Data for All: Making Visualizations Accessible for Diverse Populations

Office of Institutional Research, Planning & Assessment
October 20, 2022
Design with perceptibility, flexibility, and cognitive load in mind.

<table>
<thead>
<tr>
<th>Perceptibility</th>
<th>Flexibility</th>
<th>Cognitive load</th>
</tr>
</thead>
<tbody>
<tr>
<td>Can people access the information?</td>
<td>Can people with different learning styles and needs understand the information?</td>
<td>How much work does it take to figure out what’s going on?</td>
</tr>
</tbody>
</table>


These elements often overlap.
Perceptibility
Perceptibility
Legibility - Font

**Stylized Script**

**TIGHTSPACING** versus **WIDESPACING**

Big VS Small

Support:

- [OpenScholar Documentation](#)
- [W3C](#)
Legibility - Font Types

Gill sans (uppercase i, lower case L and the number 1): IlI

Imposter letters:
Verdana (uppercase i, lower case L and the number 1): IlI

Mirror letters:  db  qp  db qp

Humanist vs Grotesque Typefaces:
Calibri
Helvetica

Distinguishable characters: MEDIUM Article
**Contrast Checker**

**Contrast Ratio**
- Foreground Color: #1170AA
- Background Color: #FFFFFF
- Contrast Ratio: 5.35:1

**Normal Text**
- WCAG AA: Pass
- WCAG AAA: Fail
- Text: The five boxing wizards jump quickly.

**Large Text**
- WCAG AA: Pass
- WCAG AAA: Pass
- Text: The five boxing wizards jump quickly.

**Graphical Objects and User Interface Components**
- WCAG AA: Pass

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Image of a color wheel showing the contrast between the foreground and background colors.
Color

Colorblind Palette

[Table]

<table>
<thead>
<tr>
<th>DEUTAN</th>
<th>PROTAN</th>
<th>TRITAN</th>
<th>BLACK/WHITE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green-Weak/Deuteranomaly</td>
<td>Red-Weak/Protanomaly</td>
<td>Blue-Weak/Tritanomaly</td>
<td>Monochromacy/Achromatopsia</td>
</tr>
<tr>
<td>Green-Blind/Deuteranopia</td>
<td>Red-Blind/Protanopia</td>
<td>Blue-Blind/Tritanopia</td>
<td>Blue Cone Monochromacy</td>
</tr>
</tbody>
</table>

Original

Simulated

https://pilestone.com/pages/color-blindness-simulator-1
Compatibility

- Screen Readers
- Closed Captioning
Flexibility
Three ways to build in flexibility

- Provide descriptive text
- Present information in multiple ways
- Use alt text
Provide descriptive text.

### Profit and Sales

<table>
<thead>
<tr>
<th>Product category</th>
<th>Product Type</th>
<th>Central</th>
<th>East</th>
<th>South</th>
<th>West</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Furniture</strong></td>
<td>Bookcases</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Chairs</td>
<td></td>
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<tr>
<td></td>
<td>Furnishings</td>
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<tr>
<td></td>
<td>Tables</td>
<td></td>
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</tr>
<tr>
<td><strong>Office Supplies</strong></td>
<td>Appliances</td>
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<tr>
<td></td>
<td>Art</td>
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<td></td>
<td>Binders</td>
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<td></td>
<td>Envelopes</td>
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<td>Fasteners</td>
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<td>Labels</td>
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<td>Paper</td>
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<td>Storage</td>
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<td></td>
<td>Supplies</td>
<td></td>
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<tr>
<td><strong>Technology</strong></td>
<td>Accessories</td>
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<td></td>
<td>Copiers</td>
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<tr>
<td></td>
<td>Machines</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Phones</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

Source: [Author Views for Accessibility, Tableau](#)
Provide descriptive text.

Source: Author Views for Accessibility, Tableau
Make titles meaningful.

BEFORE

**Current Status - IAD Airport**

- **Departures**
  - On Time: 80%
  - Late: 20%
- **Arrivals**
  - On Time: 90%
  - Late: 10%

AFTER

**IAD flights: normal activity with majority on time or close**

- **Departures**
  - On Time: 90%
  - Late: 10%
- **Arrivals**
  - On Time: 80%
  - Late: 20%

Source: [An accessible makeover](https://example.com), Storytelling with Data
Provide descriptive text in captions.

Median household income among Asian origins group in the U.S.

Median annual household income, 2019, by origin group

Note: Figure for all Asians include mixed-race and mixed-group populations, regardless of Hispanic origin. Bhutanese, Malaysian, and Mongolian household income estimates are not shown due to insufficient sample sizes. "Chinese" includes those identifying as Taiwanese. Source: Pew Research analysis of 2017-2019 American Community Survey (IPUMS)

Source: AAPI Heritage Month: Rethinking the Asian American Identity, Culture Amp
Present information in multiple ways.
Present information in multiple ways.

Municipalities with a high share of LAND UNDER RENTAL in the NORTH region increased their share of pastureland by 12%, whereas municipalities with low share of land under rental increased their share of pastureland by 5%. The NORTHEAST follows the same pattern.

In the SOUTHEAST and SOUTH, land under rental has very little or no effect. Finally, in the CENTER-WEST high-share land under rental municipalities decreased their shares of pastureland when compared to low-share land under rental municipalities.

Source: Tim Varga
Present information in different ways.

Source: An intro to designing accessible data visualizations, Sarah Fossheim
Use alt text for images.

alt= “Chart type of type of data where reason for including chart”

Include a link to data source somewhere in the text

Source: Writing Alt Text for Data Visualization, Amy Cesal
Use alt text for images.

indicating how much you agree or disagree with the following: % agree & strongly agree

- I'm adjusting to the academic work of college. 83%
- I feel adequately prepared for the academic demands here. 70%
- I have stayed motivated. 58%
- I feel it is difficult to balance schoolwork and other aspects of life. 51%
- I feel overwhelmed by the amount of academic work I have to do. 47%

n = 2,358 - 2,360

alt = “Horizontal lollipop chart of percent of respondents who agreed with survey questions where most respondents felt academically prepared for college.”

Source: Writing Alt Text for Data Visualization, Amy Cesal
Cognitive load
It’s a data story, not a data swamp.
Create a narrative for your user to follow

Static Visualization: Do the sensemaking for your user

The percentage of students participating in Study Abroad Programs has not returned to pre-pandemic rates

(not real data)
It’s a data story, not a data swamp.

Create a narrative for your user to follow

Dynamic Visualization: What questions can users answer by exploring the data?

GIF source: tableau.com
The percentage of students participating in Study Abroad Programs has not returned to pre-pandemic rates. In 2022, program locations hosted 2% to 4% of the UMD population.
Highlight the main point.

- Make sure your viewers see the main point first
- If there are many key takeaways, present them sequentially

The percentage of students participating in Study Abroad Programs has not returned to pre-pandemic rates.

In 2022, program locations hosted 2% to 4% of the UMD population.
Minimize the need for mental math and memorization.

Current Participation Rate: 25%

(not real data)
Counterbalance: Remove unnecessary content and visual distractions.

- Color coding by year and by program
- Y-axis, individual, and aggregate labels
- Gridlines
- Red 2019 bar
- Series lines
- Linear regression trend line
- Gray box around bar chart

The percentage of students participating in Study Abroad Programs has not returned to pre-pandemic rates.

(not real data)
Mitigate User Error

● Have report documentation available
  ○ datadocs.umd.edu
● Integrate instructions or info buttons into the design
● Pilot design with multiple users
● Let users know when the report is broken
● Tell users how to fix the problem
Know your audience.

- What terms will they know? What terms need explanation?
- Have they encountered this type of data visualization before?
  - If not, can you facilitate interpretation with minimal scaffolding?
  - Alternatively, consider a more familiar or more intuitive visualization

For a wide audience, use the lowest common denominator in terms of literacy, language, and math skill levels
UG RET/GRAD DEMOGRAPHIC COMPARISON - NEW FIRST-TIME STUDENTS

Average 4-Year Graduation Rate for Focus Population and Comparison Population

I'm interested in the 4-Year Graduation Rate for All First Generation Students (Focus Population) and All Not First Generation Students (Comparison Population) in all college(s), including multiracial students and including international students.

SELECT ORGANIZATION:
All

SELECT FOCUS POP:
Focus 1: First Generation
Focus 2: All

SELECT COMPARISON:
Comp. 1: Not First Generation
Comp. 2: All

SELECT COHORTS:
2010 to 2020

SELECT METRIC:
4-Year Graduation Rate

SELECT STUDENTS:
Multiracial Students
Show Multiracial Students
International Students
Show International Students

Average 4-Year Graduation Rate

<table>
<thead>
<tr>
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<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiracial</td>
<td>54.5%</td>
<td>55.1%</td>
<td>58.4%</td>
<td>59.0%</td>
<td>61.5%</td>
<td>62.6%</td>
<td>62.4%</td>
<td>62.7%</td>
<td>62.9%</td>
</tr>
<tr>
<td>Comparison Group</td>
<td>71.2%</td>
<td>71.4%</td>
<td>72.0%</td>
<td>72.7%</td>
<td>73.9%</td>
<td>75.7%</td>
<td>75.0%</td>
<td>74.6%</td>
<td>74.0%</td>
</tr>
</tbody>
</table>

(Actual report design; fake data)
There’s a give and take to this process.

Image source: Forbes.com
Thank you!

irpa@umd.edu
reports.umd.edu