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Empower and Inspire: Designing Reports for Mobile Experiences

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ABSTRACT

What is the impact of mobile on business intelligence and reporting? According to Gartner, approximately one third of business intelligence users consume reports, dashboards, and KPIs on mobile devices. Since this content is being viewed on non-traditional devices with less screen real estate, dashboards and reports must be designed to deliver information in an easy and consumable manner. Users expect content to look great regardless of the mobile device screen size, orientation, or functionality. Hence, mobile reports need to be optimized to display data effectively so that users can easily access, interact with, and modify visualizations. SAS® Visual Analytics Apps empower users with reports and dashboards anywhere and on any device. In this paper, you will learn design and usability best practices informed by user experience research and cognitive science to help create beautiful reports that guide interaction in SAS Visual Analytics Apps. This paper presents tips for how to reduce information density with space saving-features, as well as do's and don'ts for selecting objects, fonts, and colors that enable complex analytics to be processed quickly. Come learn how to create effective reports that scale from your desktop to your mobile device screen.

INTRODUCTION

Modern business intelligence and analytics apps enable organizations to meet requirements for accessibility, agility, and analytical insight (Nabler, 2020). With the increasing use of mobile devices for business, SAS Visual Analytics Apps are bringing business intelligence closer to end users with reports and dashboards that provide access to real-time data, analytics, and information at any time and from any location. Reports and dashboards within these apps are powerful tools for communicating information at a glance. Yet, this power is rarely fully realized.

Good reports and dashboards that are well suited for mobile devices are challenging to design. They should be fast and intuitive while allowing users to access and understand them on their mobile device with minimal time and effort. SAS® Visual Analytics allows designers to create reports for desktop and mobile viewing without sacrificing functionality or ease-of-use. However, devices such as smartphones and tablets have less screen real estate; making the task of designing such reports and dashboards more difficult.

Mobile devices have different design requirements and affordances based on their physical specifications. Users rely on gestures and expect simpler content due to smaller dimensions, reduced data for optimized loading due to limited connectivity, and more consumable information under various viewing conditions due to uncontrolled external factors (McVicar, 2012). All of which must be taken into consideration when designing effective mobile reports and dashboards.

- What information should my report or dashboard include? Why is this information important to my users? How much detail should I include?
- How can I provide meaningful context in my report or dashboard?
- How will users view my report or dashboard? Is it viewed on desktop, tablet, or phone?

By asking the right questions, you will better understand your user's mental model. Then, you can provide content that will enable your users to perceive what is happening, comprehend information in a meaningful way, and project what will happen in the future to make the correct decisions and accomplish their goals.

TIP 2- DEFINE A CLEAR PURPOSE

The purpose of reports and dashboards is to inform and keep users aware of what is happening in a particular area of interest. To design an effective mobile report or dashboard, you must also clearly define its purpose. By gathering meaningful information and understanding your user's mental model, you can accurately define its purpose and categorize the type of report or dashboard necessary to achieve your user's goals.

Reports and dashboards are categorized into four types based on their purpose: strategic for monitoring long-term strategy; operational for providing critical time-sensitive information; analytical for analysis and decision making; and tactical for process monitoring. Each type has different requirements for the level of detail, analytic capabilities, and design to serve their intended purpose (Bakusevych, 2018 and Durcevic, 2019).

Great care should be taken when defining the purpose of your report or dashboard to ensure that its content meets your user's needs. With proper design and consideration, each of the aforementioned types are suitable for mobile experiences.

STRUCTURE

Presenting only the most relevant information is essential for reports and dashboards on mobile devices. Mobile users have a limited amount of brain power that is split between problem solving, viewing content, and interpreting its meaning. Consequently, the more information that you display, the harder it is for your users to find what they need.

Mobile reports and dashboards should be well structured; making complex information accessible and easy to consume (Subotin, 2018). Therefore, when faced with too much data and content, aim to display only what is most relevant and meaningful to minimize the user's cognitive load.

TIP 3- PROVIDE GOOD INFORMATION ARCHITECTURE

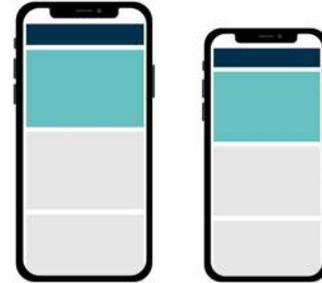
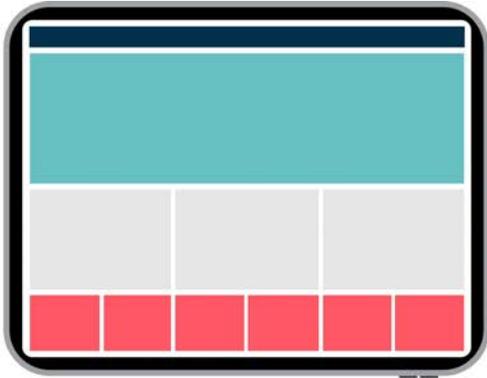
Information architecture (IA) focuses on organizing, structuring, and labeling content for the purpose of helping users find information and complete tasks in an effective manner (Usability.Gov, 2020). Poor IA in mobile reports and dashboards results in low attention to important content, decreased ability to accomplish actions or goals, a lack of exploration and navigation, longer scan times, and unnecessary scrolling.

Mobile devices have their own set of IA patterns that directly impact the design of effective reports and dashboards. While desktop reports follow more traditional patterns, mobile reports often rely on navigational structures that allow users to access supporting or secondary content (McVicar, 2012).

Hierarchy Pattern

The hierarchy pattern is a common mobile report and dashboard structure that presents the most important content first, followed by less important content. This pattern is ideal for organizing complicated content that needs to follow a particular flow or order. However, this

pattern can present a problem on small mobile device screens when such content resizes and reflows. As the layout changes from a desktop or laptop to a tablet or a phone, the number of columns reduce from multiple to single. Information that was formerly visible at the top of the screen on the user's desktop, laptop, or tablet appears further down the mobile phone screen as columns of content drop below one another; causing it to lose its visual hierarchy.



DO

Use the hierarchy pattern on tablets to present content that needs to follow a flow or order.

CAUTION

Use caution with the hierarchy pattern on phones since its structure gets lost with reflow.

Figure 2. Hierarchy Pattern Tips for Mobile Design

The best order of content on large screens may not be the best order when it reflows on smaller screens because information in the hierarchy may not be of equal importance. Therefore, consider how your design will change as content moves from multiple columns to a single column. Aim to maintain hierarchy and arrange related content in different columns so that it intermixes on smaller device screens.

Bento Box Pattern

The bento box pattern highlights detailed content and its relationships so that users can comprehend key information at a glance (McVicar, 2012). This pattern is generally most suitable for tablets due to its complexity. However, since SAS Visual Analytics offers built-in responsive design, it is also suitable for phones.

When using this structure for mobile, consider whether your users need to view multiple visualizations together for understanding or if they can be viewed independently. If your content can be understood independently, this pattern is suitable for both tablets and phones. Else, users may need to scroll to off-screen phone content that can affect how the report supports SA and their ability to make accurate decisions based on that information.



DO

Use the bento box pattern on tablets to present detailed content that has similar themes.



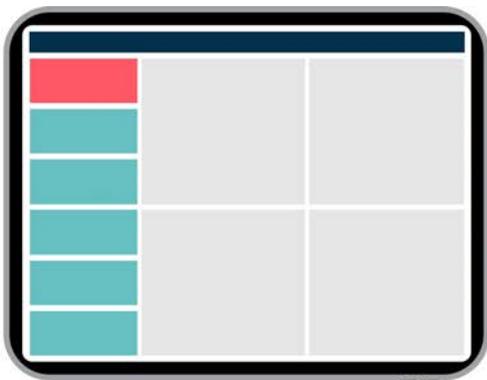
CAUTION

When using the bento box pattern on phones, understand how users interact with content to ensure adequate SA.

Figure 3. Bento Box Pattern Tips for Mobile Design

Filter Pattern

The filter pattern allows users to navigate content by selecting options that modify or create an alternative view. It is ideal for reports and dashboards with large quantities of content. In general, filters can be challenging to display on mobile devices due to their complexity and the amount of space required. Aim to optimize space and touch target size for affordances and be sure to choose the appropriate filter control based on your content. For instance, a button bar with a data item that has too many values can cause its affordances to become smaller, which is challenging on touch interfaces. Utilizing report or page control areas as well as containers can optimize space while facilitating interaction.



DO

Use the filter pattern on tablets to allow users to modify or create alternative views of content.



CAUTION

When using the filter pattern on phones, choose a control that provides a reasonable touch target size.

Figure 4. Filter Pattern Tips for Mobile Design

VISUALIZATIONS

TIP 4 - USE THE BEST CHARTS FOR MOBILE

Studies show that users understand numbers more easily when they are displayed in a visual form. If data is visualized efficiently and intuitively, it is easier for users to understand content and make better decisions. Therefore, using only the best data visualizations for mobile reports and dashboards is critical.

Choosing visualizations is challenging and requires great effort from the designer since reports and dashboards contain multiple types of information. Using the wrong visualization can confuse your users and lead them to misinterpret data. In addition, all visualizations are not equally suitable for mobile consumption. On a mobile device screen, some visualizations result in user frustrations with interactions such as zooming and scrolling or labeling on titles and axes. However, there are a variety of visualizations that you can use to accurately reflect data, optimize ease-of-use, and elicit understanding from mobile users.

Relationship

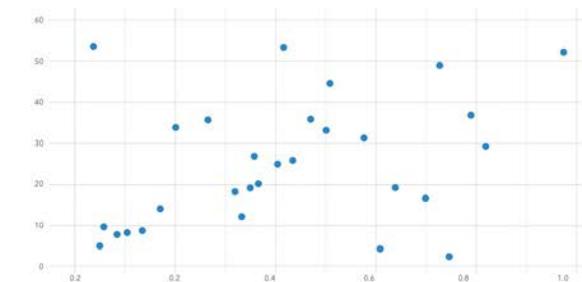
Relationship visualizations show how items relate to one other. On mobile, visualizations such as scatter plots and bubble plots can help your users see relationships in their data.

Scatter Plot

Scatter plots are used for correlation and distribution analysis when variables are uncontrolled. They serve as means of visually representing a correlation among two dimensions or measures (Miller, 2014). This type of chart is highly useful for mobile users because it shows individual data points while revealing data patterns at a glance.

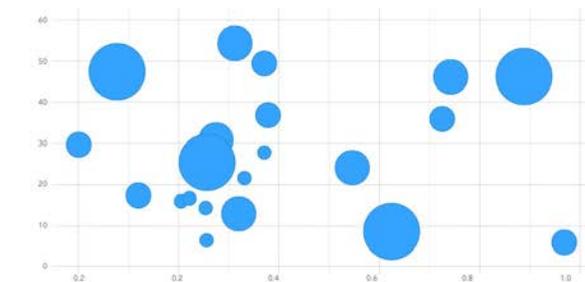
Bubble Plot

Similar to scatter plots, bubble plots replace data points with bubbles and show relationships between data by using size as a visual element. This chart is useful on mobile since bubble size variations draw the user's eye and visually emphasize values.



DO

Use scatter plots to show correlation and distribution of values.



DO

Use bubble plots to emphasize relationships between data with size.

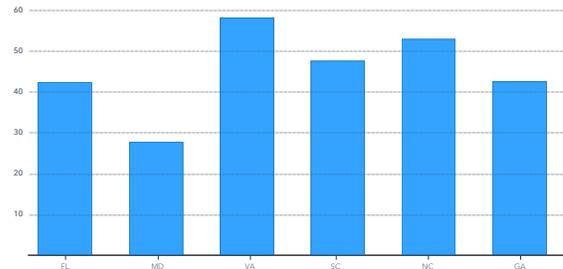
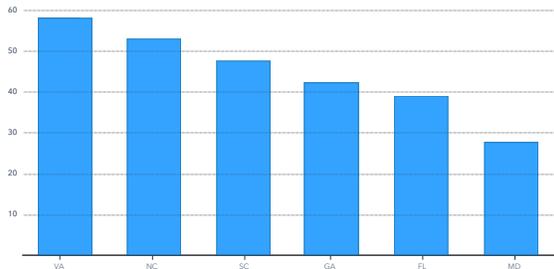
Figure 5. Scatter Plot and Bubble Plot Tips for Mobile Design

Comparison

Comparison visualizations help users compare values. On mobile, visualizations such as bar charts and line charts are ideal to help your users see relationships in their data.

Bar Chart

Bar charts are used for quantitative information based on a single dimension with one or more measures. They are useful for expressing variations in data, how data points relate to a whole, comparisons, and ranking (Miller, 2014). When using bar charts on mobile, sort bars from the largest to smallest rather than randomly to improve glance-ability. Aim to display no more than seven bars since they scale with the size of the mobile device screen; decreasing touch targets and making interaction more challenging.



DO

Sort bars from largest to smallest in bar charts to improve scanability.



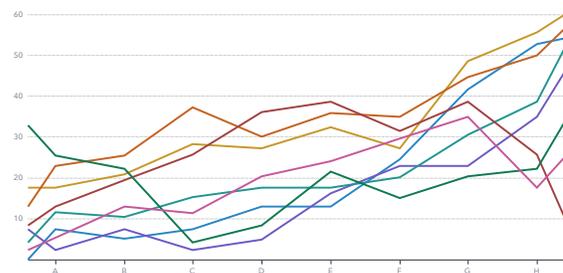
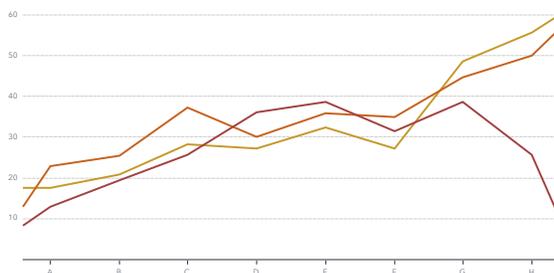
DON'T

Avoid randomly sorting bars in bar charts as they become harder to compare.

Figure 6. Bar Chart Tips for Mobile Design

Line Chart

Line charts are used for time-based consecutive intervals. They are beneficial for communicating trends or changes over time as well as helping users understand what is happening and how to plan for the future. When using line charts on mobile, show four lines or fewer to avoid visual clutter that can make them harder to read (Oetting, 2018).



DO

Use line charts to compare metrics that are time-based.



DON'T

Avoid using more than four values in line charts as they become difficult for viewing and interaction.

Figure 7. Line Chart Tips for Mobile Design

Composition

Composition visualizations help users see how individual parts make up a whole. On mobile, visualizations such as pie charts, stacked bar charts, and area charts can help your users compare their data.

Pie Chart

Pie charts display parts as slices within a circle to represent a whole. They are useful for showing percentages or proportional data. However, as the number of slices increase, ease-of-use and interpretation decreases. When pie charts include too many slices or have highly similar values, they become difficult to read and interpret. When using pie charts on mobile, include six categories or fewer to ensure differentiation between slices. To improve interpretation, order slices based on their size (Oetting, 2020).



DO

Use pie charts to compare categories as parts of a whole.



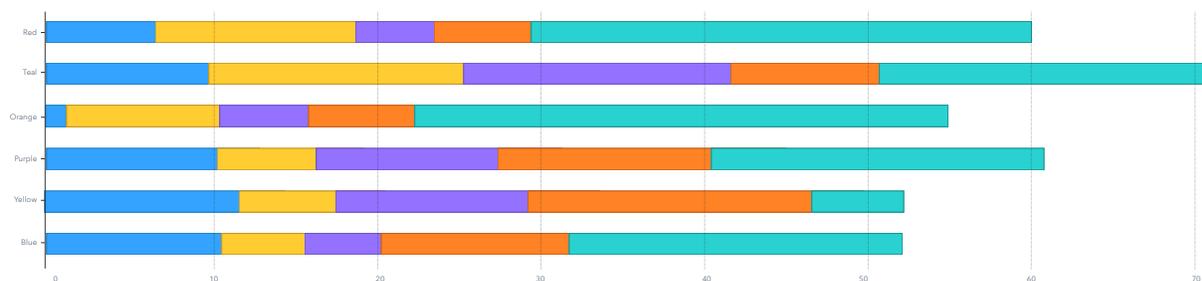
DON'T

Avoid comparing too many categories or similar values. If slices are too similar, use a bar chart instead.

Figure 8. Pie Chart Tips for Mobile Design

Stacked Bar Chart

Stacked bar charts display multiple parts of a whole across a series and visualize the distribution of values within each bar. Each bar represents a whole, and segments within each bar represent parts of the whole. When using these charts on mobile, use contrasting colors for greater data clarity.



DO

Use stacked bar charts to display multiple parts of a whole across a series.

Figure 9. Stacked Bar Chart Tips for Mobile Design

Area Chart

Similar to line charts, area charts use lines but with shading to emphasize space. They are useful for summarizing relationships and showing how parts relate to a whole to help users analyze trends in information. However, as the number of series increase, shaded areas can overlap and interfere with one another. When using these charts on mobile devices, avoid using more than four categories to minimize clutter, and use transparent colors so that information is not obscured (Miller, 2014 and Oetting, 2018).

Distribution

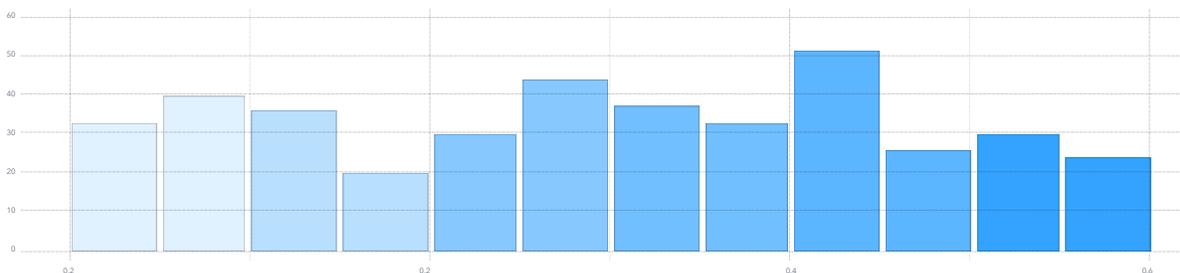
Distribution visualizations show how often values occur in a dataset and help illustrate outliers, normal tendency, and the range of information in values. On mobile, visualizations such as scatter plots and histograms can help your users see the distribution of their data.

Scatter Plot

Scatter plots are also used for distribution analysis. Dots in scatter plots help visualize individual data points as well as patterns when viewed as a whole; making them highly useful for mobile users. Although scatter plots work well with large amounts of data, overplotting can become problematic on small device screens; resulting in difficulty with seeing relationships and with interaction. When using scatter plots on mobile, reduce data size by filtering, increase visibility with transparency, and reduce point size to minimize overlap.

Histogram Plot

Histograms plot the distribution of values as a series of bars that cover a range of numeric values also known as bins. Bar heights in this type of chart depict the frequency of values within each bin. These charts are useful for showing outliers, peaks, or skews in distribution and for allowing users to quickly interpret data.



DO

Use histograms to plot the distribution of values as a series.

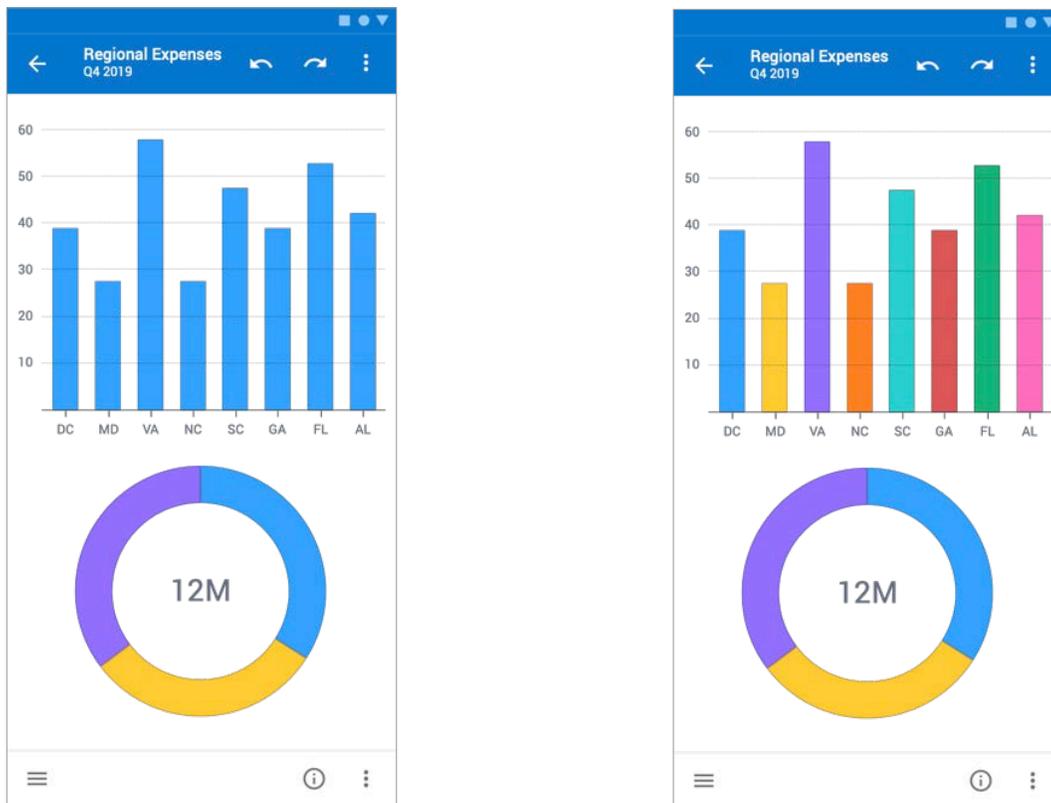
Figure 10. Histogram Plot Tips for Mobile Design

COLOR

Color is a powerful tool in mobile report and dashboard design. It plays a critical role in interaction and helps users see and interpret content (Babich, 2017). When used effectively, color guides the user's attention, helps them access information, and enables them to efficiently perform tasks. However, color is often misused in ways that are more confusing than enlightening and more distracting than compelling. Although color can add visual interest to content and engage your users, it should be applied with care to avoid interfering with their cognitive processes (Visual BI, 2018).

TIP 5 – CHOOSE ONLY A FEW COLORS

There are many factors to consider when applying color; ranging from company branding to cultural associations. Studies show that most users prefer simple color schemes consisting of two to three colors (O'Donovan, Agarwala, and Hertzmann, 2011). Therefore, to deliver the greatest impact, use color sparingly. Simple schemes with a few colors are pleasing to the eye and make content easier to understand; whereas, complex schemes with many colors make content more difficult to interpret. Keeping color combinations simple and choosing only a few colors for your mobile reports and dashboards will help improve your user's experience.



DO

Use two or three colors to ensure that content is easy to understand.

DON'T

Avoid using complex color schemes that make content more difficult to interpret.

Figure 11. Color Selection Tips for Mobile Design

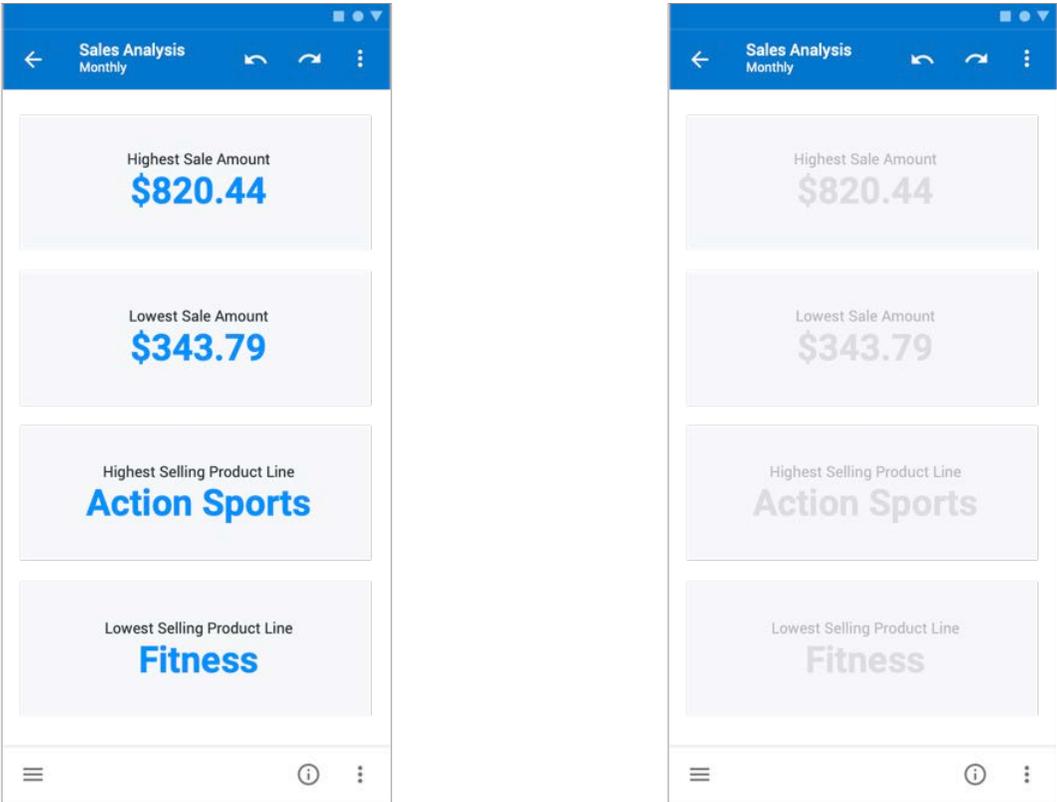
TIP 6 - APPLY COLOR CONSISTENTLY AND WITH MEANING

Consistency is another important aspect to consider when choosing colors. Using the same colors for items across charts minimize the user's mental effort, making content easier to understand; whereas, using inconsistent colors increases the user's mental effort, making it more difficult to identify and recognize patterns in content. Therefore, aim to use colors consistently across all charts in your mobile reports and dashboards to avoid confusion and make content more consumable.

When color is applied meaningfully, users understand content at a glance which is critical for viewing reports and dashboards on mobile devices. Using color purposefully draws the users' attention to the most important information. For instance, use saturation to draw the user's attention to details that you would like to highlight. Use less saturation for details that are less important; making its presence less dominant. Avoid excessive use of saturated colors as they can overwhelm users and can cause them to lose focus.

TIP 7 - USE CONTRAST TO SUPPORT USABILITY

Contrast is the degree to which colors stand apart from one another. Due to limited screen size and environmental conditions, it is important to use contrast to make mobile report and dashboard content as clear as possible. To achieve this, design your mobile reports and dashboards to have contrasting colors between background and foreground elements. For dark backgrounds, use lighter colors on foreground objects; and for light backgrounds, use darker colors on foreground objects to enable users to easily find information. When applied properly, elements will stand out from one another; reducing eyestrain and focusing the user's attention in the desired area.



DO
Use dark colors on light backgrounds and vice versa to ensure readability.



DON'T
Avoid light colors on light backgrounds and vice versa as it makes content difficult to see.

Figure 12. Color Contrast Tips for Mobile Design

Discoverability is a significant challenge in mobile reports and dashboards because the ease at which users find content and features relies on their ability to learn and recognize when to use gestures for interaction. The easier the report or dashboard is for the user to find and

interact with content, the more useful it will be to the user. Like saturation, contrast draws the user’s attention towards specific content in your report or dashboard. Using high contrast colors on interactive elements, such as prompt controls and links, helps them stand out on the report background; enabling users to quickly locate and interact with them. However, when customizing colors for mobile controls, designers should be mindful that SAS Visual Analytics Apps for iOS and Android override web controls; replacing them with native controls that are consistent with the device operating system and styling that corresponds with the mobile app theme.

TYPOGRAPHY

Visualizations are colorful and engaging. Yet, users still rely on written text to fully understand and act on information. Typography, the art and technique of arranging type, requires both thought and skill from the designer when creating mobile reports and dashboards. It expresses brand, hierarchy, emotion, and more importantly facilitates interaction when properly applied (Liu, 2017).

TIP 8 - CHOOSE THE RIGHT FONT FOR MOBILE

When deciding on typography in your mobile report or dashboard, keep user needs in mind. Unique types of content on various types of devices require distinct fonts. For instance, decorative fonts work well with reports and dashboards that are viewed on a desktop or laptop, but they may become illegible when scaled down on small mobile device screens.

Three factors, legibility, readability, and usability are important to consider when choosing a font that translates well from desktop to mobile. Research shows that 40% of mobile sessions are short and involve quick consumption of information (Laubheimer, 2017). Therefore, being able to quickly glance at and act on content is critical for mobile users.

Serif vs. Sans Serif Fonts

Clean and simple fonts work well for quick viewing sessions on mobile devices such as tablets and phones. Therefore, choose fonts that are legible under a variety of conditions as well as ones that are easy to read and understand. Serif fonts are typefaces that have a line attached to the end of each stroke in the letter; whereas, sans serif fonts do not (Pearson, 2016). Since sans serif fonts have less detail than serif fonts, they tend to be more easily read when scaled down on smaller devices.



DO
 Sans serif fonts promote glanceability on mobile devices.



CAUTION
 Serif fonts are more difficult to read when scaled down on mobile devices.

Figure 13. Font Choice Tips for Mobile Design

On mobile, limit fonts to a maximum of two in order to avoid adding complexity on small screens. If using both serif and sans serif fonts in your mobile report or dashboard, ensure that they are easy to read and work well together to provide uniformity. Use the serif font for body text and the sans serif font for headings, subheadings, and labels (AHRQ, 2019).

Also ensure that your font’s characters are highly distinguishable from one another. Compare its uppercase “i”, lowercase “l”, and the number “1” as well as its combination of the lowercase letters “r” and “n”. If these characters are highly similar or run together when you place them next to one another, the font may slow the user’s reading time or ability to interpret content (Scacca, 2018).

TIP 9 – USE COMPATIBLE CROSS-PLATFORM FONTS

Although SAS Visual Analytics reports and dashboards can be viewed on mobile devices, designers typically create content on desktops or laptops. As a result, designers often neglect to consider whether their chosen font is supported by the native platform on which the report will be viewed. Each mobile platform offers various levels of font support. Not all fonts that are available to you as a designer on the web are available to your users consuming content on native mobile devices. If the font chosen for your report or dashboard content is not available on your user’s device, it will revert to the system’s default font. Therefore, aim to use fonts that are compatible across as many platforms as possible (Scacca, 2018).

By default, iOS, Android, and Windows 10 mobile apps use native operating system fonts in their user interfaces: San Francisco, Roboto, and Segoe respectively. Both iOS and Windows 10 devices provide several pre-installed system fonts such as Arial, Courier New, Georgia, Times New Roman, Trebuchet MS, and Verdana that are compatible on web and mobile. Android devices, however, are more restrictive and default report and dashboard content to Roboto regardless of your specified font choice.

Font	iOS 13	Android 10	Windows 10
Arial	✓		✓
Avenir Next	✓		✓
Courier New	✓		✓
Georgia	✓		✓
Roboto		✓	
San Francisco	✓		
Segoe			✓
Times New Roman	✓		✓
Trebuchet MS	✓		✓
Verdana	✓		✓

Table 1. iOS, Android, and Windows 10 Mobile App Font Support

It is important to be aware of these constraints when designing reports and dashboards for mobile to ensure that your content meets expectations. To minimize the appearance of visual inconsistencies between web and mobile content, use fonts that are compatible across multiple platforms, a native system font, or a simple sans serif font.

TIP 10 - MAKE FONT SIZES WORK ON ALL DEVICES

Similar to native font types, iOS, Android, and Windows 10 operating systems have unique recommendations for minimum sizes. However, choosing the appropriate font size can be tricky. Small fonts in your report or dashboard will appear even smaller on a mobile device screen; leading to eye strain and increased scan time. Yet, fonts that are too large in your report or dashboard consume extra screen real estate, breaking up flow, and causing content to become unreadable or inaccessible (Liu, 2017). For instance, a button with an extremely large font on a mobile device can cause text to clip or truncate; making your users less likely to interact with it because the action is not clear.

Studies show that larger, wider, and capitalized text outperforms smaller, narrower, and lowercase text (Laubheimer, 2017). Hence, when designing for mobile devices, use formatting to make font sizes bigger. Aim for a size of around 16 pixels for the best legibility across mobile devices and platforms.

INTERACTIONS

There are many elements to consider when designing mobile reports and dashboards for touch. Issues such as tapping the wrong element and executing an undesired action or experiencing difficulties with gesture-based navigation can be extremely frustrating for users who are trying to accomplish business tasks on their mobile device. Considering how users interact with content on mobile devices provides the greatest opportunity for designers to deliver optimal user experiences.

TIP 11 – DESIGN WITH TOUCH IN MIND

Generally, as the number of objects on a page increase, so does complexity. This results in visualizations scaling to a smaller size on tablets as well as scrolling on phones. Avoid using too many charts on a single page, because it scales elements and results in scrolling on phones. As a designer, aim to limit the number of objects on a page. Using no more than four to six visualizations on each page not only enables you to deliver a concise report, but it also enables your users to better interact with content.

The smaller the touch target size, the more accuracy is required to hit it. Therefore, it is also imperative that navigational elements are of adequate size and that there is enough space for users to tap the desired element without touching the element next to it. For instance, with stacking containers, use button or tab controls instead of using dots or links to provide larger, more visible touch target affordances.

With respect to Human Factors, it is important to consider how device ergonomics affects user experience in your mobile report or dashboard. The physical size of mobile devices has grown tremendously in recent years, while users' hands have stayed relatively the same (Wroblewski, 2014). Placing frequently used interactive elements within the "thumb zone" of your report or dashboard ensures that interactions are comfortable to reach with respect to how the user holds their device (Helguera and Cannon, 2018). On tablets in landscape orientation, this zone is located horizontally along the bottom third of the device screen and extends upward on each side of the device. On phones in portrait orientation, the zone arcs outward from the bottom left or right corner of the device to approximately half of the screen's height. Locating interactive elements such as links, filters, and other visuals within these areas ensure that interaction is quick and easy for your users.

LEFT-HANDED
Phone

COMBINED
Tablet

RIGHT-HANDED
Phone

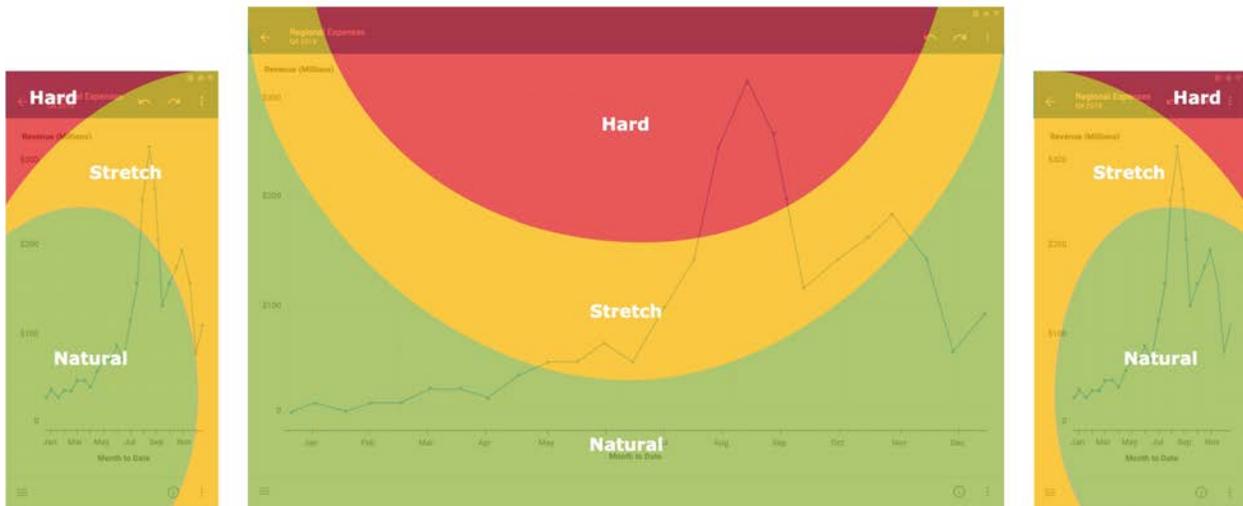


Figure 14. Mobile Device Touch Zones

Providing adequate space is one of the most overlooked components by designers when creating reports and dashboards for mobile experiences. Unlike desktop applications, mobile devices require users to rely on touch or gestures to interact with app content, which can make navigational tasks more challenging.

Swipe space is defined as the area within the user interface that is free of navigational or interactive elements (Ingram, 2016). When there is a lack of swipe space in your report or dashboard, it prevents users from accurately and efficiently swiping up, down, left, or right. To incorporate swipe space into your mobile report or dashboard, add padding around the report itself or around elements with internal scrolling such as list tables, crosstabs, maps, and scrolling containers. Incorporating swipe space around content that can be problematic on small screens will mitigate navigational issues that traditionally cause frustration on mobile devices and facilitate ease-of-use for your users.

TIP 12 – ENHANCE MOBILE EXPERIENCES WITH CUSTOMIZATION

Mobile users expect report and dashboard content to be timely and relevant. Therefore, one of the newest and most powerful tools that you can ultimately provide to your users is the power of customization. Customization is enabled by you as the designer and applied by the end user to ensure that what they see is the most important to them.

With SAS Visual Analytics 8.4 and later, you can give your users the capability to customize report and dashboard content for their individual user needs. At the default viewer customization level, your users can make comprehensive edits or changes that alter the original intent of the report such as changing object types. However, by increasing viewer customization to the highest level, your users can make data edits or changes including, but not limited to, data assignments, filters, ranks, and display rules to gain insights from your report or dashboard in new ways.

CONCLUSION

Mobile reports and dashboards are powerful tools that communicate data and other information when you follow user-centered design processes and best practices that adhere to user experience research and cognitive science. As designers, it is easy to forget that mobile users view reports and dashboards in non-traditional environments or while

multitasking. However, they still expect content to look great regardless of their device specifications or functionality and to be able to interpret information quickly because the context is rapidly changing. Although every mobile report and dashboard has its own goals, requirements, and limitations, you can use these best practices to keep users at the forefront of the design process and to create outstanding mobile experiences that empower and inspire.

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