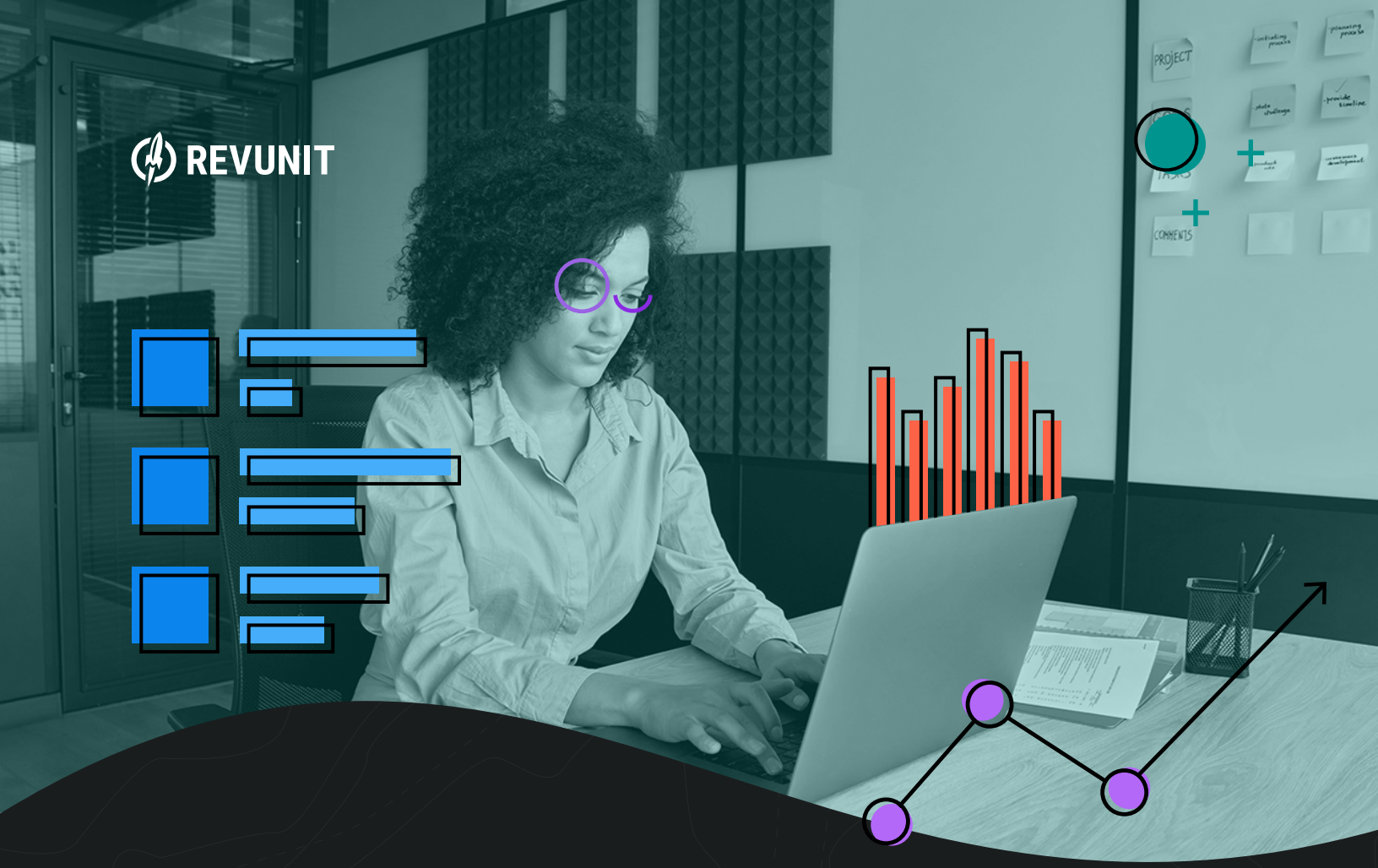


REVUNIT

The Complete Guide to Better Data Visualization

What every leader and data practitioner should be thinking about right now in order to develop their skills and “level-up” their data visualization game

The demand for data visualization knowledge and skills has never been greater.

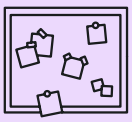
In fact, the global data visualization tools market is projected to grow from $5.9 billion in 2021 to $10.2 billion by 2026, according to a Research and Markets report. The need for accurate, real-time data storytelling is only growing in the current environment, placing more pressure on individuals and teams to “level up” their data visualization game. Yet, many individuals—especially those who haven’t had classical design training—often lack the foundational knowledge needed to be successful.

This resource is intended to get to the crux of how and where you should focus your learning in order to “level up” your data visualization skills.

01– Take the time to better understand how perception, memory, and psychology influence data visualization

Psychology helps us better understand how humans find patterns and make meaning in visual space. Understanding our natural tendencies can help designers ensure meaning is easily accessed and understood from a noisy landscape. Humans are pattern-seeking creatures, so if we don't emphasize the patterns that matter most, viewers are left to create their own.

– Allison Hu, Director, Design Research, RevUnit



How Understanding Perception Can Level Up Your Data Viz Skills

- Highlights the fact that visuals are processed quickly and subconsciously
- Creates awareness of how visuals impact memory through our photoreceptors
- Furthers understanding of how form, color, position, and motion draw the eye
- Forces you to be mindful of how shape and color can be used with intention

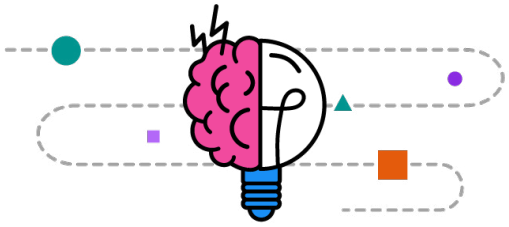
Take an active interest in the physiological aspects of data viz

The unintentional misuse or miscommunication of data is one of the most common, yet consequential results of poor data visualization techniques. But many of these errors can be corrected over time, especially if you learn to master the underlying principles that most directly influence our perception and understanding of statistical data. Even the slightest uptick in applied, foundational understanding can be a force multiplier toward better data storytelling.

Anyone interested in the meaningful, predictable, and repeatable visual communication of data should be actively looking to “up” their data visualization game. Doing so starts with a much more thorough understanding of the confluence of biology, psychology, and visual design (which we’ll only briefly touch on in this Guide). When you’re able to understand even the foundational principles, you’re more easily able to translate your knowledge into practical guidelines for displaying complex information in ways that are more easily understood.

Learn more about how the brain makes sense of visual information

Your brain is made for visual processing. In fact, it processes visuals 60,000 times faster than text. That is why it is essential to have a fundamental understanding of the physiology of the human eye, what it’s role is in shaping perception, and how certain types of memory work together to make sense of visual information.



After visual input hits the retina, the information flows into the brain, where information such as shape, color, and orientation is processed in as little as 13 milliseconds according to MIT neuroscientists. This rapid processing of visual information is the result of subconscious accumulation of information from the environment; this is known as Preattentive processing (PaP). It’s a product of the rods and cones, the two forms of photoreceptors within the retina, being drawn to the various ways that shape and color are constructed in the world around us.

Preattentive processing is also associated with our short-term, or "iconic," memory; it's often referred to as tapping into our "reptilian" brain in that it allows us to quickly process things at a superficial level for the sake of drawing our attention to things that might be of importance. This ability, at its most basic level, helps us survive, which is why it is so strongly rooted in our system.

Form, color, position, and motion are all examples of elements that affect preattentive processing. Knowing how the brain processes this information provides the opportunity for data practitioners to develop more effective, clearly communicated data visualization.

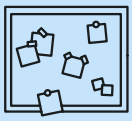
The field of data visualization is almost entirely dependent upon one’s ability to absorb and process a variety of stimuli, primarily via our sense of sight. Our visual system, then, is the first line of absorbing and understanding data via visualization. Knowing how the visual system works is a crucial part of understanding how we can more effectively present and communicate key data stories.

— CJ Weatherford, Director of UX, Data Visualization & Strategy, RevUnit

02– Learn to recognize when and where it’s most appropriate to use basic visualization techniques

If you do a quick Google search for ‘data visualization,’ or if you simply browse the catalog of options in most BI tools, you'll find that there's no shortage of visual options available to you. But you should ask yourself, ‘Is this simply an option, or is this an optimal, efficient, and effective option?’ What generally happens when we become more intentional with a craft is we learn that there are basics that can be heavily leaned on to put us in a great position for success. It’s no different when it comes to data visualization.

— Corey Campbell, Director of Design, RevUnit



How Mastering Foundational Techniques Can Level Up Your Data Viz Skills

- Increases familiarity with the range of visual display formats at your disposal
- Creates a deeper understanding of the strengths of individual display formats
- Helps to more quickly identify what kind of visual display best suits your aims
- Allows for the chosen visual display format to be used with greater intention

Master the basics, know your way around common visual display formats

When you know more about the ways in which certain visuals impact perception, you will have greater comprehension of how graphs, tables, and other display formats affect data visualization, so it’s important to understand the basics of these different formats.

While there are others, most visual data display formats can be broken down into two categories: tables or graphs.

Fundamentally, **a table is a series of rows and columns in which textual information is used to show relationships**. Tables are used for looking up and comparing individual values, for when the quantitative information being communicated involves multiple units of measurement, or when both summary and detail values are included.

While there are far more variations than with tables, **graphs (or charts), at their most basic, are a visual representation of information**. Graphs provide scale, typically an axis, used to label and assign values to visual objects. Typically they're used when the message of the data displayed is needed to reveal relationships or trends rather than individual values. Common graphs employed in data visualization include column charts, bar graphs, dual axis charts, line graphs, bullet charts, and more. You can look at a deeper dive on graph types by HubSpot.

With a greater understanding of the basic structures of different display formats and their unique visual impacts, data practitioners can be far more intentional with their display format choices for clearer insights and better data storytelling.

Select the most appropriate format for your needs, consistently

For each visual display option you choose for your data, you should always ask, "Is this simply an option, or is this the most efficient, effective, and optimal option for the data story I want to tell?"

Gene Zelazny, in his 2001 book *Say It With Charts*, noted five analysis types: component comparison, item comparison, time-series, frequency, and correlations. Stephen Few, in his 2004 book Show Me the Numbers, added three more categories: nominal comparisons, deviation, and geospatial comparisons, resulting in the following complete taxonomy:

→ Time Series
→ Ranking
→ Part-to-Whole
→ Deviation
→ Distribution
→ Correlation
→ Geospatial
→ Nominal Comparison

So let's break those down, and determine what graph types to use with each.

Time Series

Time series trends and comparisons display quantitative values along multiple, sequential points in time.

Example: You're looking to purchase stock with a specific company so you want to understand the historical trend of that stock's performance, as well as the performance of the industry/market it's in, so you can see its volatility and growth patterns.

Key phrases for this analysis type: change, rise, increase, fluctuate, grow, decline, decrease, trend

Best graph types to use: lines, lines and points, points only, vertical bars, vertical boxes

Ranking

Ranking displays how distinct/separate quantitative values relate to one another sequentially by magnitude, from low to high or high to low.

Example: You're the director of a major region for your company and you want to understand how the markets in your region compare to one another so you can plan your priorities for the next quarter.

Key phrases for this analysis type: larger than, smaller than, equal to, greater than, less than

Best graph types to use: Points only, bars

Part-to-Whole

Part-to-Whole relates the individual parts of a grouping to the whole of that grouping. magnitude, from low to high or high to low.

Example: You're running for political office and you want to know the demographics of your base so you can make better decisions about where to spend your campaign funds and where to plan out stops for rallies.

Key phrases for this analysis type: rate, rate of total, percent, percent of total, share, accounts for X percent

Best graph types to use: Bars, stacked bars

Deviation

Deviation displays the degree to which one or more sets of quantitative values differ in relation to a primary set of values.

Example: You're the operations director at a plant and you want to understand the production variance to plan for all the items you produce to find where the largest gaps exist.

Key phrases for this analysis type: the degree to which, differs from, plus or minus, variance, difference, relative to

Best graph types to use: Bars, lines

Distribution

Distribution displays the way in which one or more sets of quantitative values are distributed across their full range from the lowest to the highest and everything in between.

Example: You're trying to plan out a work schedule for your employees and you want to know the number of call-ins for each day of the week over the past year to see if there's an equal distribution or if there's a concentration around specific days.

Key phrases for this analysis type: frequency, distribution, range, concentration, normal curve, normal distribution, bell curve

Best graph types to use: bars, lines, points, boxes

Correlation

Correlation displays the relationship between two paired sets of quantitative values to demonstrate whether or not they are related, and if so, the direction of the relationship and the strength of the relationship.

Example: You're interested in the relationship between units per basket and total transaction price to better understand shopper behavior.

Key phrases for this analysis type: increases with, decreases with, changes with, varies with, caused by, affected by, follows

Best graph types to use: Points, bars

Geospatial

Geospatial features the geographical location of values, positioning those values on a map.

Example: You want to understand how where you live is doing with regards to confirmed cases of COVID compared to other areas of the country.

Key phrases for this analysis type: geography, location, where, region, territory, country, state, city

Best graph types to use: Color intensity, lines, points (varying size and/or varying color intensity)

Nominal Comparison

Nominal comparison displays a series of discrete quantitative values to highlight their relative sizes.

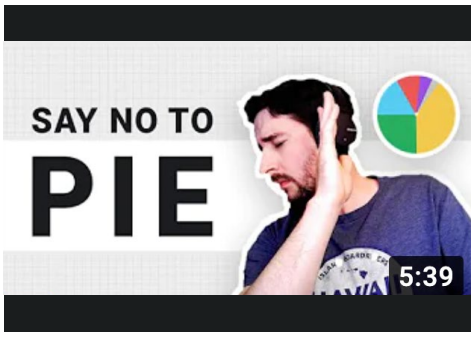
Example: You need to build a sales report that's updated everyday for your SVP of sales. She prefers to see all sales regions in a specific order, and for that order to be the same every day. Rather than having the regions dynamically update based on rank, they stay static so she can quickly identify approximate performance without reading labels.

Best graph types to use: Bars, points

By knowing what display formats are best tailored for your data visualization aims, you're far more likely to gain critical insights into your data sets.

Probably the most common mistake we see is the misuse of a graph type in data visualization. A good rule of thumb is to stay away from pie charts and default to bar graphs. And in our opinion, a highly underrated format is the bullet graph. It was developed by Stephen Few (a pioneer in data viz) and is used to showcase a primary measure against other measures in a single view.

To learn more about our insight into pie charts, you can watch the following video →



03– Use the principles of visual design to improve organization and clarity of information

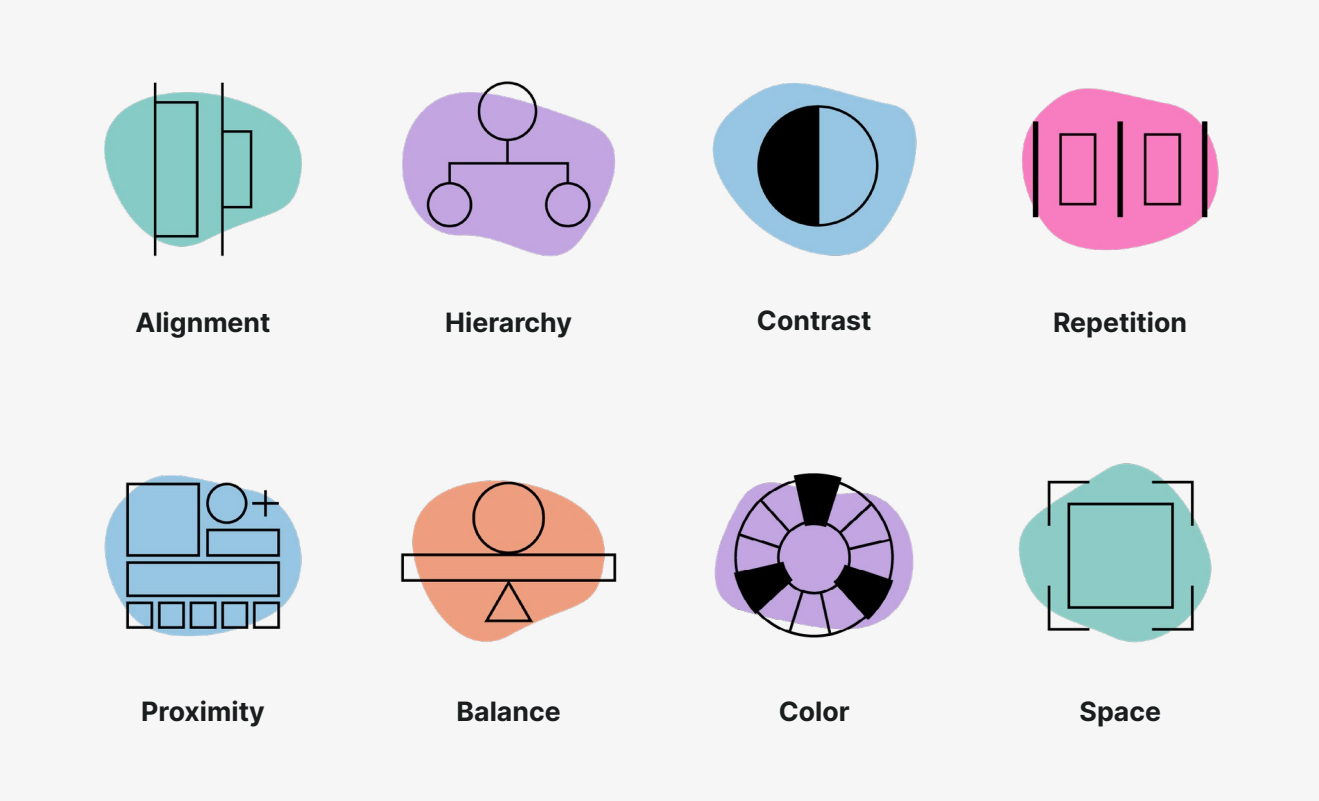
> *Visual designers are trained in using techniques and strategies to move a viewer's eye across a design in intentional ways. Use of even the most basic visual design techniques can help data practitioners—especially those who aren't designers by trade—explore visualization techniques that can be used to add a strong sense of organization, unity, hierarchy, and clarity.*
>
> — Courtney Ulrich Smith, Director of Design Strategy, RevUnit

How Understanding Basic Design Principles Can Level Up Your Data Viz Skills

- Helps to reinforce narratives or perceptions of data by using specific color schemes
- Creates a framework for techniques to move a viewer's eye across a visual display
- Informs how typography can influence visual hierarchy and clarity of information
- Provides a window into how our perceptions are influenced by shape and color

Familiarize yourself with foundational design principles

With any visualization of data, the intention is to move the viewer's eye across the display in a specific way. This is known as compositional flow; it determines how the eye is led, where it looks first, where it looks next, and where and how long it pauses. The eight principles of design greatly influence this flow, so we encourage every data practitioner to have a basic understanding of them.

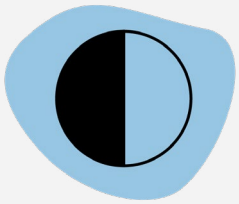


These principles play a part in all areas of your display; shape, color, typography, relation. For our purposes, we'll look at just four of these principles that we've found to have the most impact when it comes to data visualization.

THE C.R.A.P. METHOD

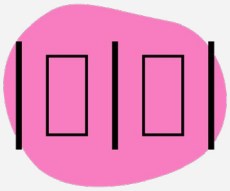
> *I've yet to see a more straightforward and easy way to teach layout and visual design implementation than the C.R.A.P. method. Further, it has extra holding power due to the sweet acronym. Not to be confused with methods that we should throw away or ignore, the C.R.A.P. method actually stands for Contrast, Repetition, Alignment, and Proximity.*
>
> — CJ Weatherford, Director of UX, Data Visualization & Strategy, RevUnit

The C.R.A.P Method is a straightforward, easy way to approach layout and visual design implementation, and can help take your designs to the next level.



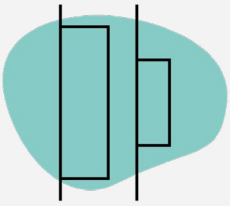
Contrast

Contrast is an efficient way to differentiate what's important from what's not, and to aid in creating hierarchy to help a viewer find the information they're looking for.



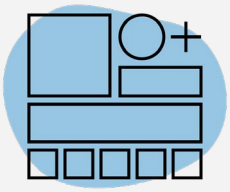
Repetition

Repetition is basically the fancy visual design code word for the Gestalt principle of "similarity. Repetition allows you to group like elements, assigning attributes to each as needed, then re-using those elements in your visualizations.



Alignment

Alignment is the placement of visual elements so they line up in a composition; it's used to create visual hierarchy, to organize elements, to group elements, to create balance, to create structure, to create connections between elements, to create a sharp and clear outcome. And when used skillfully, can be a powerful tool in organizing statistical or categorical information.



Proximity

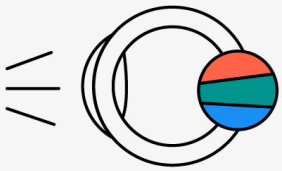
Proximity refers to the location of various elements in relationship to one another. When items are organized close together, and those items are separated from other items, they are perceived to be related by proximity. The principle of proximity is tied directly to the Gestalt principle of the same name.

If you're interested in learning more about the C.R.A.P. design method (and a whole bunch of other useful design tips), you might want to check out the Non-Designer's Design Book by Robin Williams. We do NOT receive any commissions if you purchase the book; we're simply big fans of the book and recommend it whenever we have a chance.

Get to know the principles of color theory and its role in visualization

As a data practitioner seeking to create effective visualization, you should familiarize yourself with the principles of color theory and what effects they can have in your visual displays — especially if you aren't classically trained in design. Color theory is the study of color from both scientific and subjective perspectives to understand both how it influences human perception, and how you can use it in communication and design.

There are a few elements of color that you should care about most when it comes to data visualization:

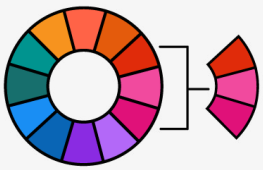


Color Anatomy

This is the various aspects that make up color and how we view it. Color is made up of three parts: Hue, Saturation, and Lightness values.

Color Wheel

The color wheel is literally a wheel of colors. The number of colors can vary depending on a variety of factors and there are multiple ways to use a color wheel for maximum impact.

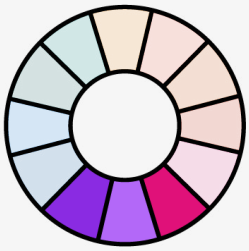


Color Harmony

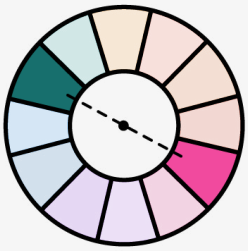
Color harmony is a look at how we can use the color wheel to make different types of palette decisions. Depending on our need with the data, we can use different arrangements to maximize the impact.

Understanding these concepts will help you choose the right color scheme for your visual display. Color schemes can be repeated to emphasize similarity; they can be contrasted to differentiate what's important from what's not, which also creates visual hierarchy. These design principles should be incorporated often into visual displays to reinforce intended narratives.

For example, a **monochromatic palette** can be used to suggest that the data varies in degree, not kind.



Analogous pairings might be used to create far less contrast and give the perception that the items are closely related but different in some way.



And using **complementary colors** can give the perception that the things they code are opposing, such as "positive" and "negative" impact.

This doesn't mean it's suddenly necessary for you to memorize complementary and analogous colors; what does matter here is that you know how you can leverage colors to provide adequate meaning in your data visualizations.

Use typography principles to create hierarchy

Typography is the study and practice of styling and arranging type. It goes beyond just knowing a few fonts. It's about understanding font types, how to manipulate letters and spacing, and how to use letters to create hierarchy and make content easy to consume. It can get pretty complicated, but to start, you should focus on font color, size, alignment, and proximity.

The color, size, alignment, and proximity of type all impact the visual hierarchy of your data, and, by extension, others' perceptions of it. Using a larger font and incorporating more vibrant colors in your typography gives more emphasis and weight to it within your display, while proximity and alignment of individual characters aid to establish balance and clarity in your composition. Organizing, grouping, balancing, and structuring typographical elements in this way creates a strong visual hierarchy with a sharp and clear outcome.

Our suggestion is to start with a single font and stick with it, using the font's weight, size, and color to create contrast rather than adding more variables with more fonts to choose from.

Wrapping Up

Most organizations would readily recognize that they sometimes don't choose the most effective data visualization option for their data storytelling aims. What's more, anyone who's charged with interpreting data may not have a good understanding of core design principles, which can negatively impact how critical data is visualized and reported.

It's important for every leader and data practitioner to recognize how perception influences visualization, as well as the positive impact that understanding the principles of design has on their data visualization skills.

It's up to each individual, then, to better understand the ways in which fundamental design principles play into data visualization and how perceptions of data are affected by how it is presented. Taking a deeper dive into the subjects of human perception, properties of different visual display formats, and principles of design will serve as an invaluable tool set to help you begin to up your data visualization game.

1. **Understand how perception, memory, and psychology influence data visualization**
2. **Learn to recognize when it's most appropriate to utilize certain visualization techniques**
3. **Take an interest in the foundational principles of visual design**

ARTICLE

BUILDING A REPORT PEOPLE ACTUALLY USE

A guide to finding what data your decision makers need when, and how to deliver it on your presentation tool.

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THE ROLE OF COLOR THEORY IN DATA VISUALIZATION

Colors affect our perception of information, so it's important to leverage these best practices when it comes to data viz.

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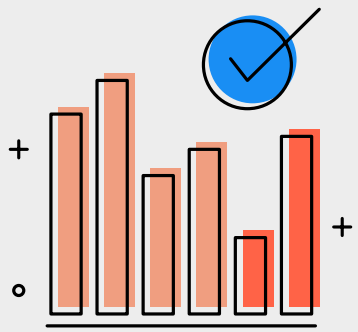

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