



Design's hidden influence:

What data analysts can learn from leading designers and psychologists

Any dashboard can and should be considered as a design project. Thinking like a designer enables your audience to succeed in understanding data and taking action. In this eBook, we look at some of the most well-known theories from the design world and explore how to apply them to dashboards.

Great designers (and analysts) consider their audience

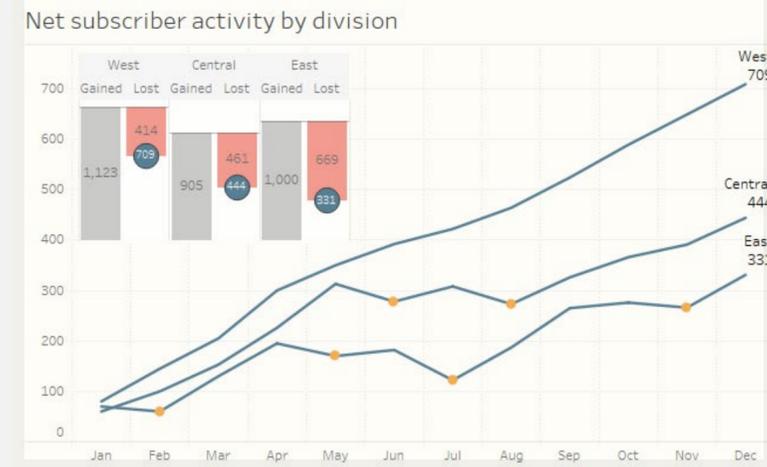
Donald Norman author of *The Design of Everyday Things* and director of The Design Lab said “Great designers produce pleasurable experiences.” When you build a dashboard, you’re hoping to convey data in an easy-to-consume way, creating a pleasurable, productive experience for your audience. The design of your dashboard will influence how the information is framed and interpreted. Consider the two following visualizations.

“

Great designers produce pleasurable experiences.

- DON NORMAN

Subscriber Churn Analysis



Details

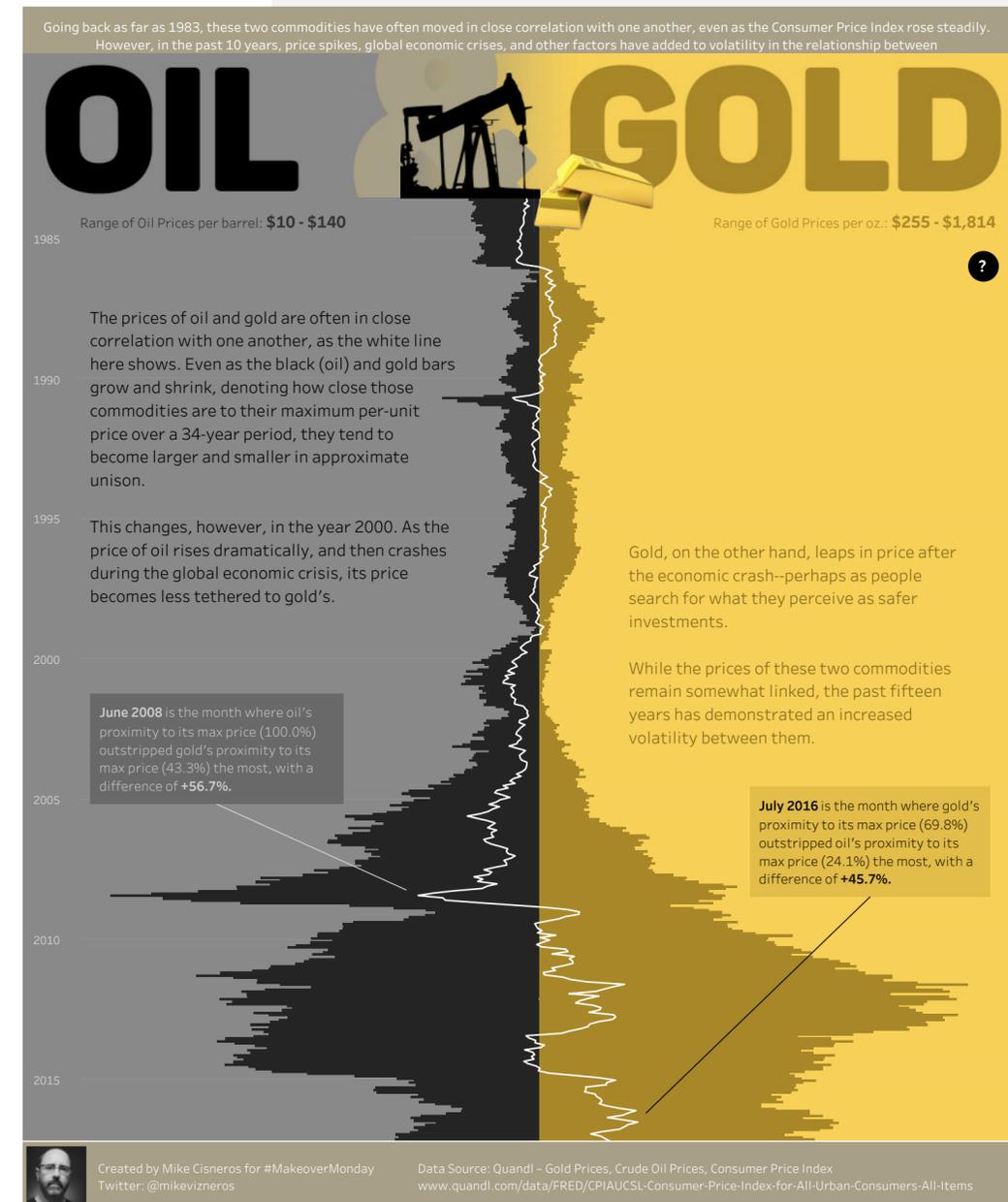
		Gained	Lost	Net	Running total
West	January	80	0	80	80
	February	80	-15	65	145
	March	90	-30	60	205
	April	120	-25	95	300
	May	100	-50	50	350
	June	119	-77	42	392
	July	75	-45	30	422
	August	119	-77	42	464
	September	90	-30	60	524
	October	80	-15	65	589
	November	80	-20	60	649
	December	90	-30	60	709
Total	1,123	-414	709		
Central	January	60	0	60	60
	February	85	-45	40	100
	March	80	-27	53	153
	April	90	-17	73	226
	May	120	-33	87	313
	June	45	-80	-35	278
	July	75	-45	30	308
	August	45	-80	-35	273
	September	80	-27	53	326
	October	85	-45	40	366
	November	60	-35	25	391
	December	80	-27	53	444
Total	905	-461	444		
East	January	70	0	70	70
	February	80	-90	-10	60
	March	100	-30	70	130
	April	110	-45	65	195
	May	70	-95	-25	170
	June	45	-33	12	182
	July	50	-110	-60	122
	August	99	-34	65	187
	September	112	-34	78	265
	October	99	-88	11	276
	November	55	-65	-10	266
	December	110	-45	65	331
Total	1,000	-669	331		
Grand Total	3,028	-1,544	1,484		

On the left

is a dashboard showing churn for a subscription service. It serves a functional purpose, with three clear goals. Each goal covers an entire row and has four panels and charts to support them. There is an executive summary on the right side for added context.

On the right

is a dashboard that shows the price of oil on the left-hand side and the price of gold over 30 years. The layout serves as a vehicle to convey an argument and engage with the audience.



Oil and Gold by Mike Cisneros

For business-monitoring purposes, you would generally favour the one on the left. But both dashboards are functional and beautiful. Like any design, the preferred format depends on the audience and the purpose.

Subscriber Churn Analysis

Subscriber activity - All

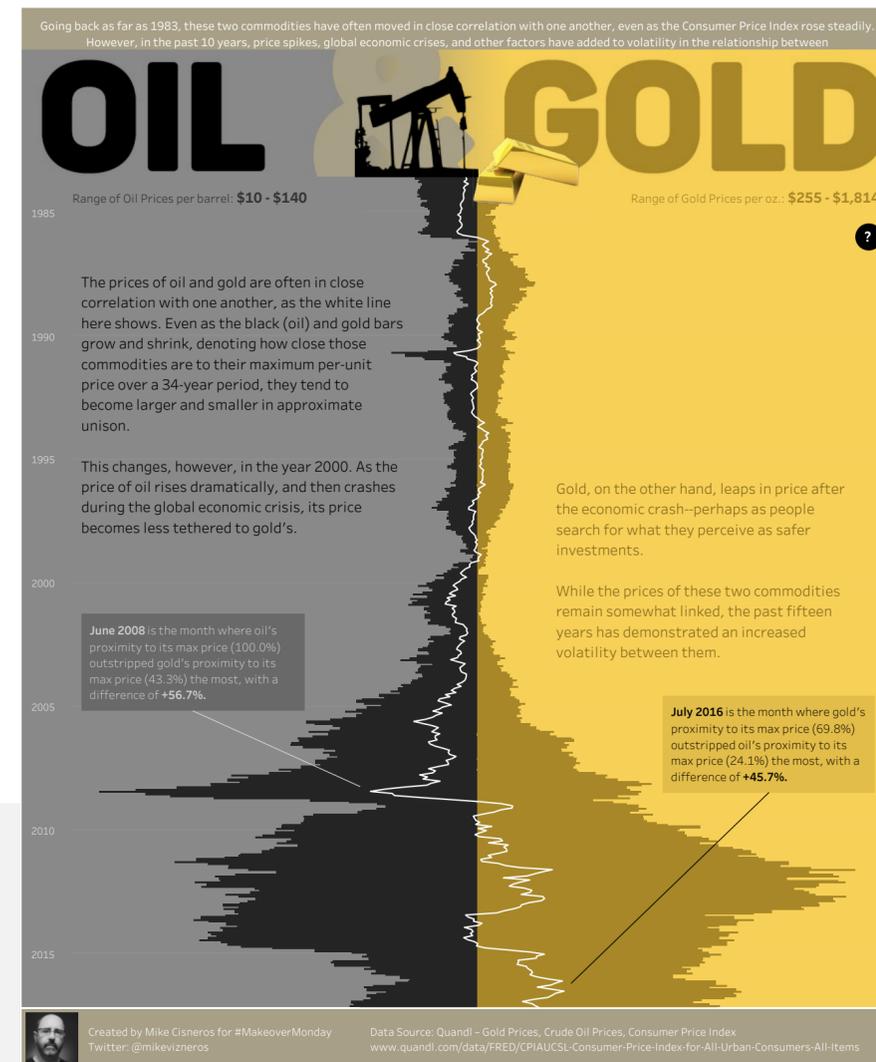


Net subscriber activity by division



Details

		Gained	Lost	Net	Running total
West	January	80	0	80	80
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Humans interpret design through three levels of processing

Don Norman describes how humans interpret designs through three levels of processing: visceral, behavioural, and reflective.

The three levels are the visceral level, which is the gut reaction evoked by the object's appearance, the behavioural level, which refers to whether or not you can perform the task that the object in question was designed to help you do, and the reflective level, which is whether or not the user felt that the task was successful.

**Whether you like it or not,
appearances matter.**

Subscriber Churn Analysis

Subscriber activity - All



Net subscriber activity by division



Details

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Subscriber Churn Analysis, The Big Book of Dashboards

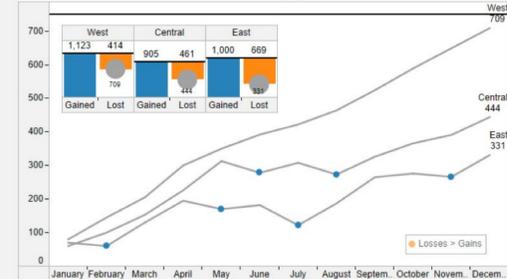
Visceral Level of Processing

Whether you like it or not, appearances matter. Thinking about how your dashboard looks is the first step to success. People like to use something that they like the look of. Consider the following two dashboards.

Subscriber Churn Analysis



Net subscriber activity by division



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	September	90	-30	60	524
	October	80	-15	65	589
	November	80	-20	60	649
	December	90	-30	60	709
Total	1,123	-414	709	4,829	
Central	January	60	0	60	60
	February	85	-45	40	100
	March	80	-27	53	153
	April	90	-17	73	226
	May	120	-33	87	313
	June	45	-80	-35	278
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The dashboard shows customer churn for a software-as-a-service company. The version on the top has a modern design with calm colors, and gentle formatting. The one on the bottom has much harsher, more saturated colors and inconsistent shading.

Behavioural Level of Processing: Affordances and signifiers

Although all of these layers of processing apply to dashboard design, the behavioural level of processing is critical, determining how a person interacts with your dashboard and eventually discovers an insight. A behavioral task is shaped by many things, including affordances and signifiers:

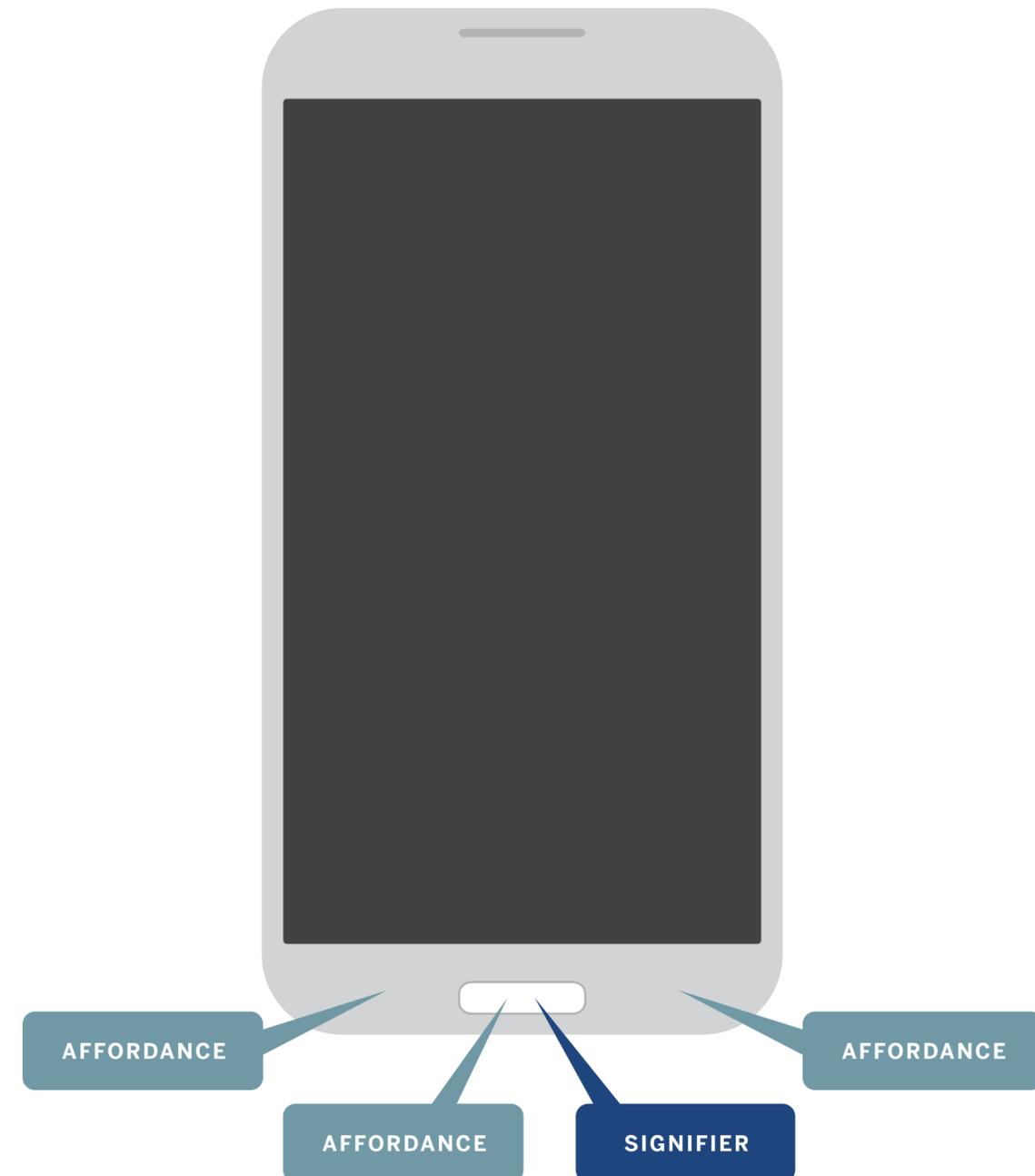
An **affordance** refers to the things an object can do.

A **signifier** refers to the indicators that show me how I can perform a task.

Let's apply this concept to a familiar object. On an Android smartphone, I know that I can press the middle button to wake up my device. This button is the only **signifier**—a visual guide where I know that if I press it, it will act as my Home button.

If I press on the left side of the button, I switch applications and the right side acts as a back button to undo the previous task. These are **affordances** that the device can perform. If you didn't know how to use an Android phone, you probably wouldn't know that the flat edges were buttons you could press.

Take the same concept and apply it to a dashboard. Think about how people can discover the things a dashboard can do. If there is nothing to signify an interaction, they may not know that they can take an action—and they may miss an insight as a result.



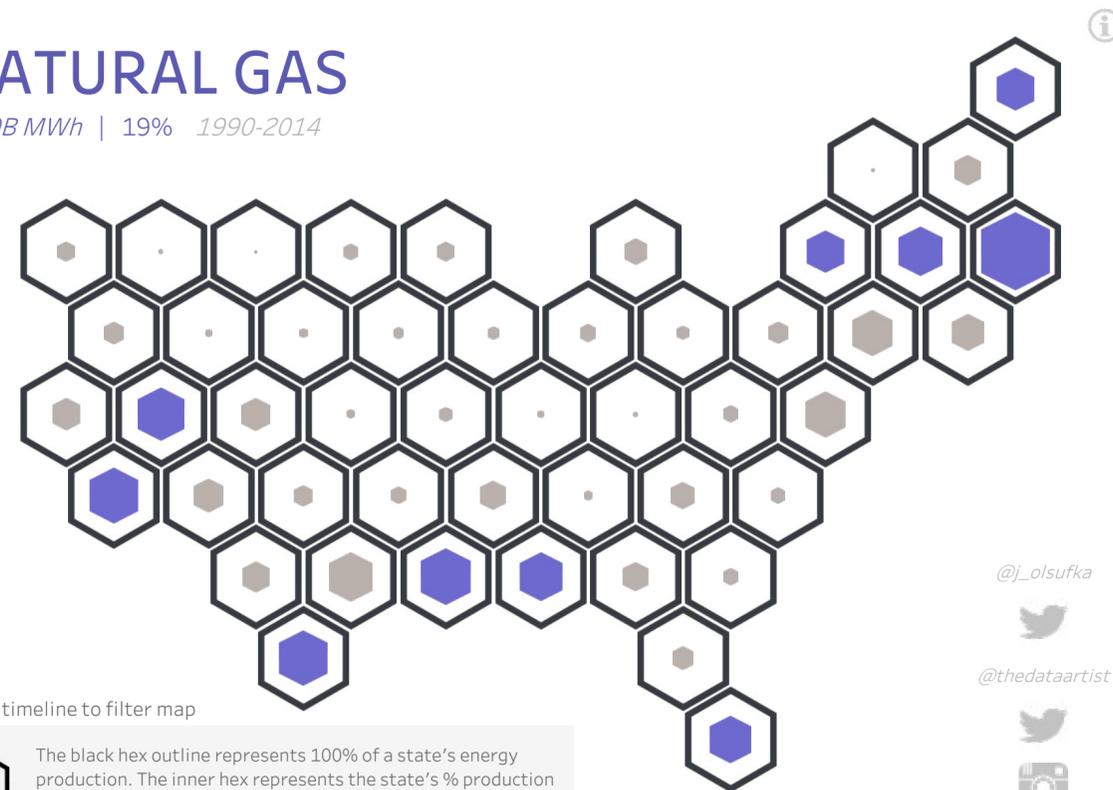
This example shows how different energy types are used across the USA.

ENERGY IN AMERICA
CREATED BY JACOB OLSUFKA AND HUNTER BARRETT



NATURAL GAS

17.9B MWh | 19% 1990-2014



@j_olsufka



@thedataartist

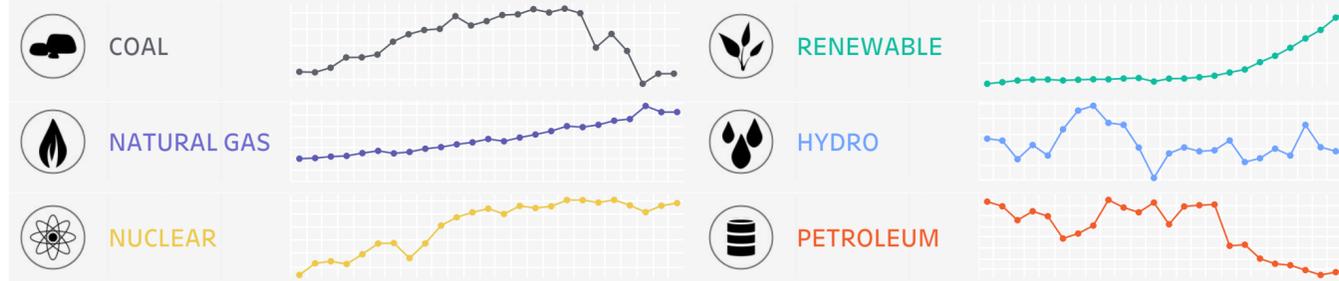


LEGEND click icon or timeline to filter map



The black hex outline represents 100% of a state's energy production. The inner hex represents the state's % production of the selected energy source. If the inner hex is colored, the selected energy source is top ranked for the state.

'90 '91 '92 '93 '94 '95 '96 '97 '98 '99 '00 '01 '02 '03 '04 '05 '06 '07 '08 '09 '10 '11 '12 '13 '14

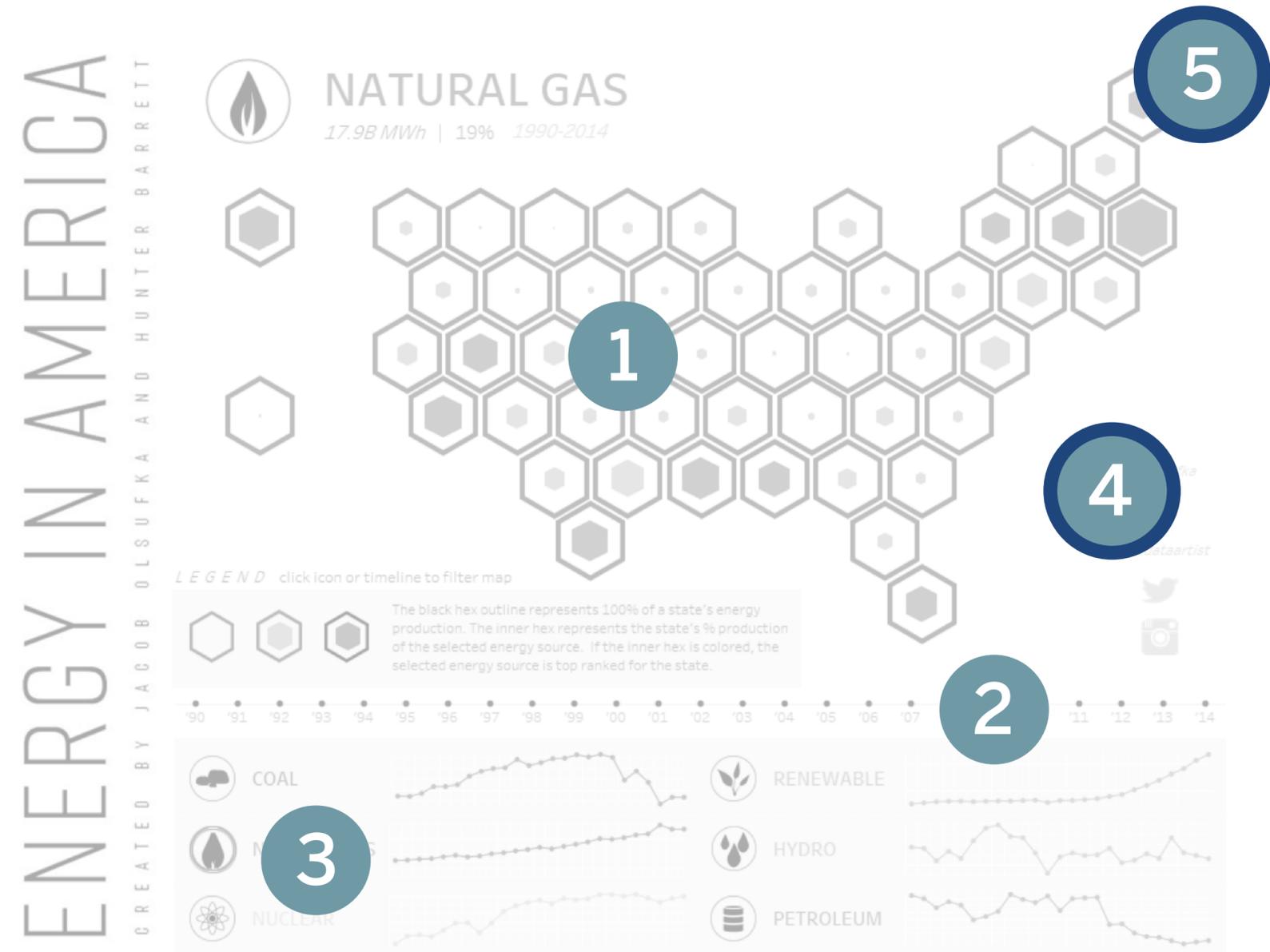


Energy in America by Jacob Olsufka

There are five affordances, but not all have signifiers:

1. The Hex Map of the USA is clickable and changes the timelines at the bottom of the dashboard. There is no signifier for this. Users have to discover this for themselves.
2. Clicking on the timeline dots filters the map to that point in time. The text (“a”) is a signifier for the user.
3. Clicking on the icons by the timeline changes the map to show power for that energy type. The text (“a”) is a signifier, telling the user this can be clicked on.
4. The social media icons link to Jacob’s Twitter and Instagram pages. While these may not appear as buttons, most people will interpret them as clickable objects.
5. The little “i” in the top right contains a tooltip with lots of background information about the data source. This is likely to be seen as a signifier, but it’s position in the top right reduces its discoverability.

When you design a dashboard, you need to consider how users will discover the affordances that lead them to take action. If there is no signifier, your audience might not discover the interactivity available to them. A design looks sleek when you remove the affordances but it makes the behavioural level of processing harder. Your dashboards exist to enable your audience to complete a data-related task; assume that more affordances are better for most dashboards.



SIGNIFIER

AFFORDANCE

Framing affects how people interpret information

Psychologists Amos Tversky and Daniel Kahneman are considered psychology pioneers, with their first research published in 1981. They found that the framing of a question determines how people respond to the question, and ultimately, how they make decisions. The way that you present your data (even in a dashboard) will control how people interpret the information.

Scenario: Imagine that there is a fatal disease affecting a population of 600 people and there are two treatment options: A and B (displayed in the dashboard on the right).

Did you choose A or B?

In their research, this framing led 72% of people to choose Treatment A.

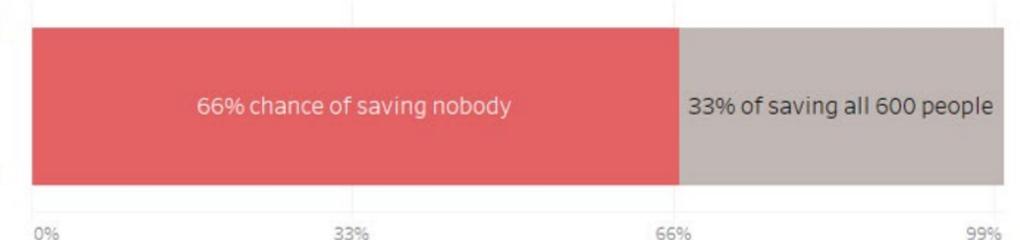
600 people are affected by a deadly disease. We have two treatment options, A and B.

Which treatment should we choose?

Treatment A will save 200 lives.



Treatment B has a 66% possibility of saving no one, and a 33% chance of saving all 600 people.



Now consider the following version. Would you make the same choice?

Note that in both cases the data is exactly the same. It is only the presentation and wording—the framing—that is different.

This framing lead only 22% of people to choose Treatment A.

600 people are affected by a deadly disease. We have two treatment options, A and B.

Which treatment should we choose?

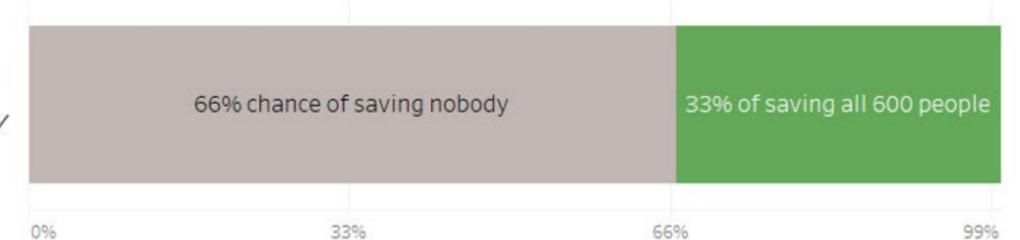
Treatment A:

400 people will die



Treatment B:

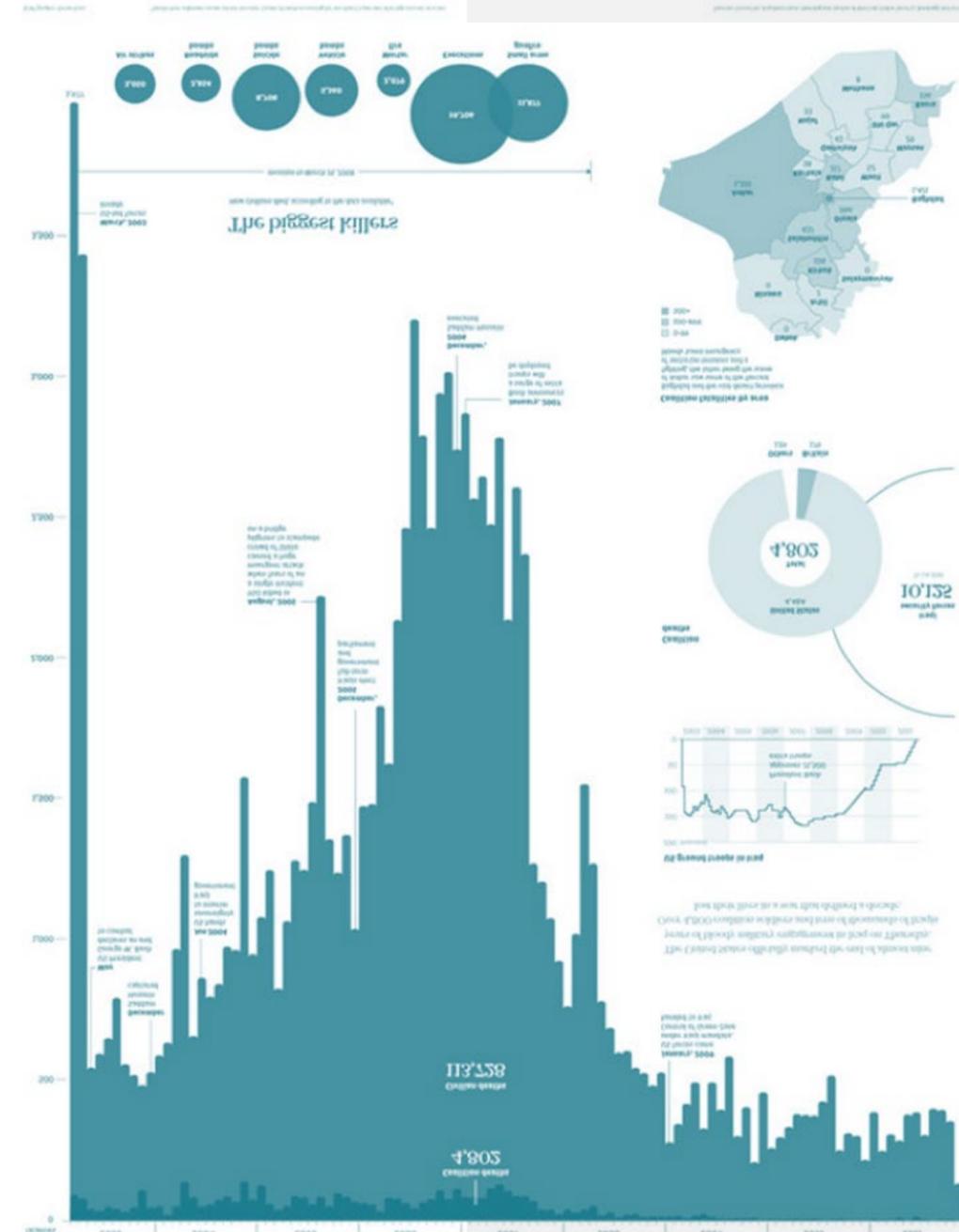
A 33% chance no people will die, 66% probability that all 600 will die.



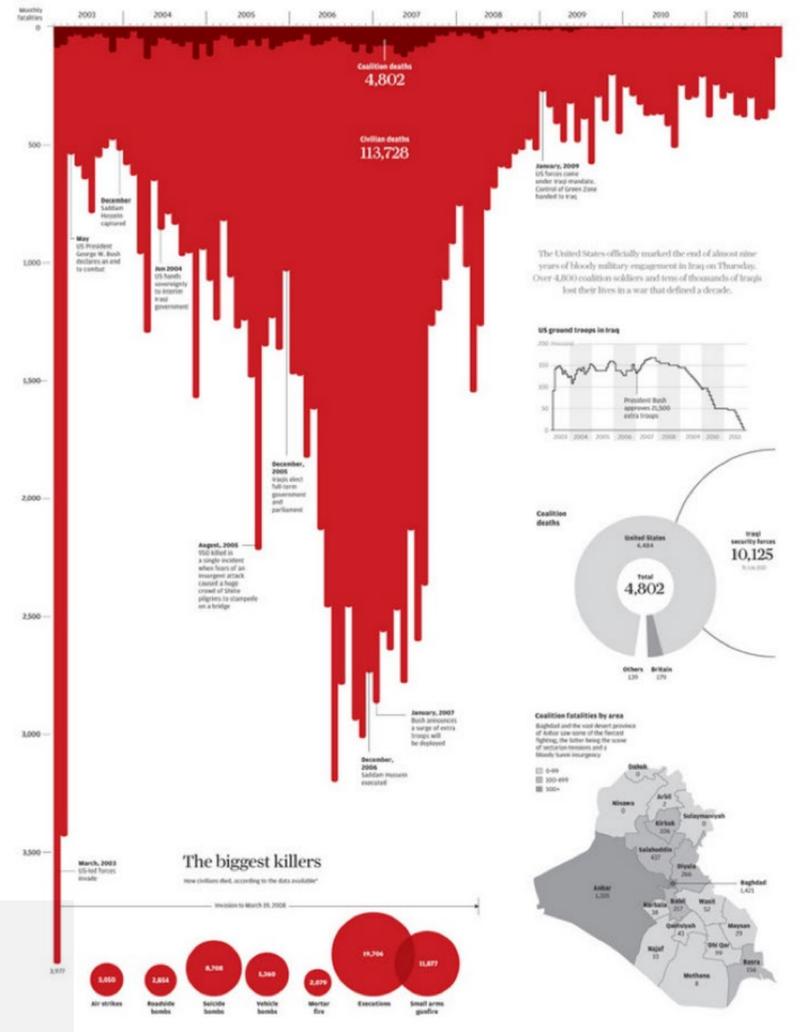
Iraq: Deaths on the decline

On the right

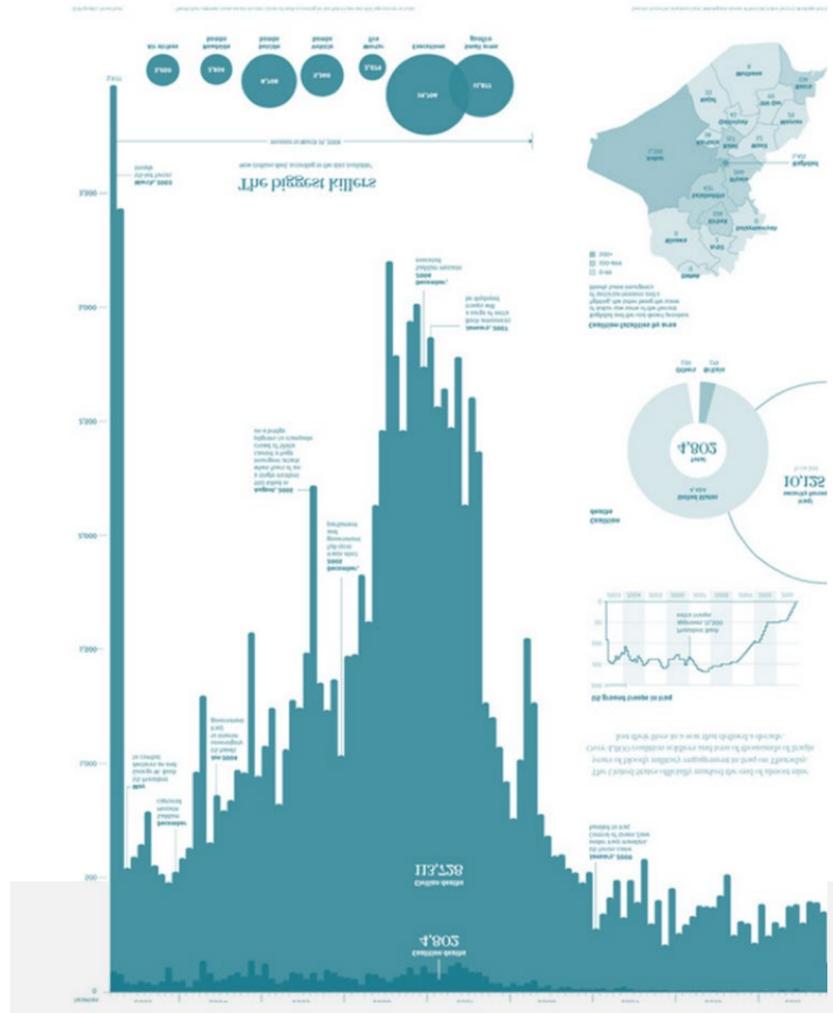
the visualization takes a different approach—the bars are flipped and the color scheme is non-evocative.



Iraq's bloody toll



Iraq: Deaths on the decline



The data hasn't changed and neither has the chart. But changing the orientation, color, and the title of the visualization completely shifts the message and the viewer's reaction.

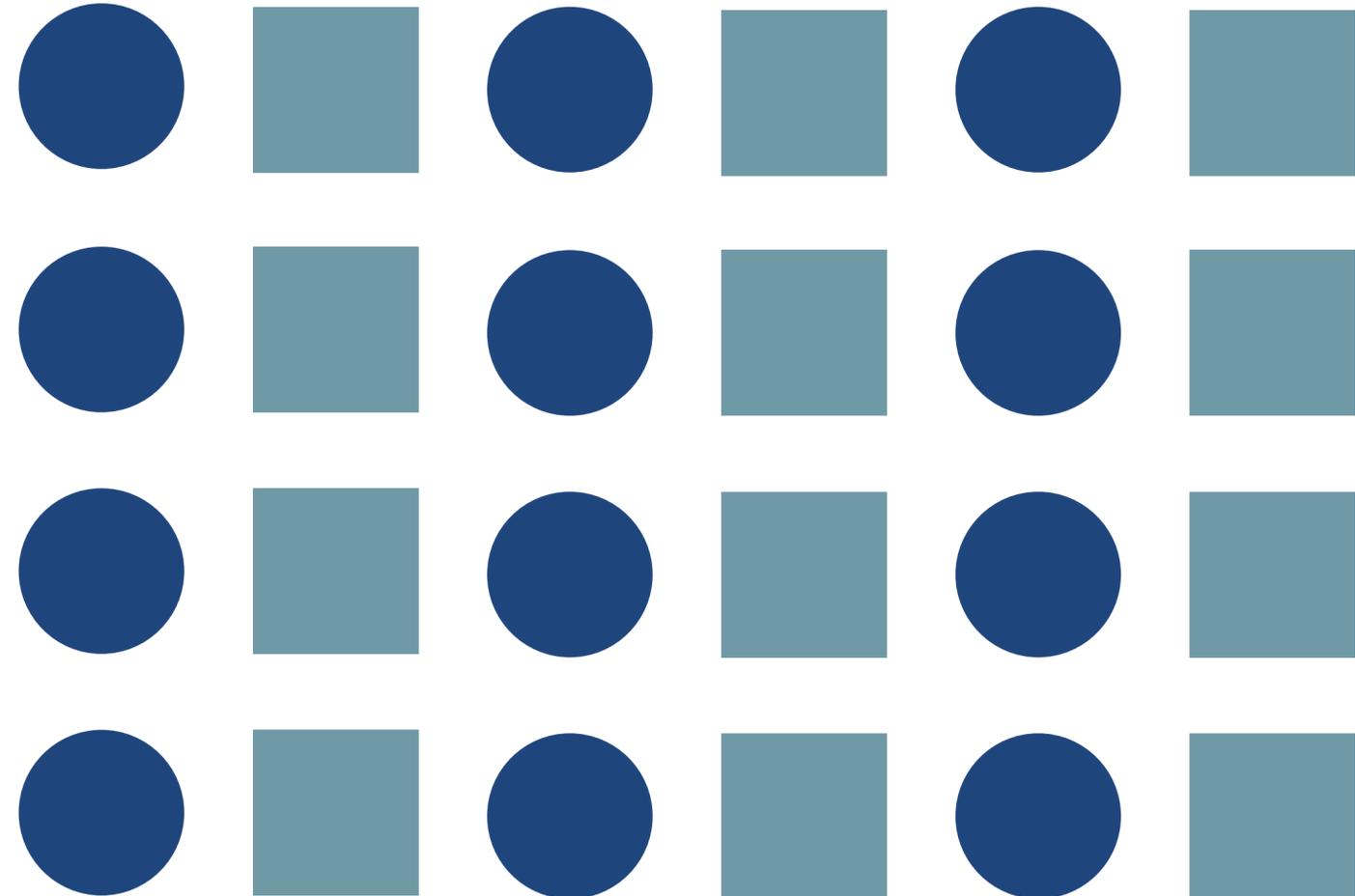
This is the power you wield as dashboard designers. Color, orientation, and text are just three ways you can control how people interpret your dashboards and discover insights.

Dashboard layout should follow a logical flow

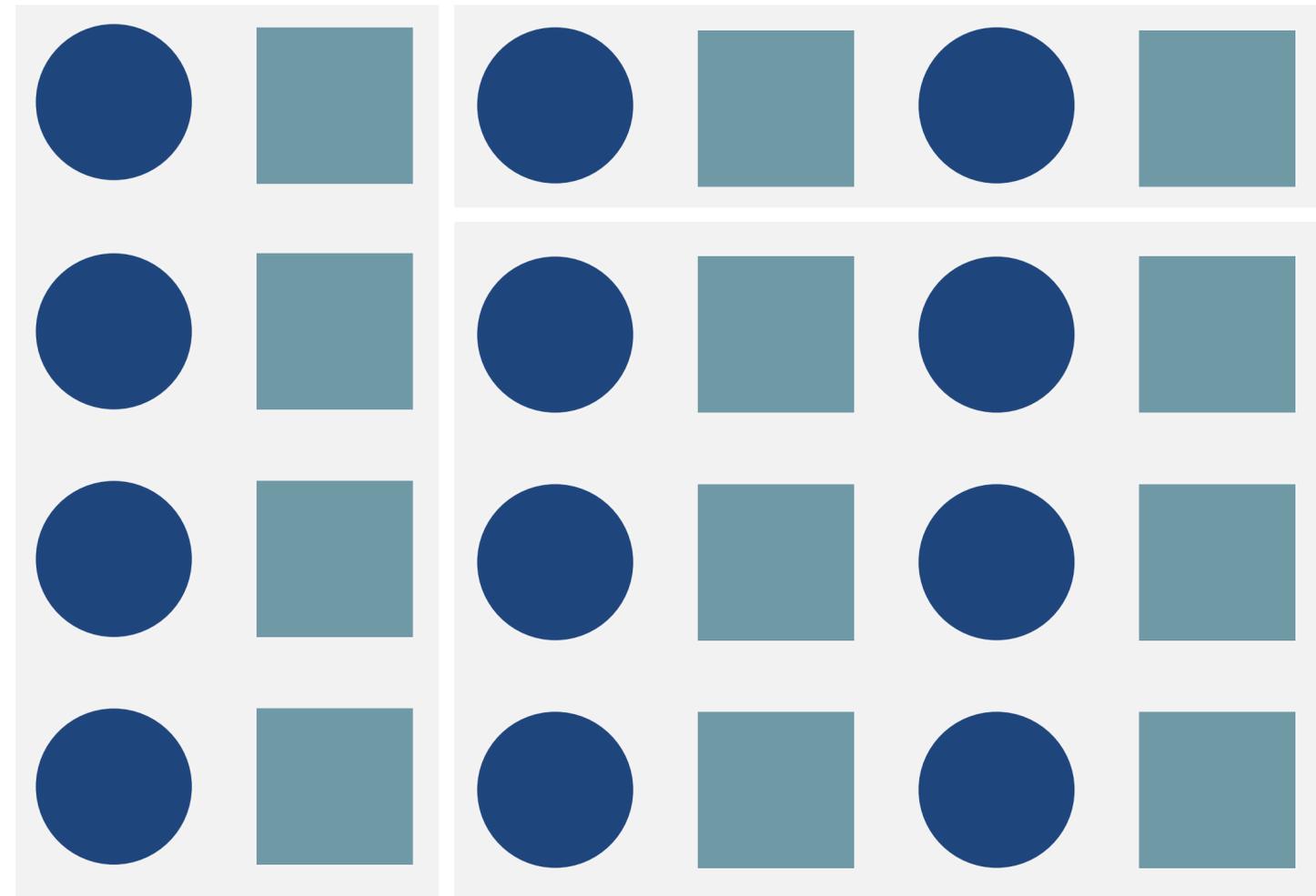
How your audience “reads” your dashboard is not a trivial consideration. Your dashboard needs a sensible “flow” and a logical layout of different pieces of information. Design theory gives us plenty of advice on how best to succeed.

Uniform Connectedness

In 1983, Stephen Palmer, a UC Berkeley researcher and teacher of visual perception, came up with the theory of uniform connectedness. When you take a grid of shapes, the very nature of the shapes creates a sense of connectedness. In this example, the shapes appear as six vertical columns. You could take the objects and use visual encodings to group apparently similar objects into distinct groups.



What if I draw grids around them? Now I've created four different groupings just by adding borders. Or I could use shading. Now these objects are grouped into three separate places.



TRANSPORTATION REPORTS

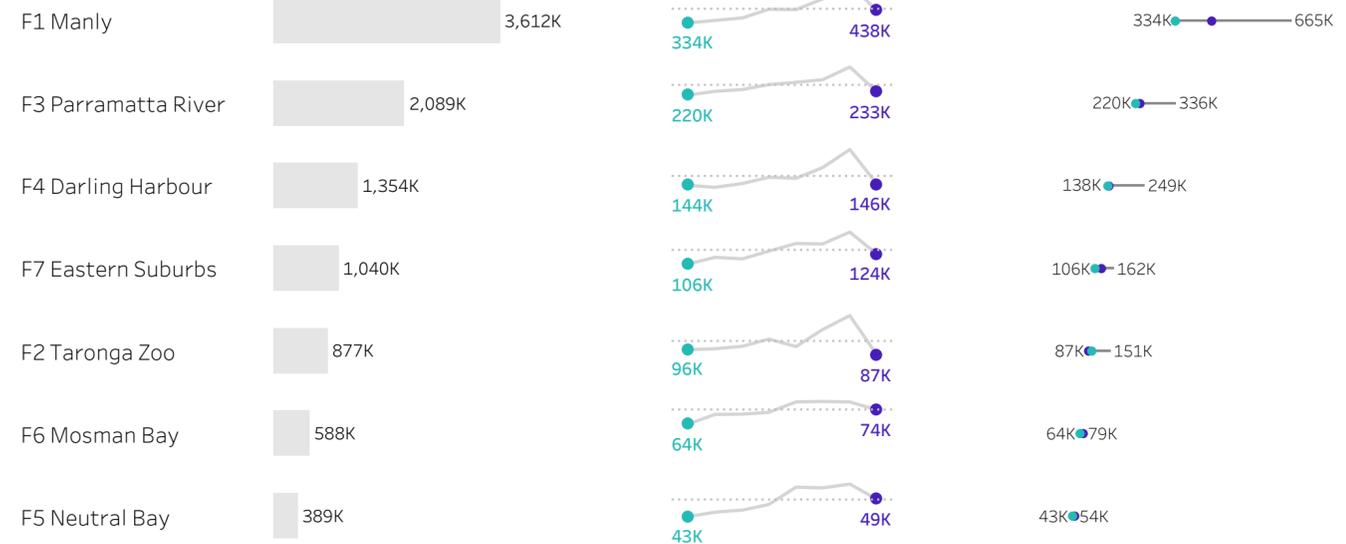
SYDNEY FERRY PASSENGER TRENDS AND ANALYTICS

CARD TYPE All
MONTH/YEAR Jul 16 Feb 17

SUMMARY DATA



LINE DATA



Designed by @DavidAKrupp

Source Transport for New South Wales Open Data

Legend min Jul 16 Feb 17 max

On the left

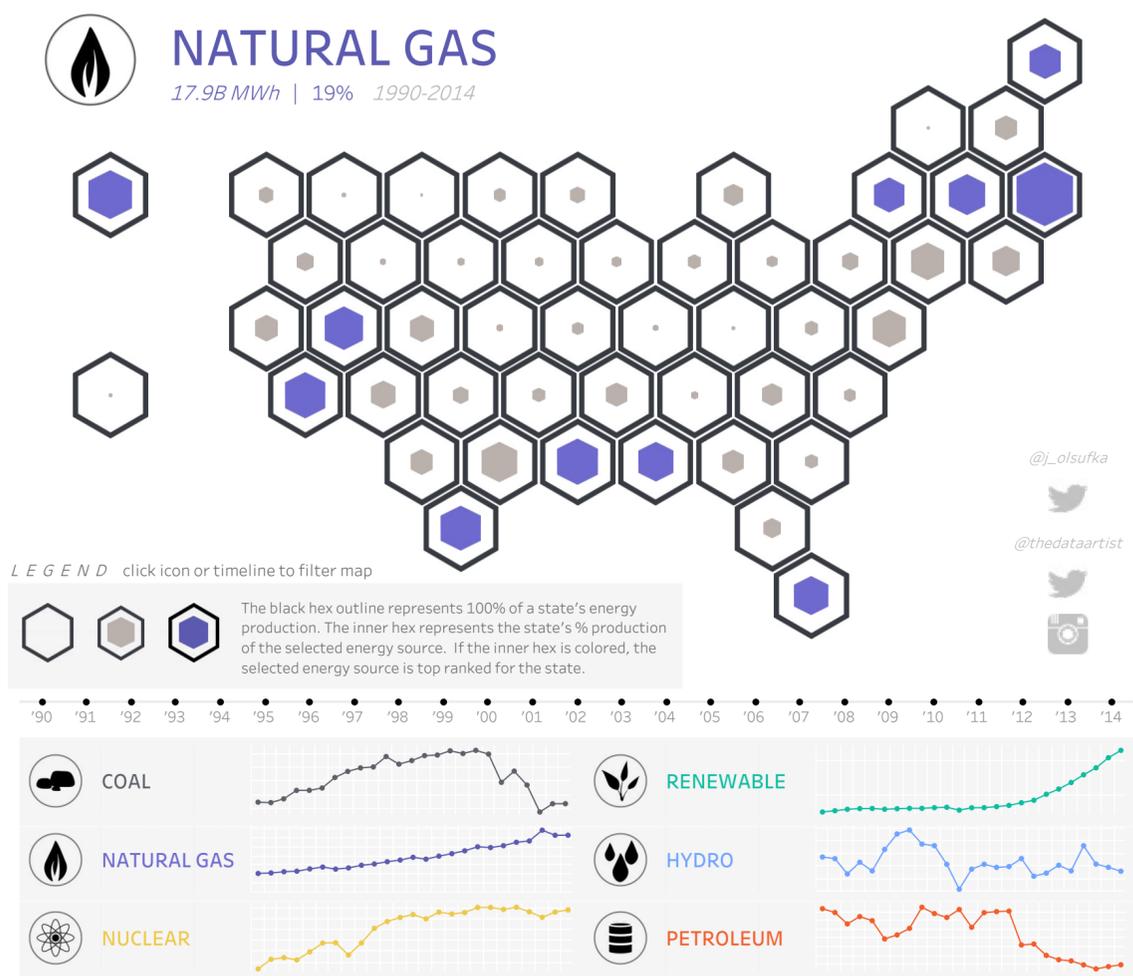
David Krupp uses horizontal lines to divide the summary and the detail. Each column has a separate style—text, grey bar, dotted sparkline and dot plot. They sit well within the white space but are clearly linked together. If everything was glued together and there were no lines, it would require a lot more cognitive work for the user to understand exactly which charts and columns are related to each other.

On the right

Jacob Olsufka grouped the hexes closely so we easily perceive the map of the United States, gave the legend and supporting text a common background, and grouped the social icons using proximity.

As you design your dashboard, consider the parts form logical groups and use your design to group them together. Shading, lines, white space, and color are all useful ways to make the connections.

ENERGY IN AMERICA
CREATED BY JACOB OLSUFKA AND HUNTER BARRETT



Energy in America by Jacob Olsufka

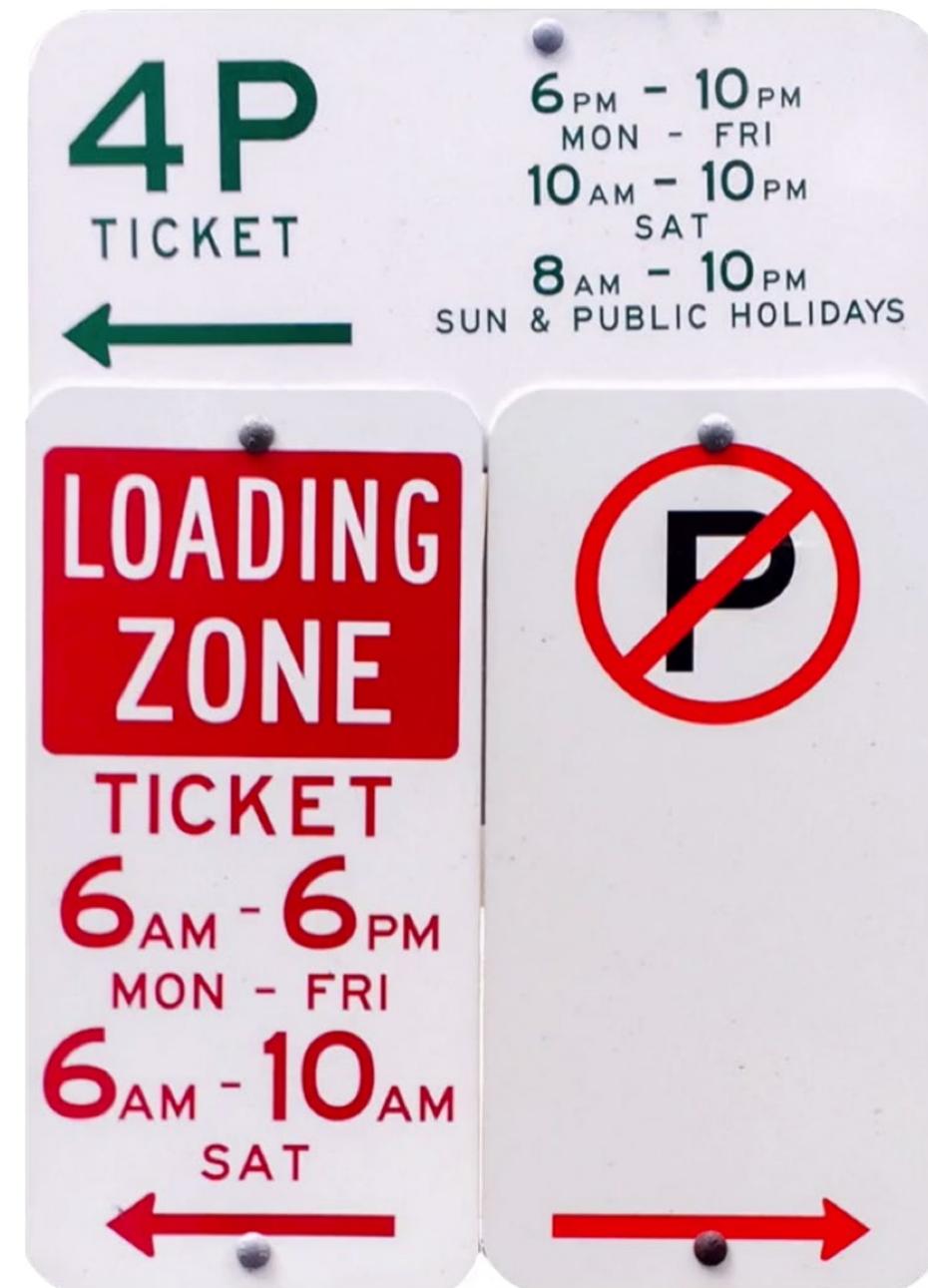
Simplify your design for maximum impact

Hick's Law

Hick's Law (developed by psychologists William Edmund Hick and Ray Hyman) states that when the number of alternatives increases, the time it takes to make a decision increases. So the more elements in the visualization, the harder it will be for your audience to make a decision based on the information.

We can support complicated decisions by reducing the cognitive load on our end users. Whenever you build dashboards, step back and measure how many interactions, how many eye movements, and how many mini tasks it takes to answer the question that dashboard is purporting to support. Your goal is to lay out your charts and filters in a way that simplifies your audience's role in interacting with the dashboard.

Let's use this example of a street sign. It's 6:00 PM on a Sunday. You're stressed and under time pressure. You're driving past this sign. Can you park? And if so, for how long? Note: 4P represents a four-hour parking pass.

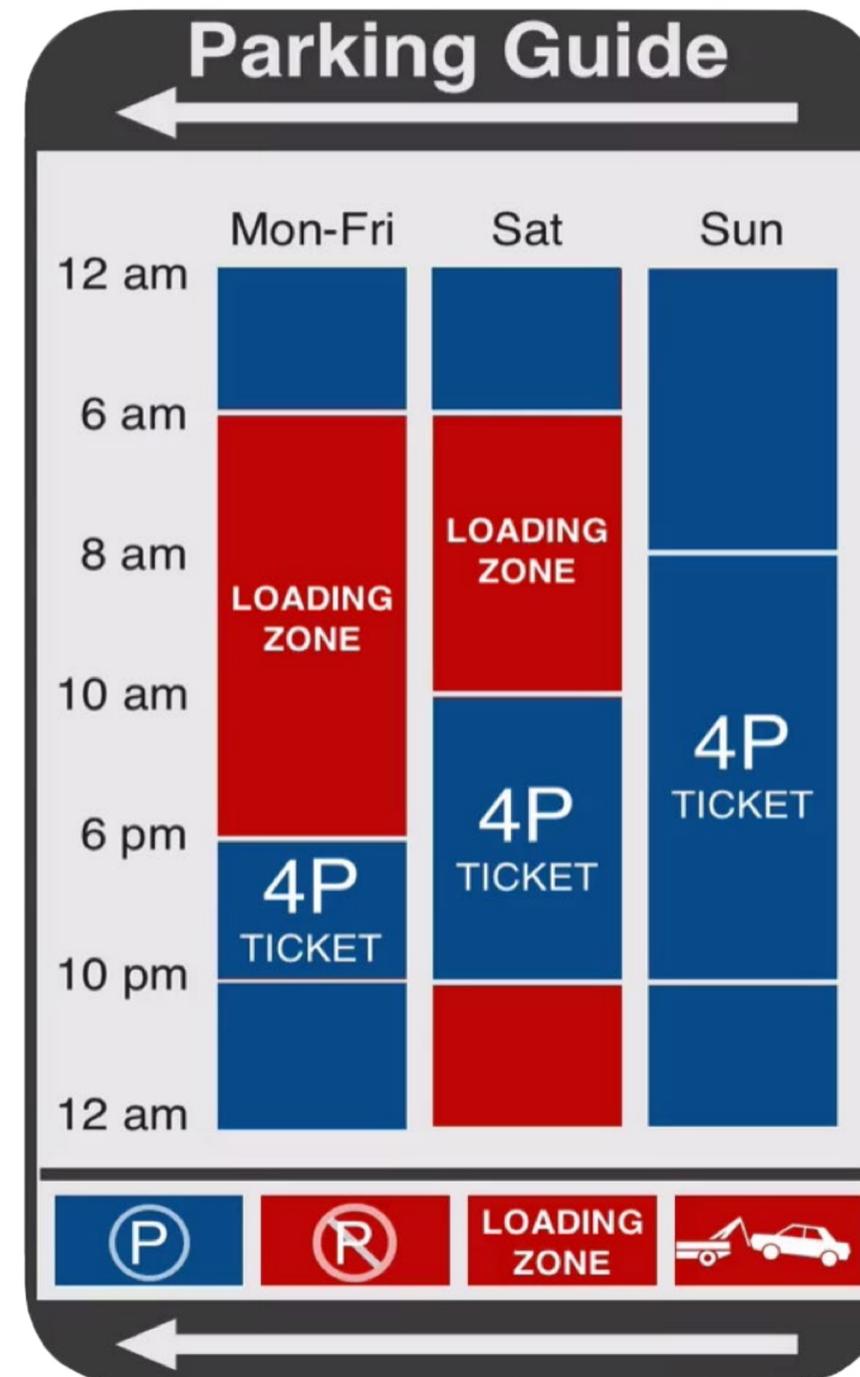


It's a difficult decision, right?

To show how this relates to data visualization, Mac Bryla redesigned this sign (below), using color, layout, and formatting to make it easier for the user to reach a decision.

Hick's Law doesn't say decisions themselves must be simplified. Instead, it states that the more complexity you involve in reaching a decision, the harder it is to reach that decision. Simplifying dashboard layout is an important aspect in helping your users reach the right insight, quickly.

Simplifying dashboard layout is an important aspect in helping your users reach the right insight, quickly.



Conclusion

A dashboard is successful when people can easily use it to derive answers. Even a beautiful dashboard with an interesting data source could be rendered useless if your audience can't use it to discover insights. Think not just as a data scientist, but also as a psychologist and a designer. Dashboards should:

- Be a pleasure to use.
- Have interactive elements that are discoverable and predictable
- Follow a sensible, logical layout
- Have a simplified design that makes complex decisions easier

Additional Resources:

[Good Enough to Great: A Quick Guide for Better Data Visualizations](#)

[Making Flow Happen: Dashboards that Persuade, Inform, and Engage](#)

[The 5 Most Influential Data Visualizations of All Time](#)

