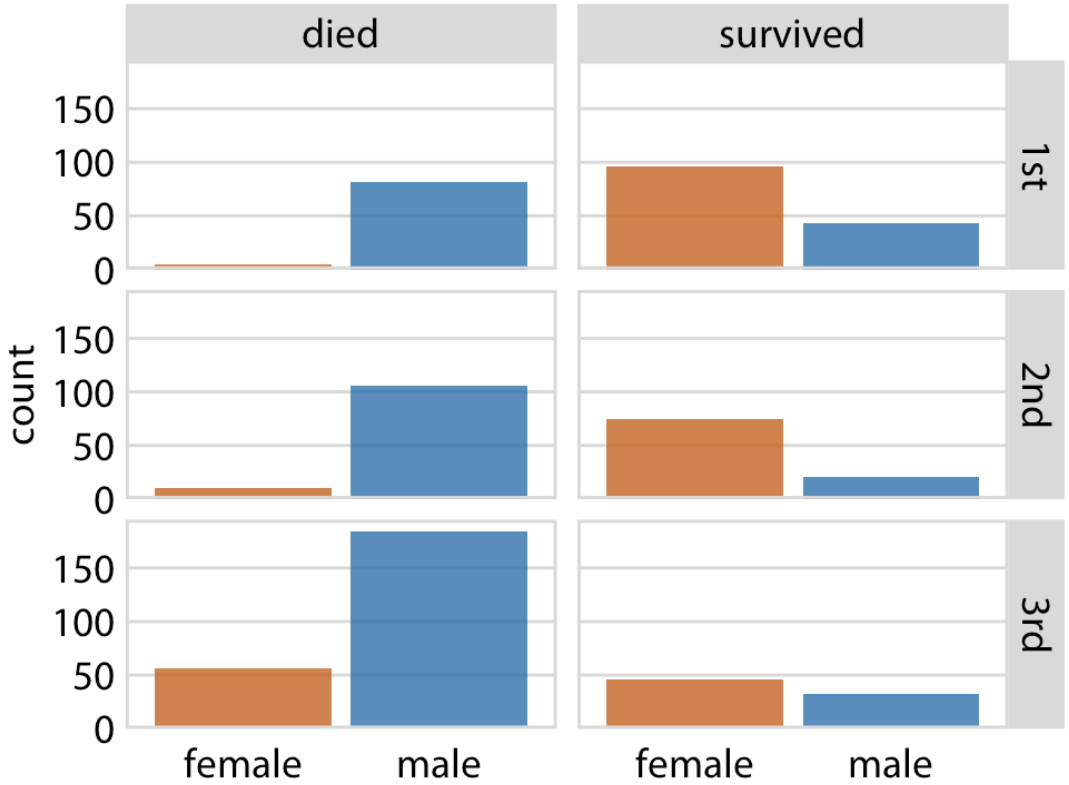


Figure 21.1: Breakdown of passengers on the Titanic by gender, survival, and class in which they traveled (1st, 2nd, or 3rd).

Figure 2: Wilke, Ch. 21

Compound Figures

- Take plots and arrange them into some sort of grid. (We talked about this last week with `grid.arrange()`).
- Less straightforward when to do this, but main issues is that the information between plots should speak to one another.
- Don't want to alter the task too much for the audience.
- Keep the visual language consistent!

Maximum Information

- We know that people can handle about 3-5 categories.
- This is even less if there is some transformation entailed in our data (Ceja and Franconeri 2020). Then we might be dealing with like 3 max. categorical points that are usable.
- What about beyond categories? What is the capacity tipping point?

Maximum Information

Let's return to this table:

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Is there a hierarchy of difficulty?

Either on the basis of information or the specific plot type?