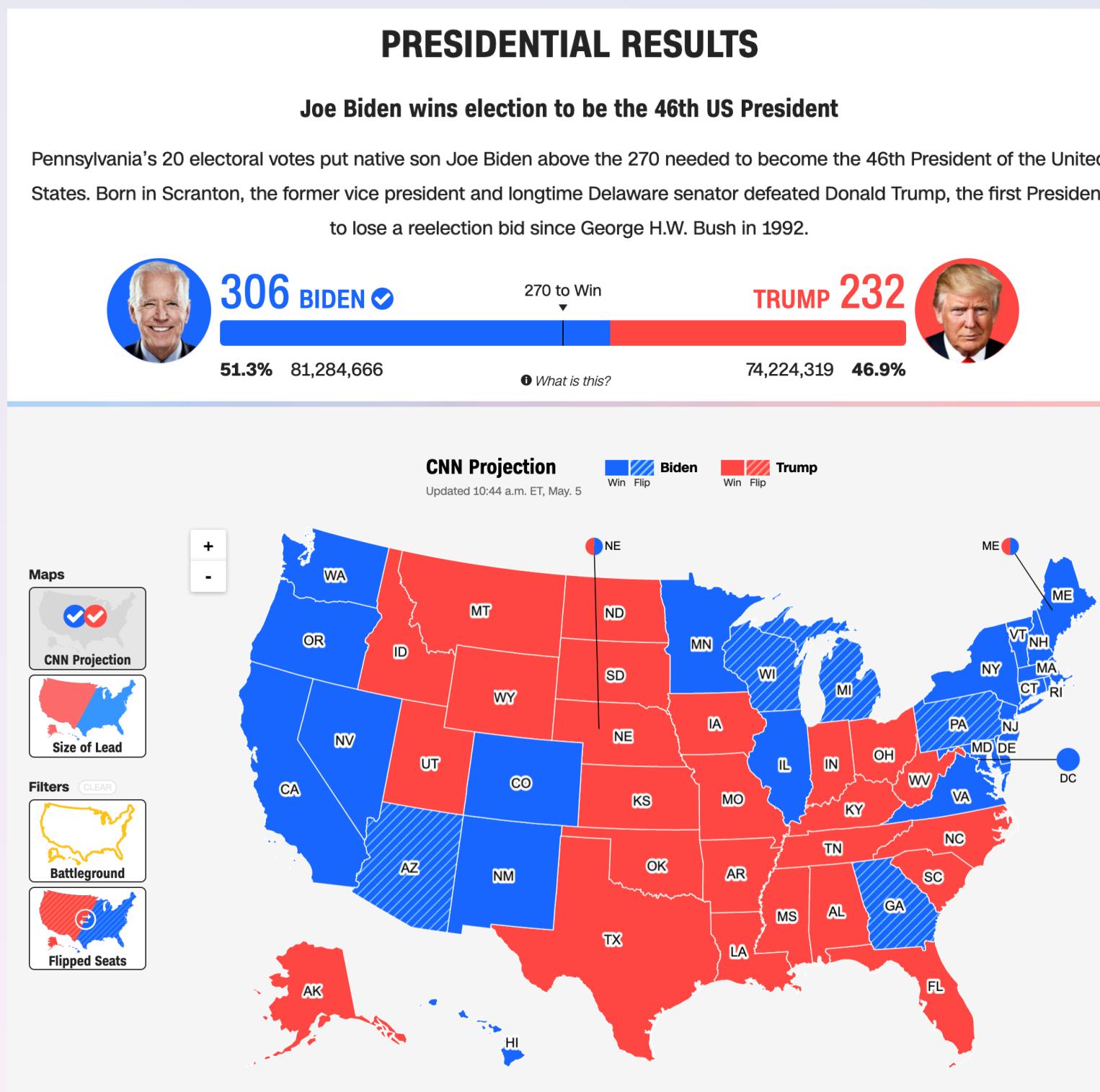


Chapter 4, Episode 4: Building a better world

People with disabilities deserve to:

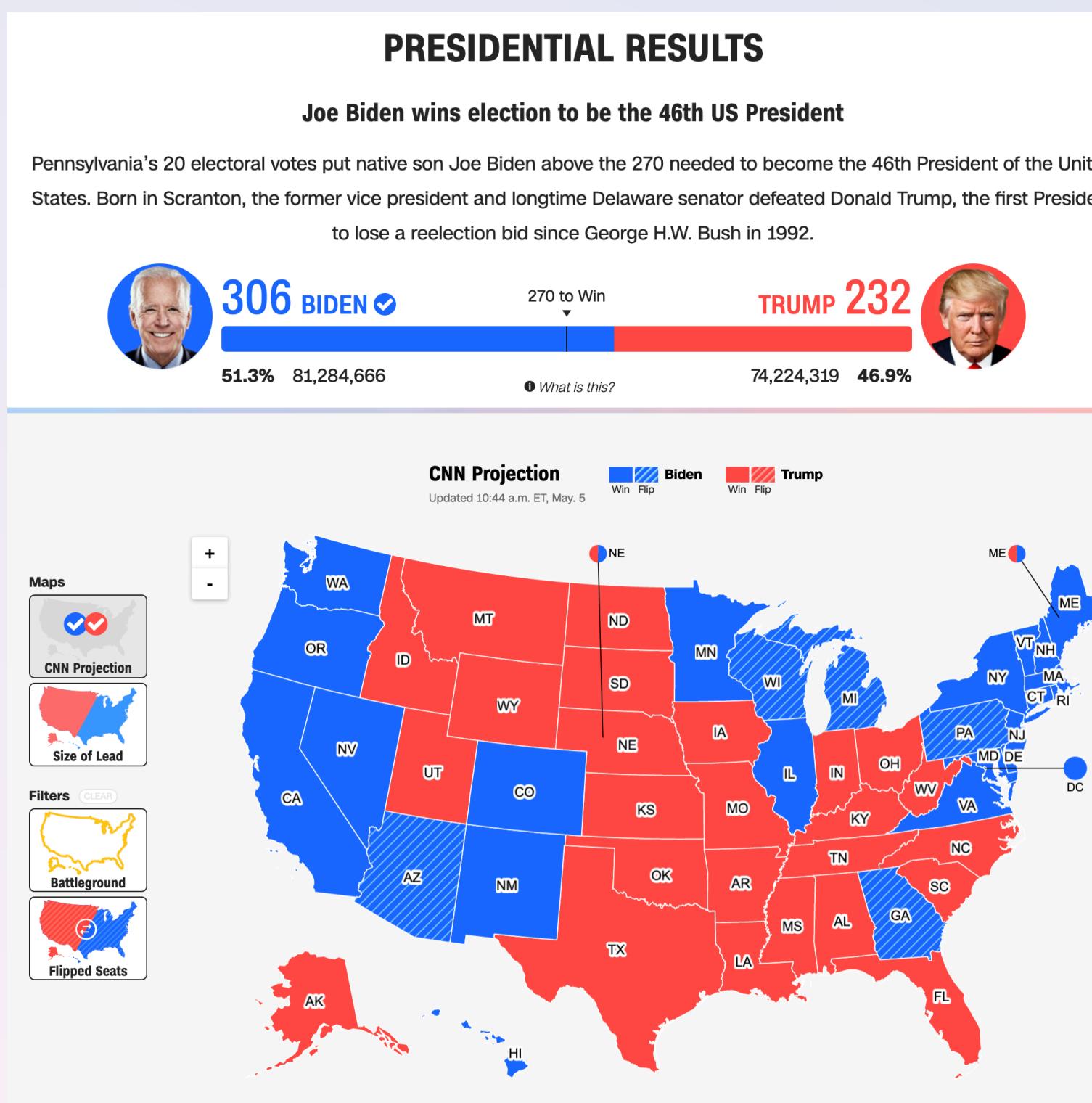
Participate in politics



Credit: [CNN](#)

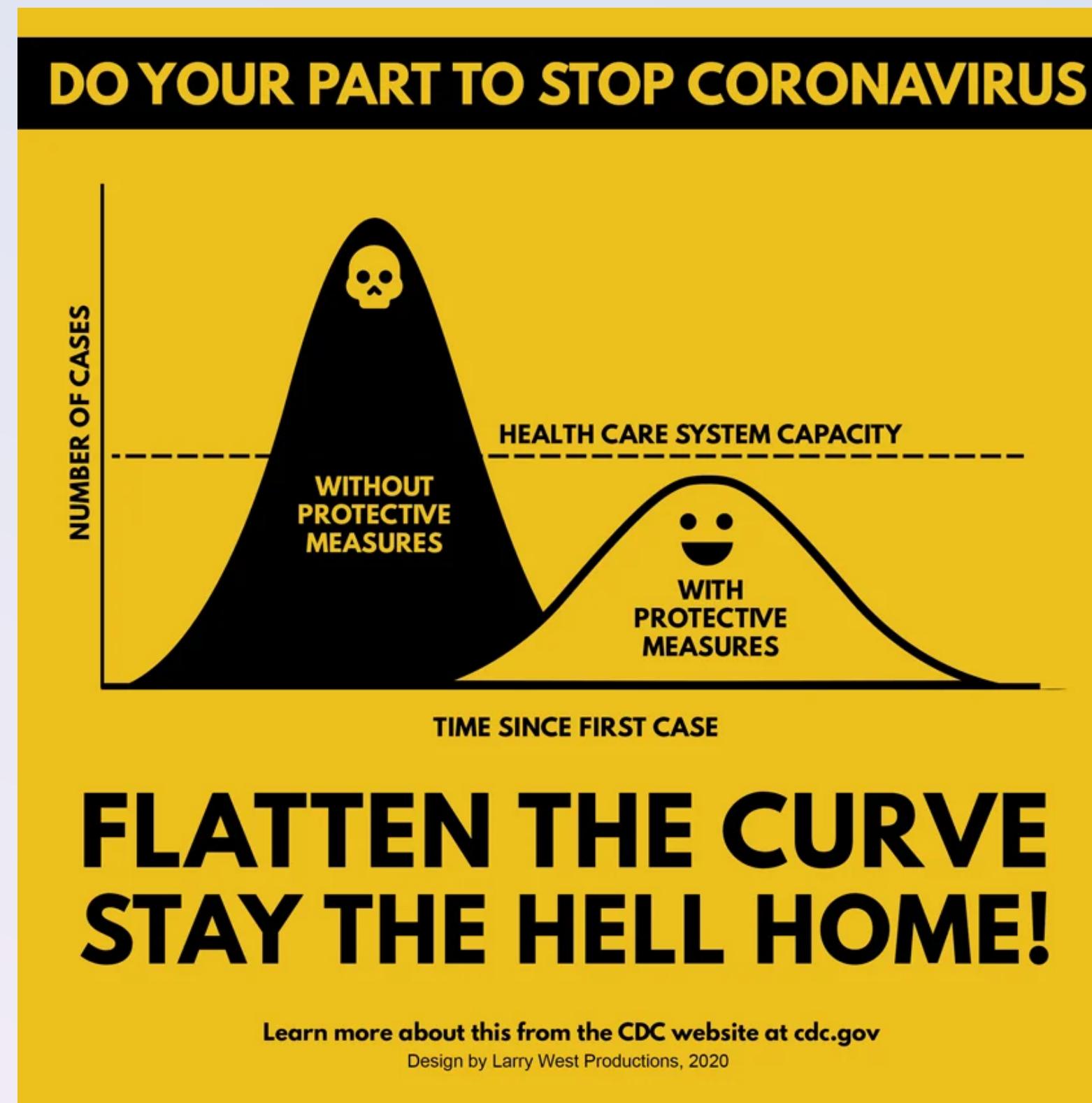
People with disabilities deserve to:

Participate in politics



Credit: [CNN](#)

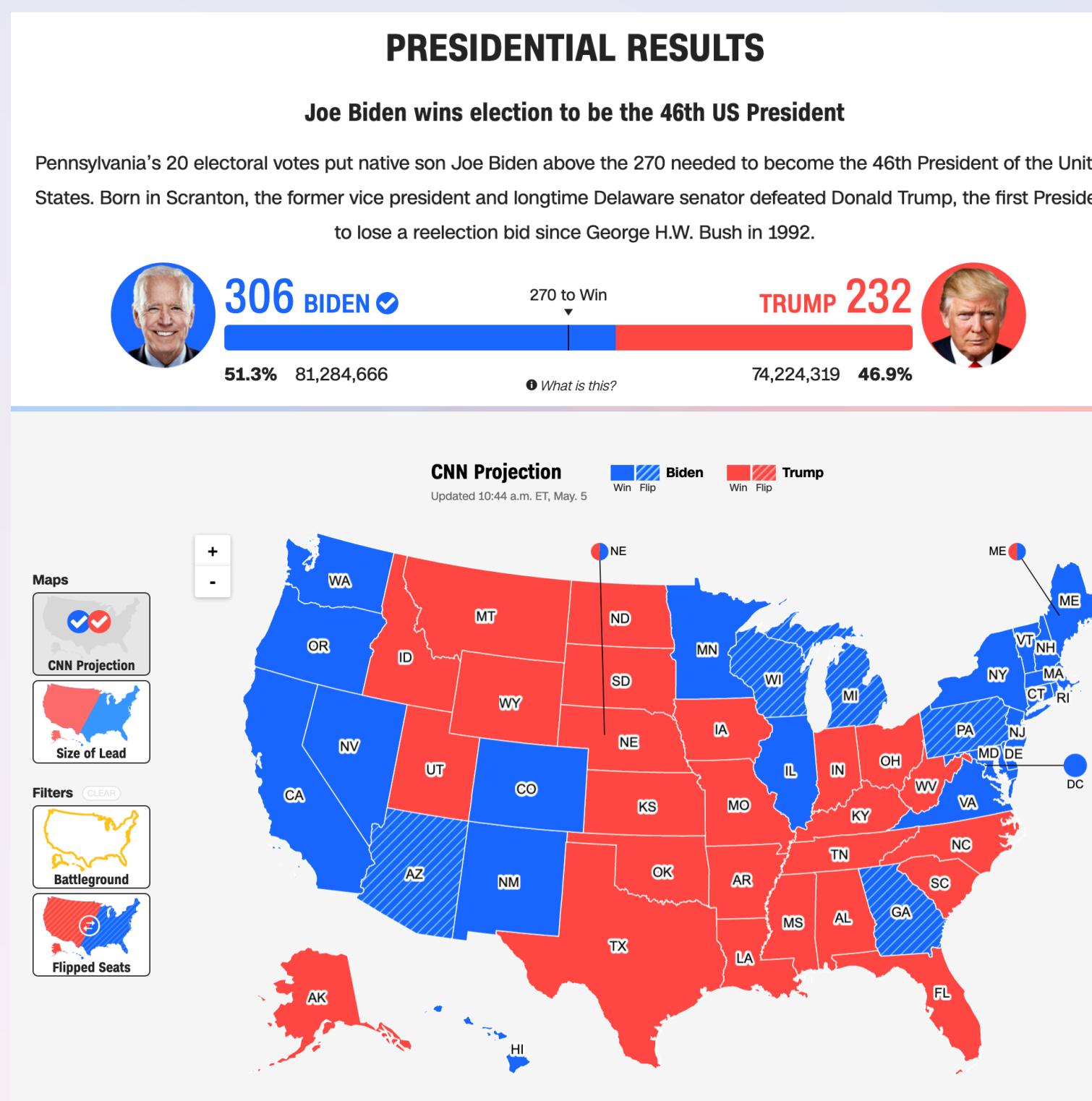
Make informed decisions



Credit: [Reddit](#)

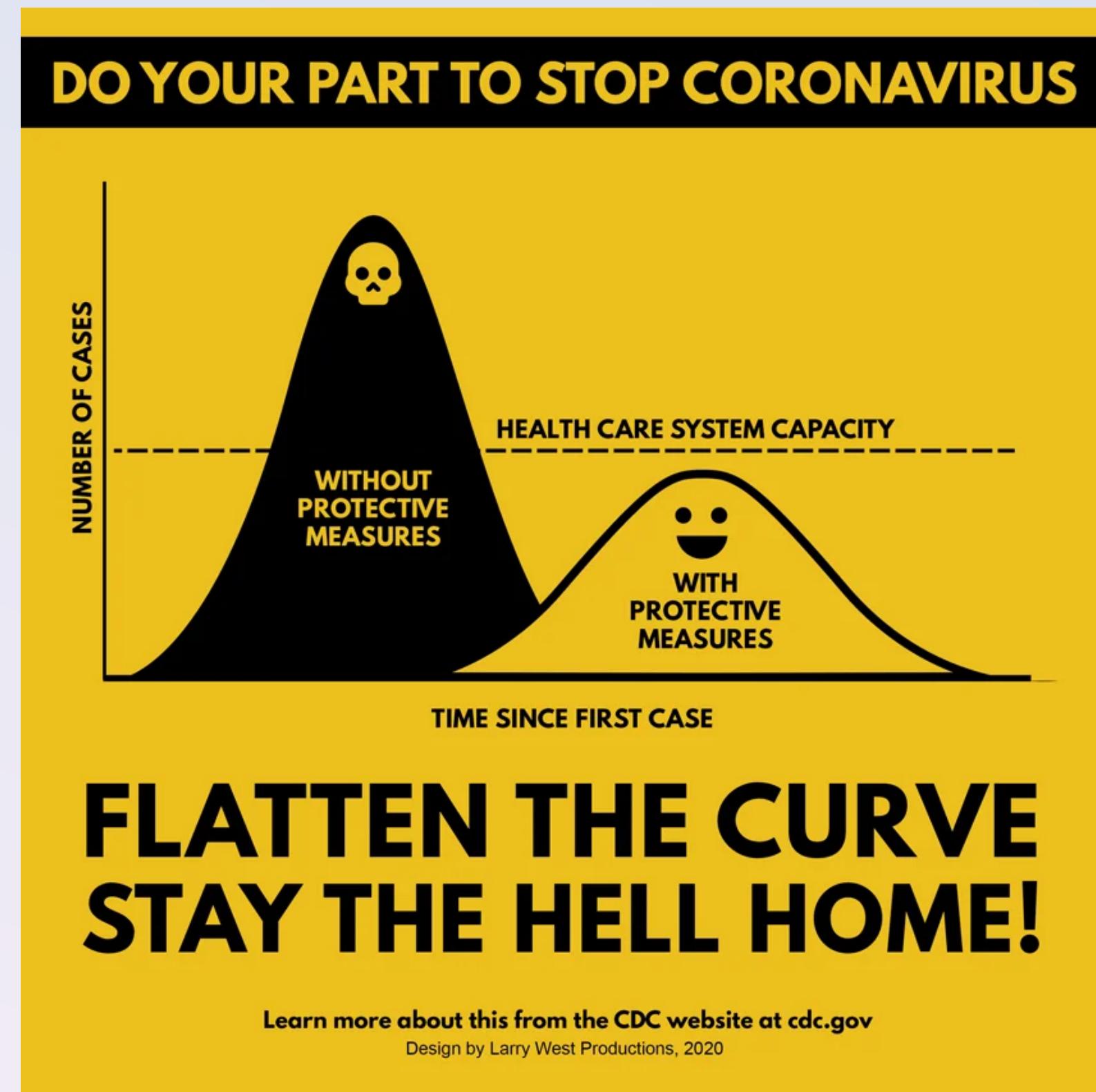
People with disabilities deserve to:

Participate in politics



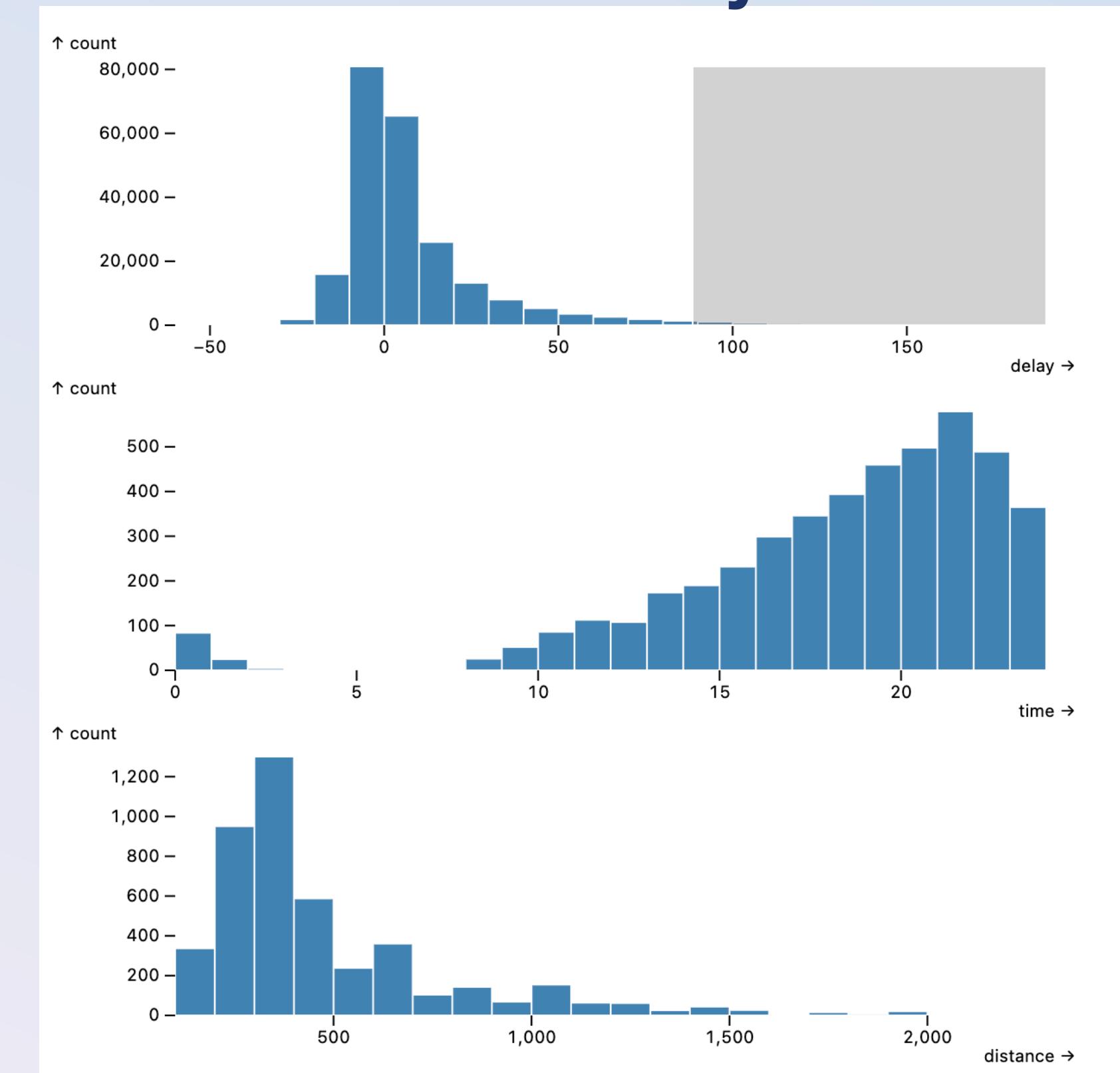
Credit: [CNN](#)

Make informed decisions



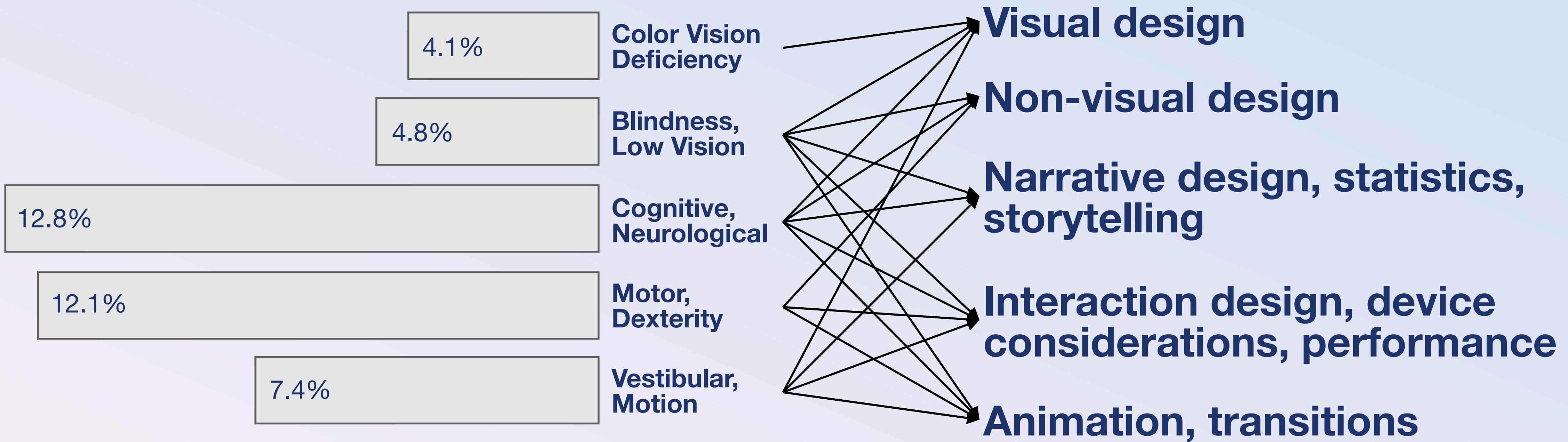
Credit: [Reddit](#)

Analyze data quickly and efficiently

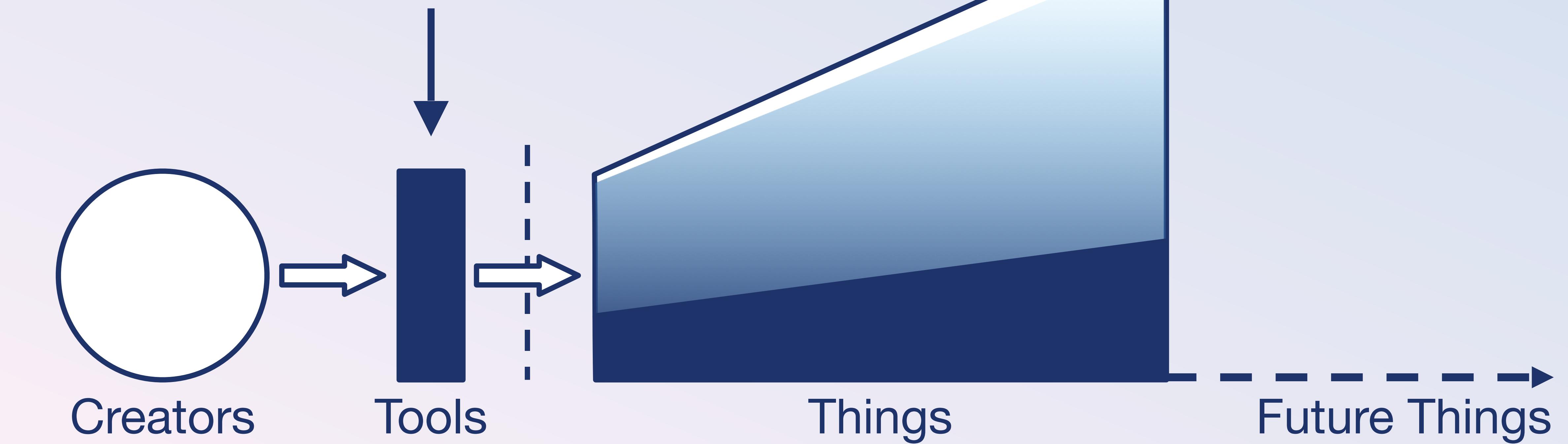


Credit: Our research

Accessibility affects every aspect of visualization work



Can better visualization tools reduce inaccessibility?



All principles are *incomplete*,
but some are *useful*.

**Perceivable
Operable
Understandable
Robust**

Chartability's additions:

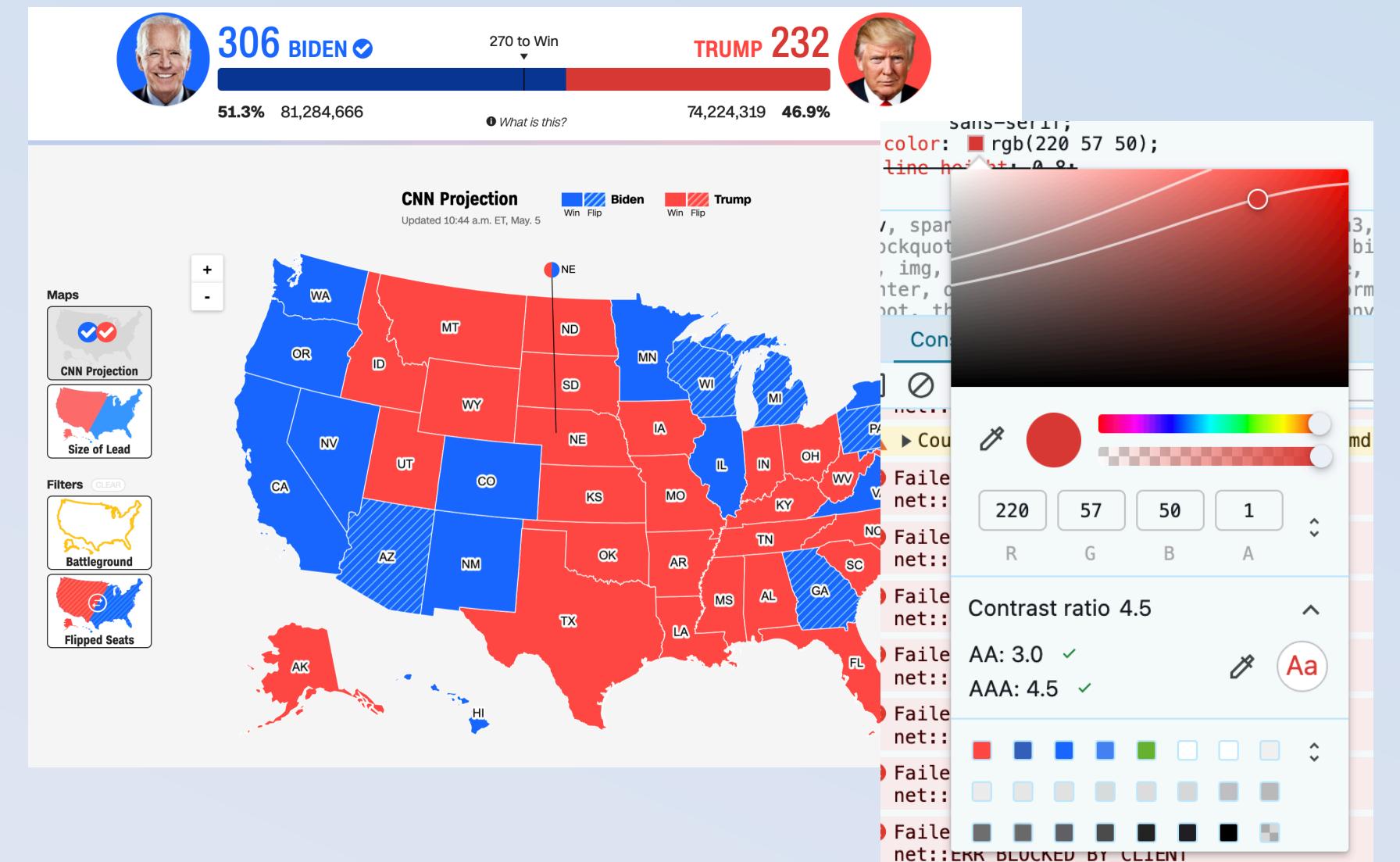
+

**Compromising
Assistive
Flexible**

Elavsky et al, “Chartability.” (2022)

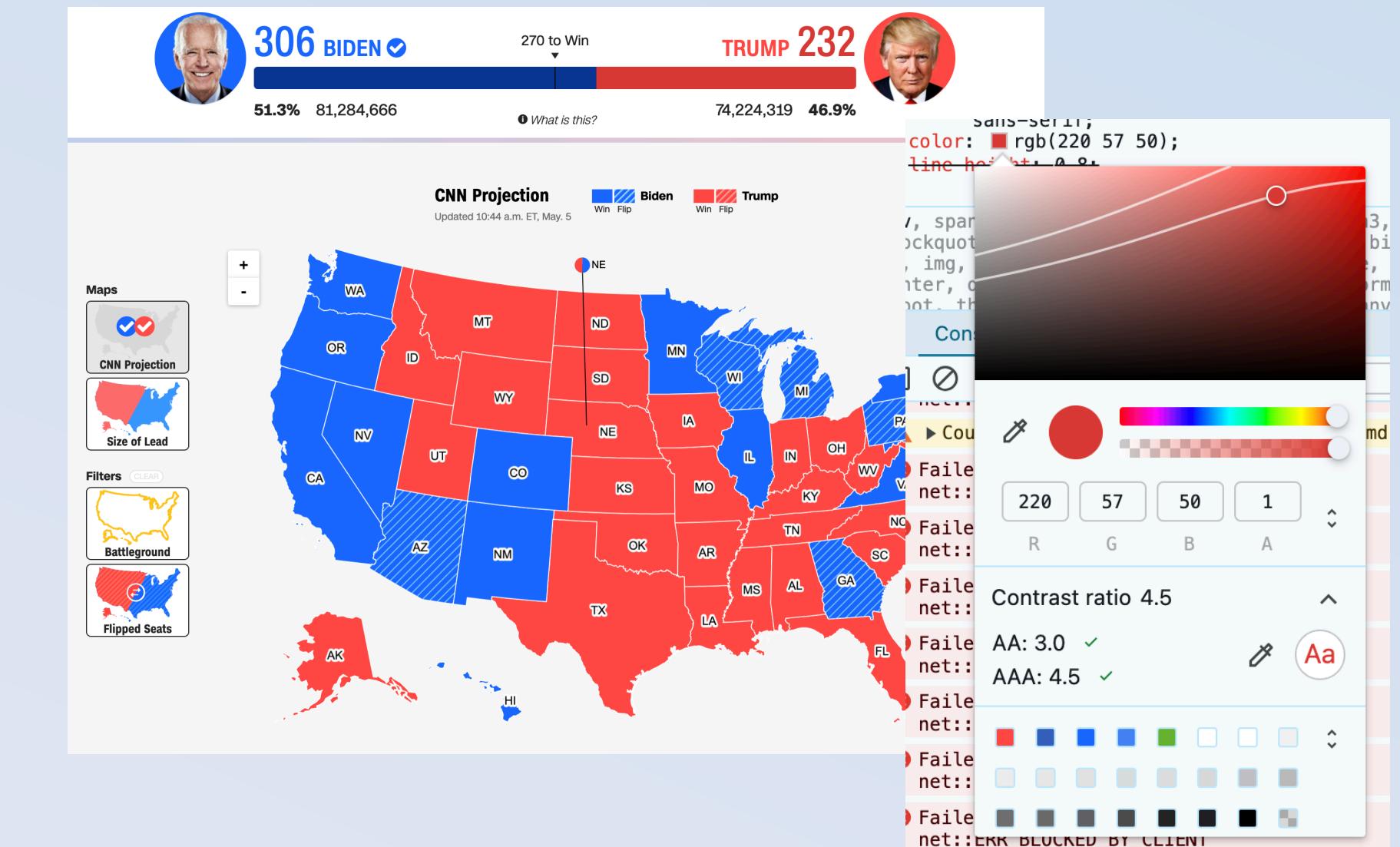
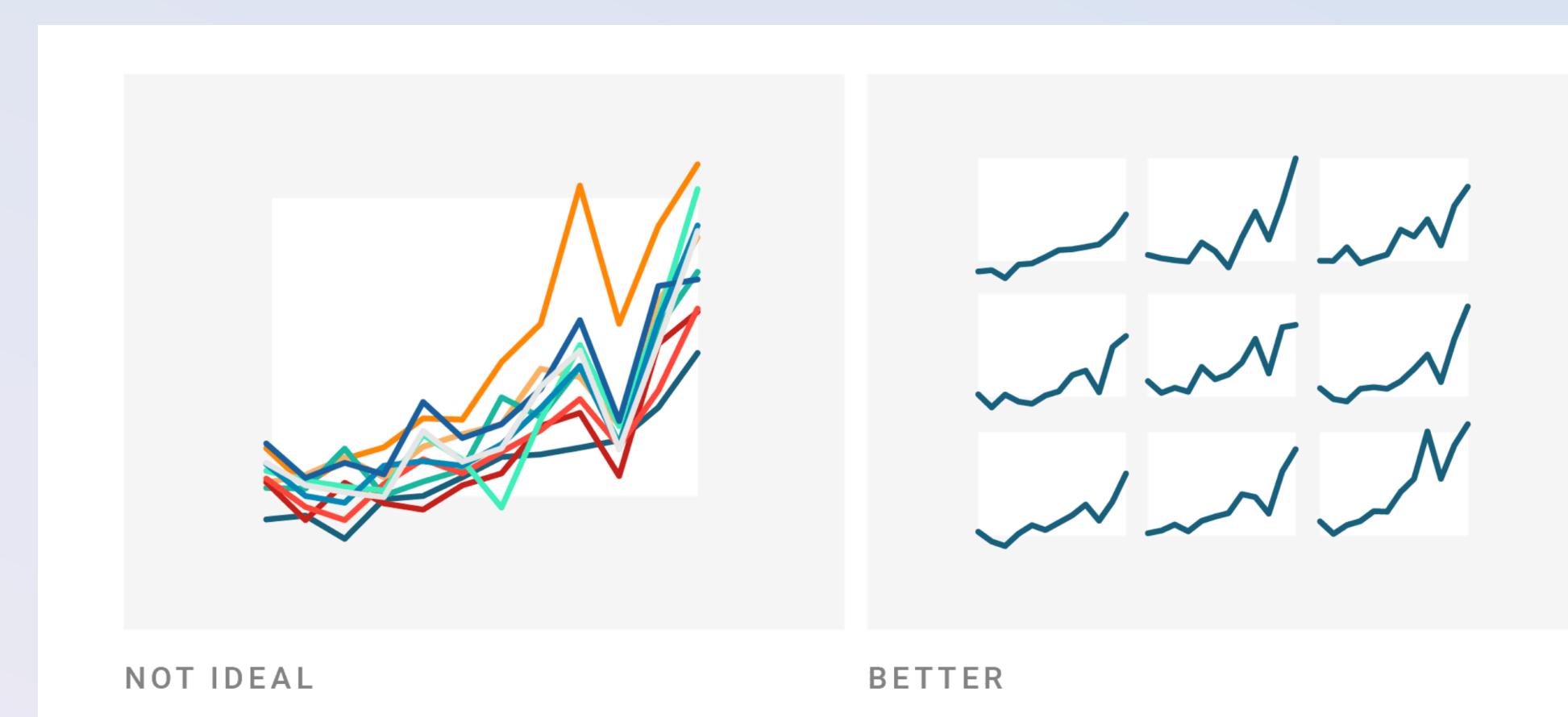
Perceivable

Can someone perceive this in multiple ways? Is each way easy?



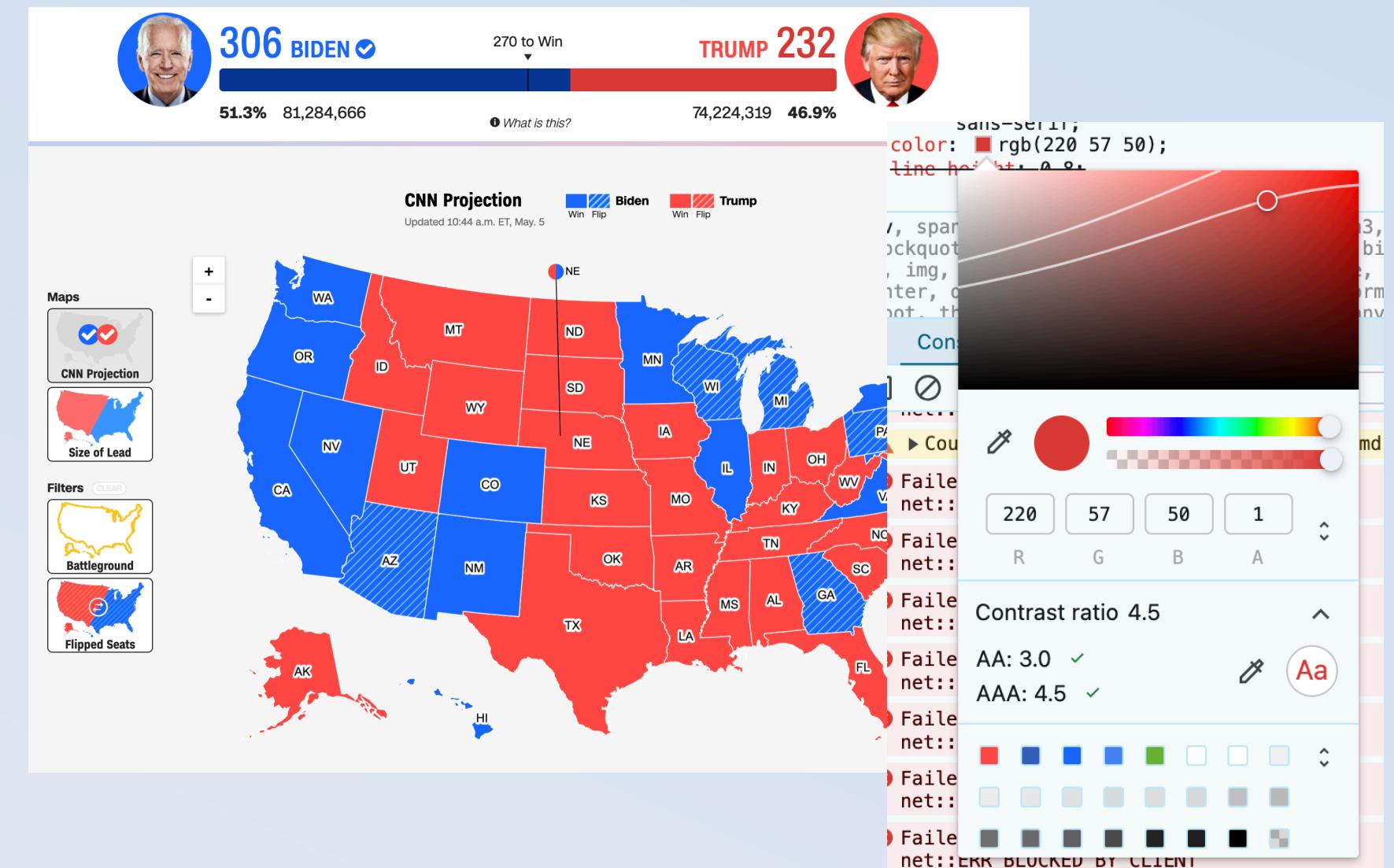
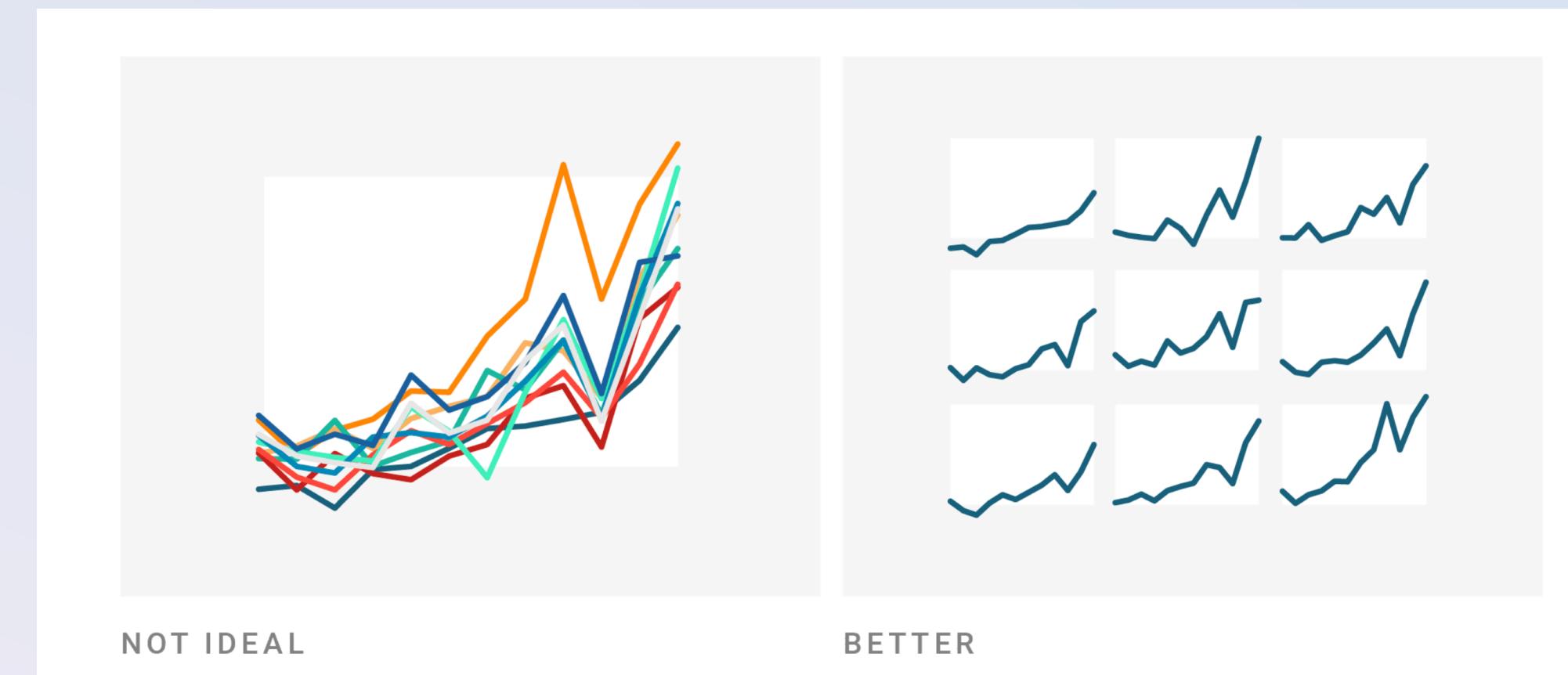
Perceivable

Can someone perceive this in multiple ways? Is each way easy?



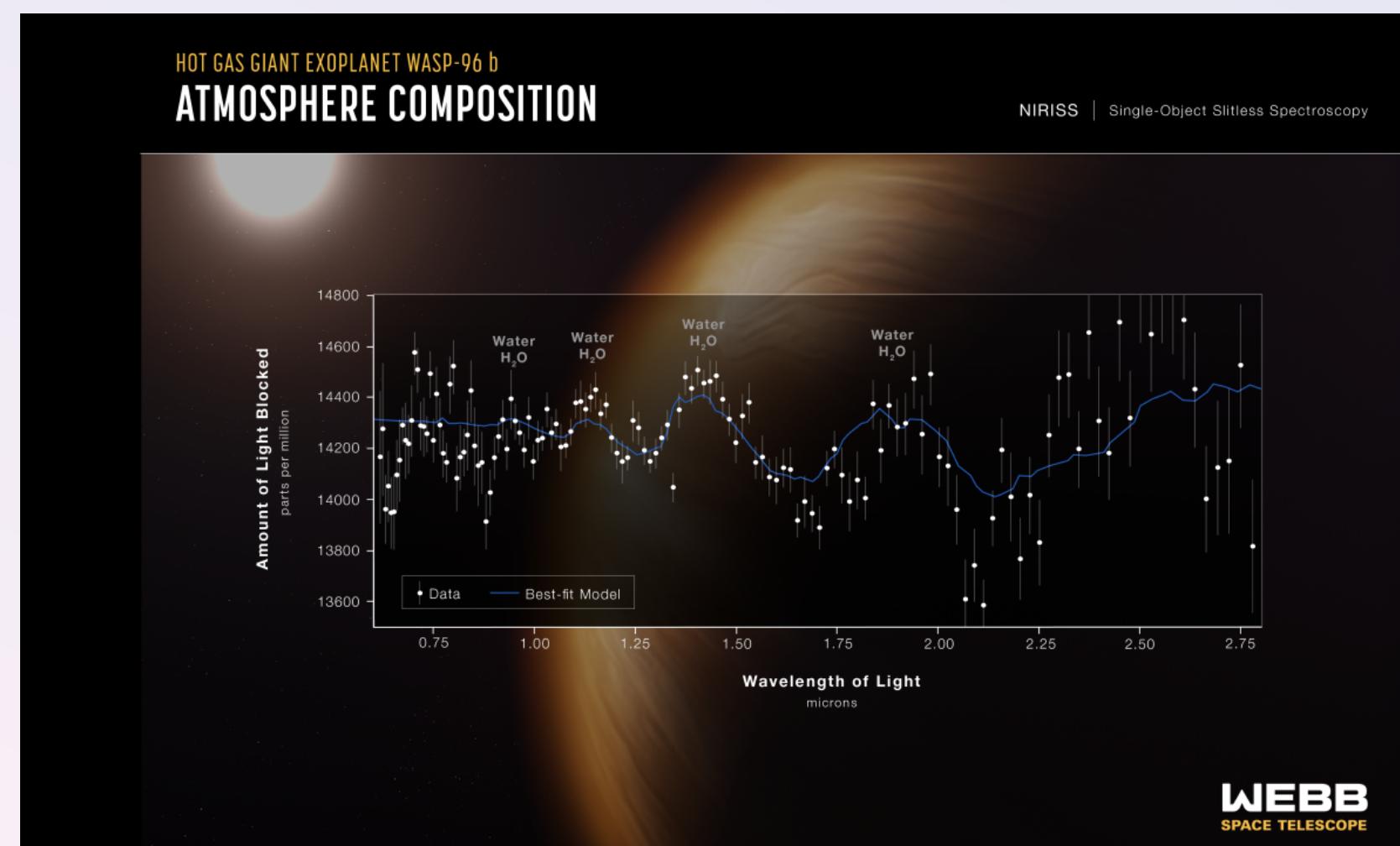
Perceivable

Can someone perceive this in multiple ways? Is each way easy?



Perceivable

Can someone perceive this in multiple ways? Is each way easy?



Exoplanet WASP-96 b (NIRISS Transmission Spectrum)

Extended Description
Graphic titled "Hot Gas Giant Exoplanet WASP-96 b Atmosphere Composition, NIRISS Single-Object Slitless Spectroscopy."

The graphic shows a transmission spectrum in the form of a graph of the Amount of Light Blocked by the planet's atmosphere in parts per million on the vertical y-axis versus Wavelength of Light in microns on the horizontal x-axis.

Graph
Axes
The y-axis ranges from 13,500 parts per million (less light blocked) at the bottom to 14,800 parts per million (more light blocked) at the top, with labeled tick marks every 200 parts per million, starting at 13,600.
The x-axis ranges from 0.6 microns on the left to 2.8 microns on the right, with labeled tick marks every 0.25 microns, starting at 0.75 microns.

Key
The graph includes a key showing that the solid white circles centered on gray vertical lines represent data points, and a blue solid line represents a best-fit model.

Data and Model
The graph consists of 141 data points, each with a gray error bar. The points range in value from 13,589 to 14,883 parts per million. The data points are not connected. They follow a jagged trend from left to right, with a number of broad peaks and valleys. The lengths of the error bars vary from a minimum of plus or minus 43 to a maximum of plus or minus 314. The error bars are smallest between about 1 and 1.3 microns, generally increasing in length toward the left from 1 to 0.6 microns, and toward the right from about 1.3 to 2.8 microns.

A solid blue line with several prominent peaks and valleys represents the best-fit model. The model begins at the far left with a very slight downward slope toward the right with a small peak around 0.95 microns, and another peak at about 1.15 microns. The line then becomes more sinuous, forming a taller, broader peak centered at about 1.4 microns and a slightly shorter broad peak at 1.9 microns. Starting around 2.15 microns, the line trends back upward with a wavy slope of about 30 degrees.

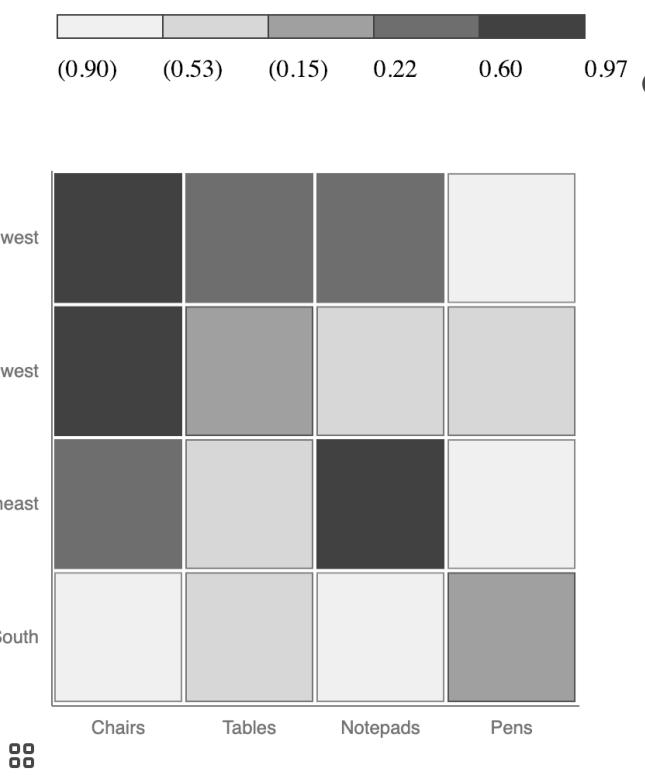
The blue best-fit model line generally follows the trend of the data. It intersects some data points, but does not match the data perfectly. The match between the model and data is clearest between about 0.9 and 1.65 microns.

Operable

Can someone operate this in multiple ways? Is each way easy?

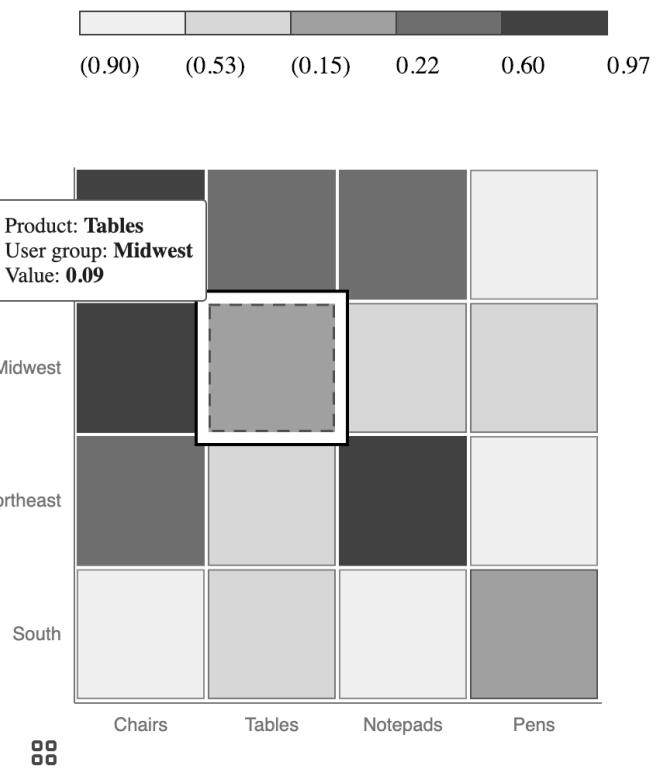
Comparing how user groups correlate to approval rates of product types

A high correlation value (close to 1) indicates that these users have a high approval rate of that product. A low correlation value (close to -1) indicates a negative approval rate of those products.



Comparing how user groups correlate to approval rates of product types

A high correlation value (close to 1) indicates that these users have a high approval rate of that product. A low correlation value (close to -1) indicates a negative approval rate of those products.

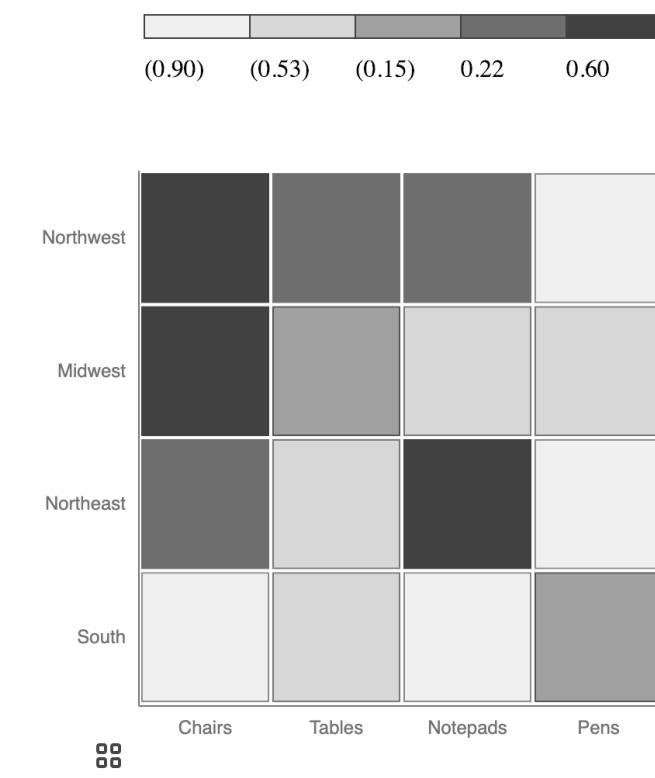


Operable

Can someone operate this in multiple ways? Is each way easy?

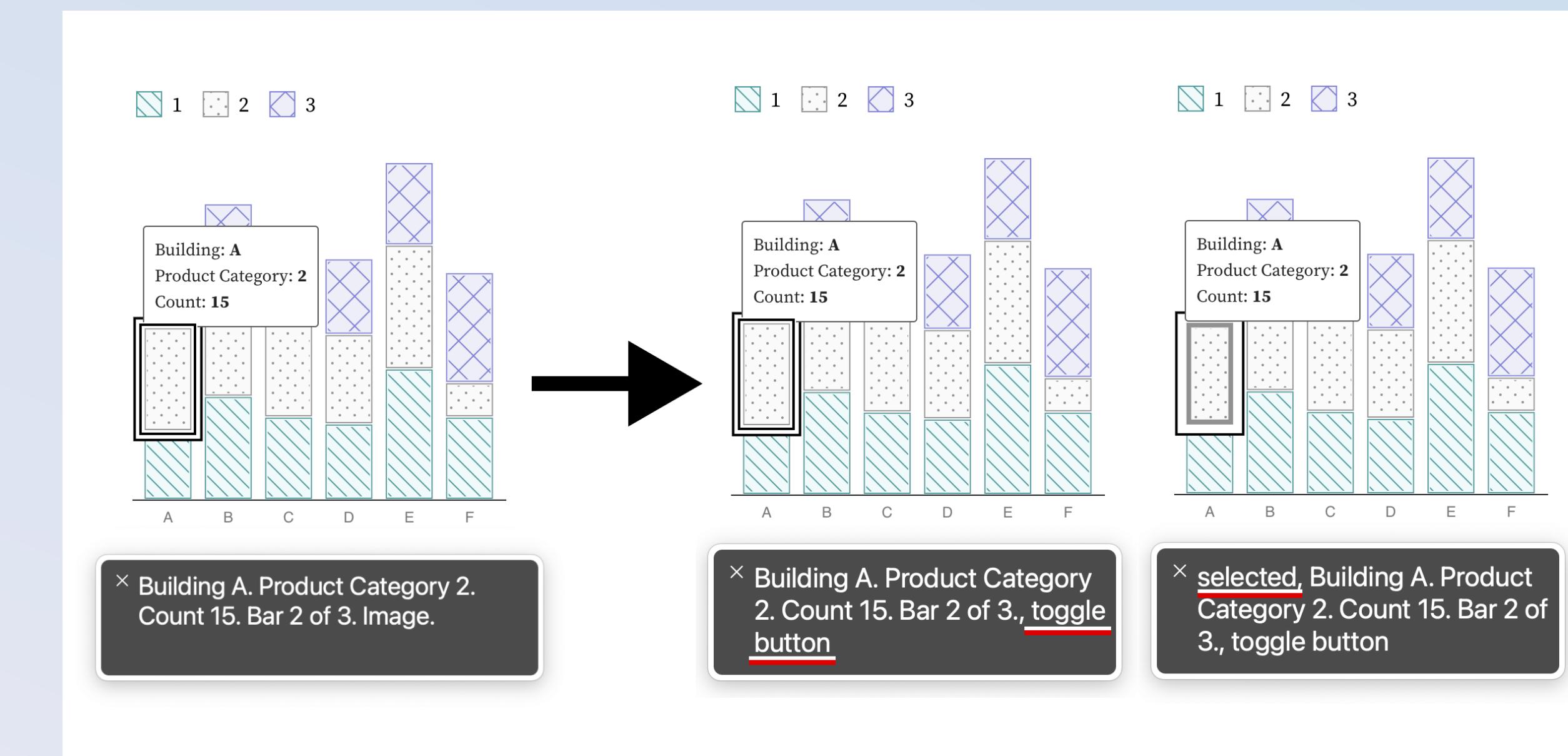
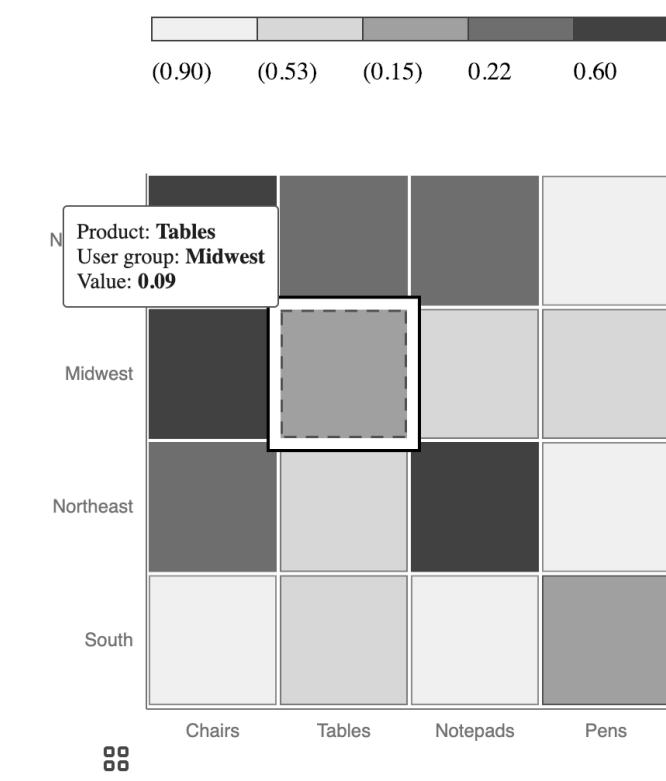
Comparing how user groups correlate to approval rates of product types

A high correlation value (close to 1) indicates that these users have a high approval rate of that product. A low correlation value (close to -1) indicates a negative approval rate of those products.



Comparing how user groups correlate to approval rates of product types

A high correlation value (close to 1) indicates that these users have a high approval rate of that product. A low correlation value (close to -1) indicates a negative approval rate of those products.

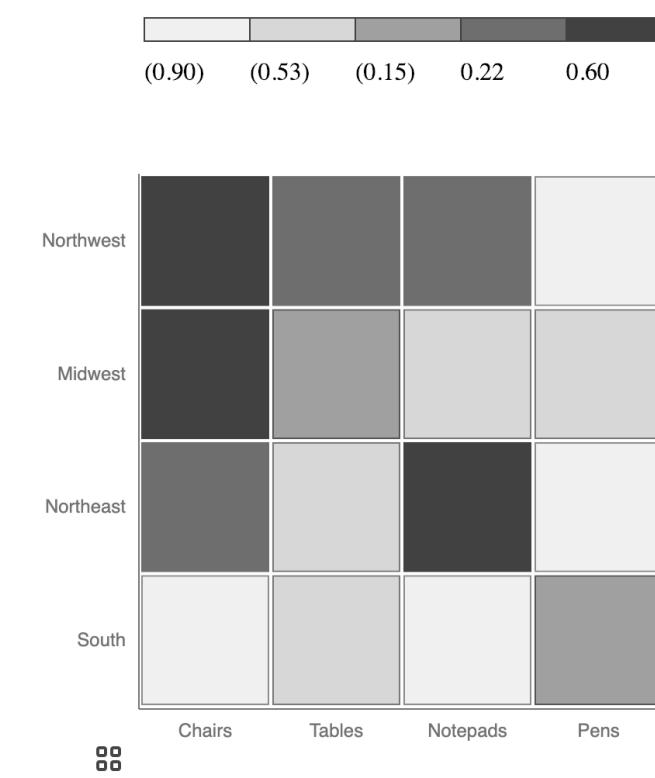


Operable

Can someone operate this in multiple ways? Is each way easy?

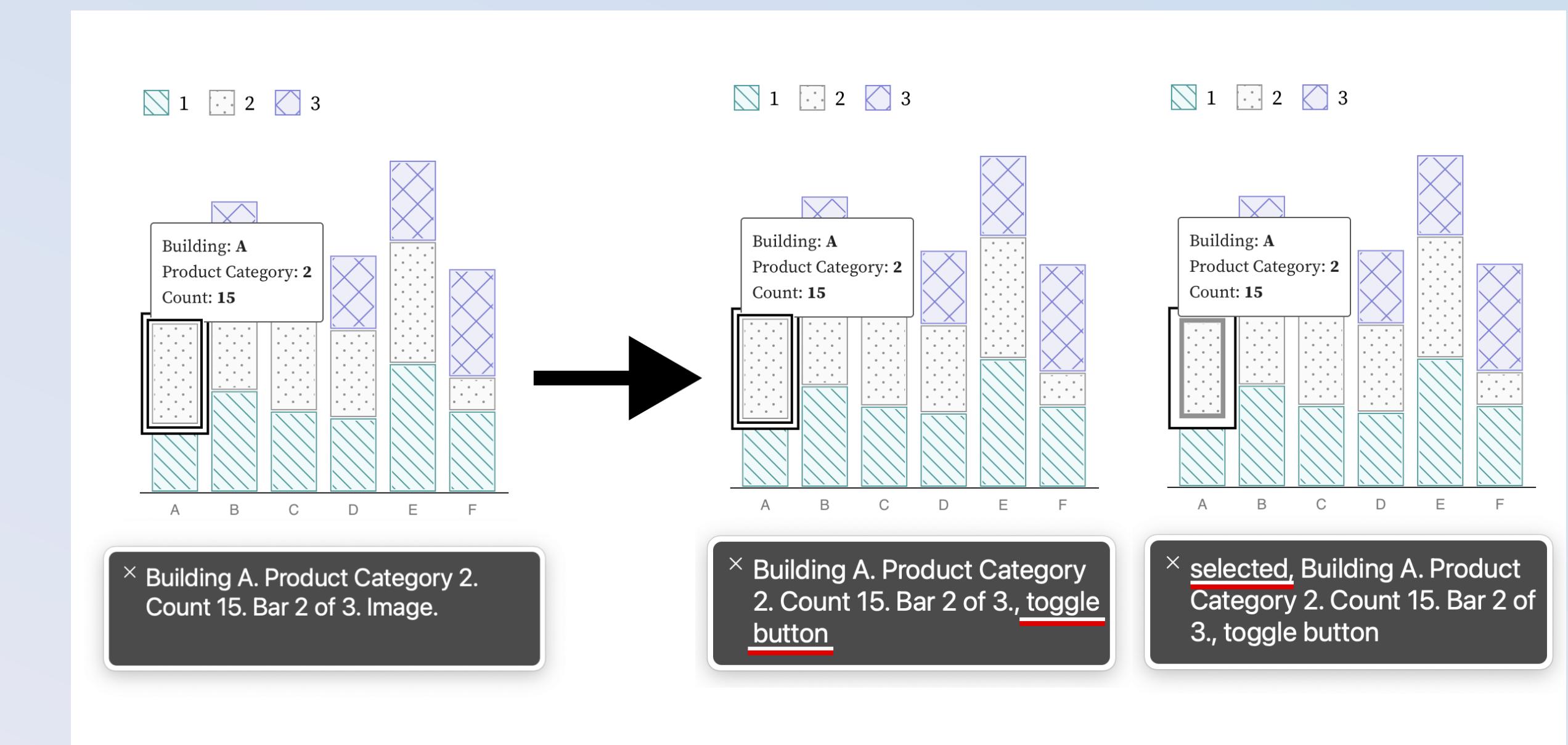
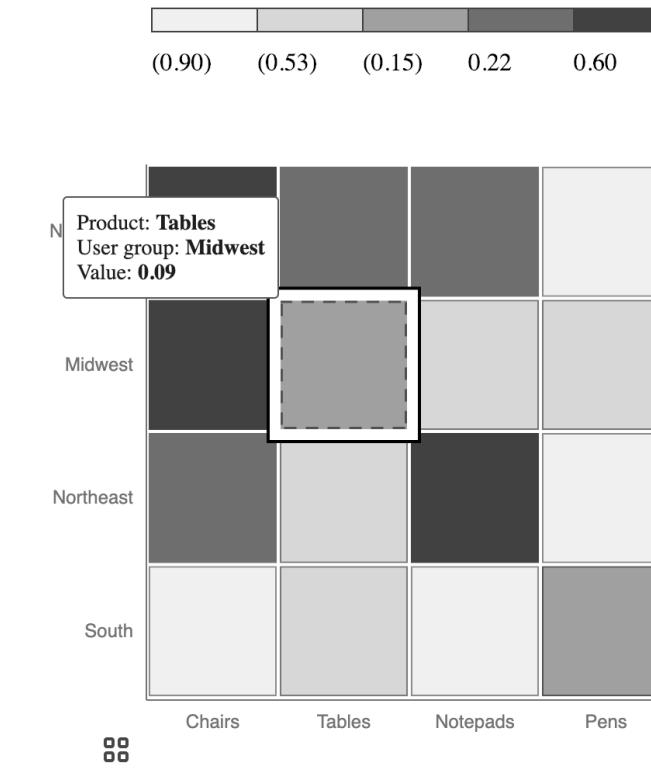
Comparing how user groups correlate to approval rates of product types

A high correlation value (close to 1) indicates that these users have a high approval rate of that product. A low correlation value (close to -1) indicates a negative approval rate of those products.



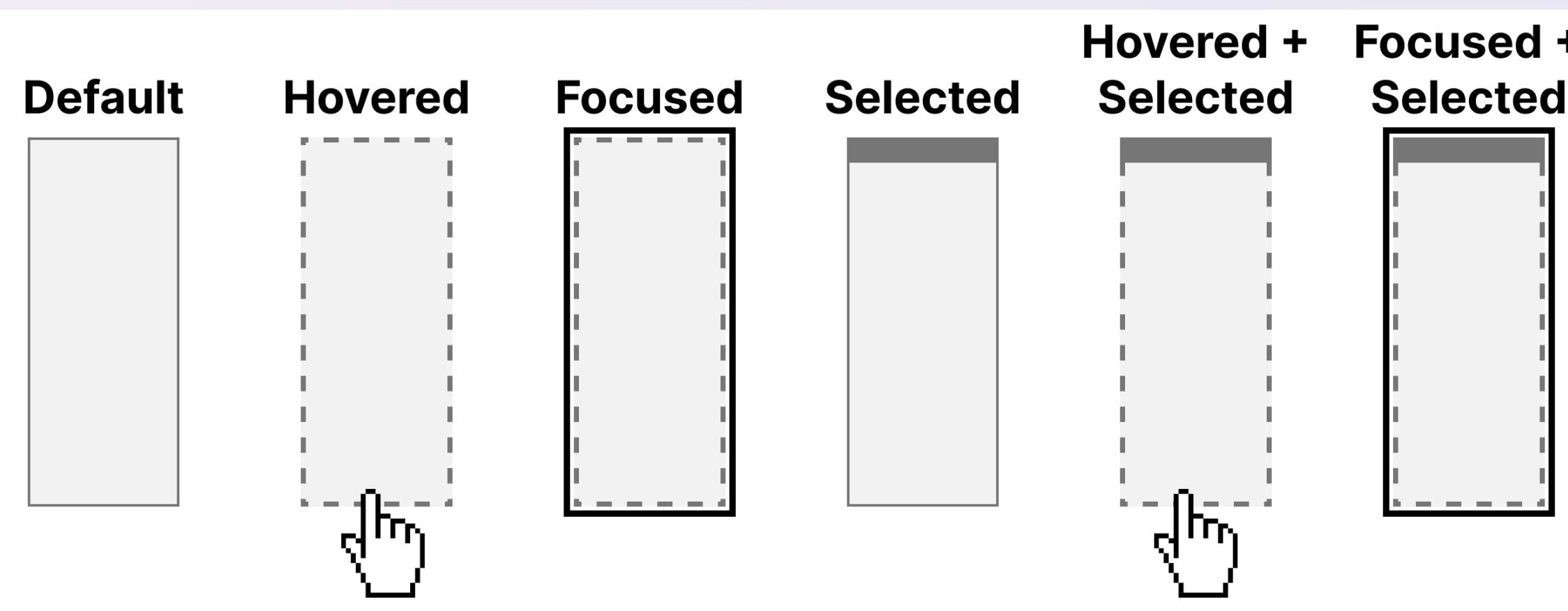
Comparing how user groups correlate to approval rates of product types

A high correlation value (close to 1) indicates that these users have a high approval rate of that product. A low correlation value (close to -1) indicates a negative approval rate of those products.



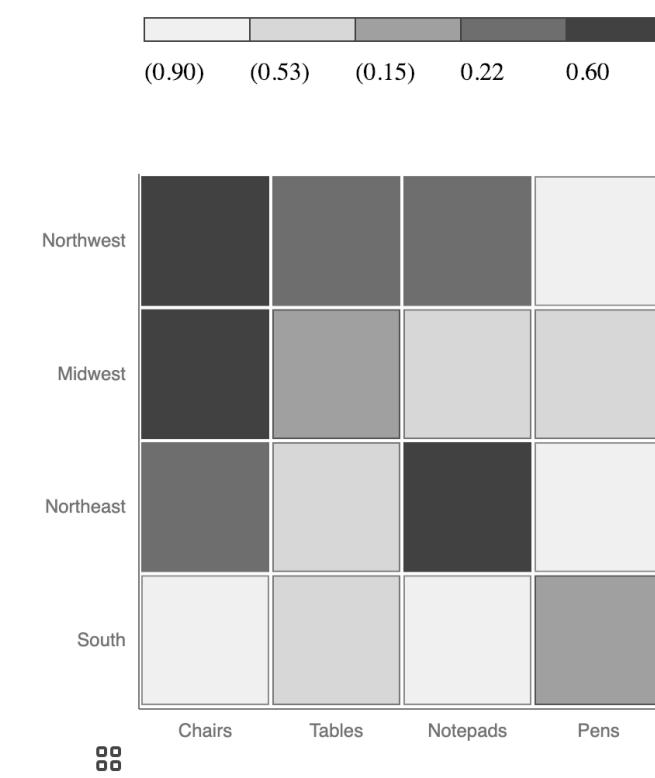
Operable

Can someone operate this in multiple ways? Is each way easy?



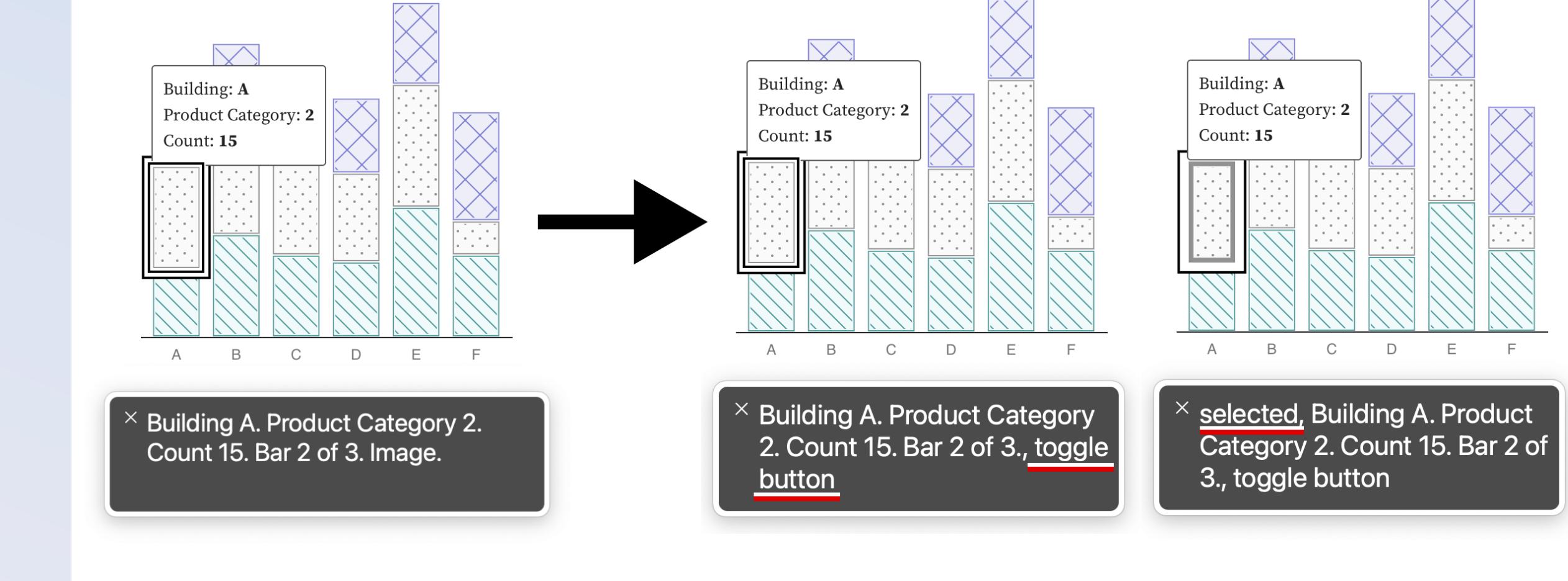
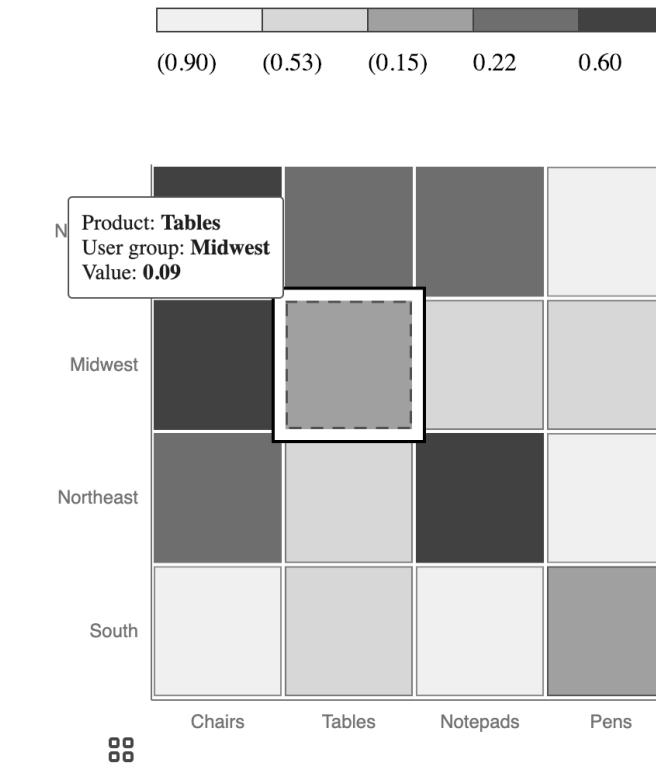
Comparing how user groups correlate to approval rates of product types

A high correlation value (close to 1) indicates that these users have a high approval rate of that product. A low correlation value (close to -1) indicates a negative approval rate of those products.



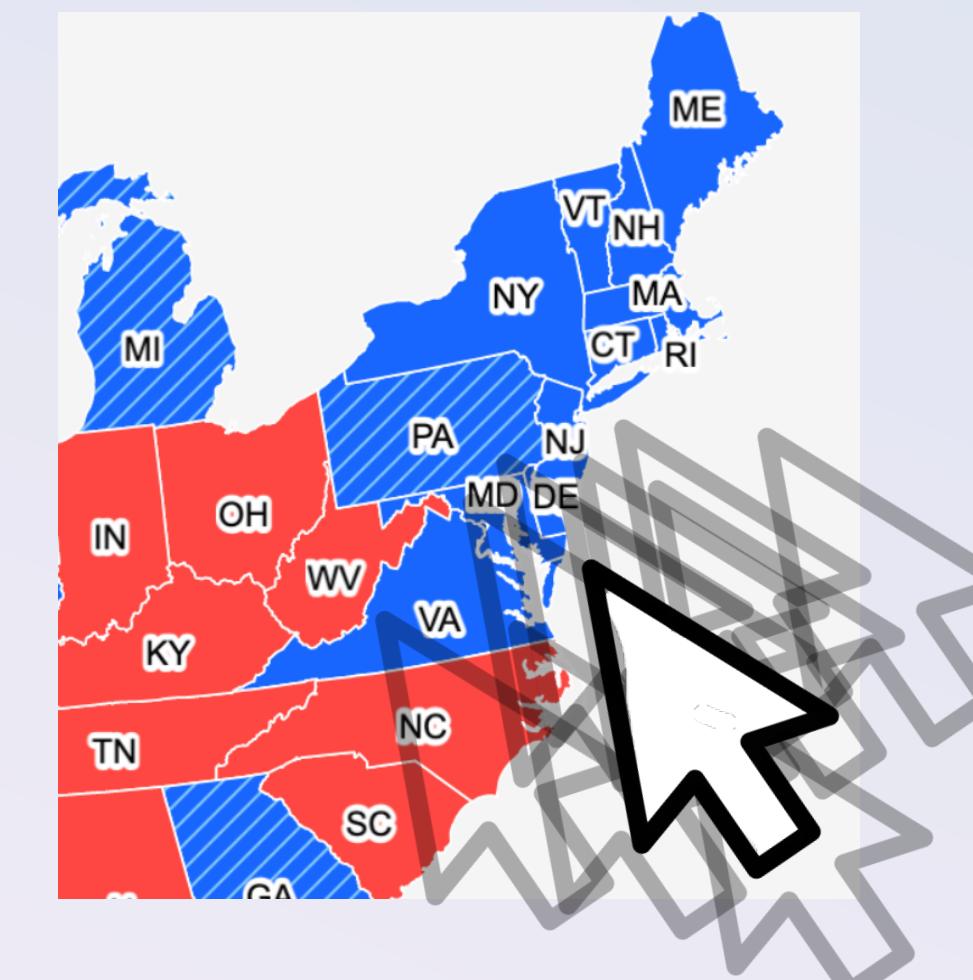
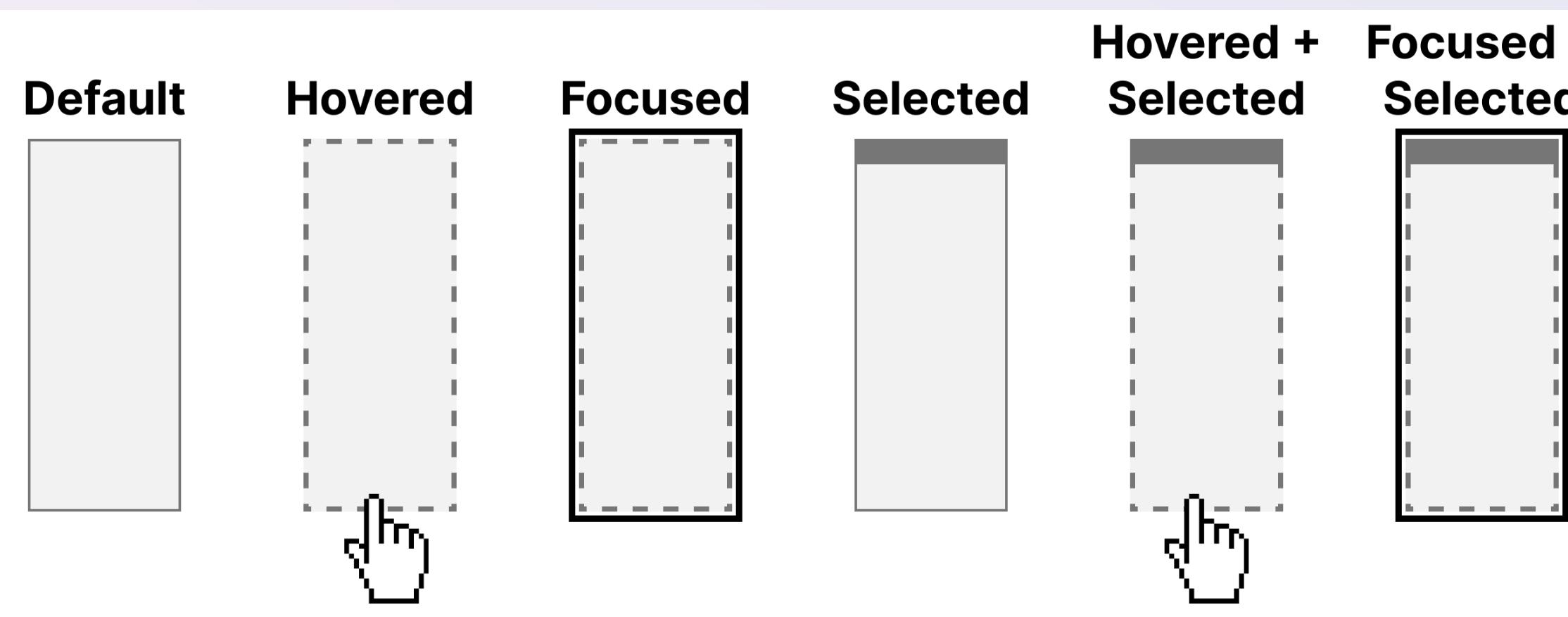
Comparing how user groups correlate to approval rates of product types

A high correlation value (close to 1) indicates that these users have a high approval rate of that product. A low correlation value (close to -1) indicates a negative approval rate of those products.



Operable

Can someone operate this in multiple ways? Is each way easy?

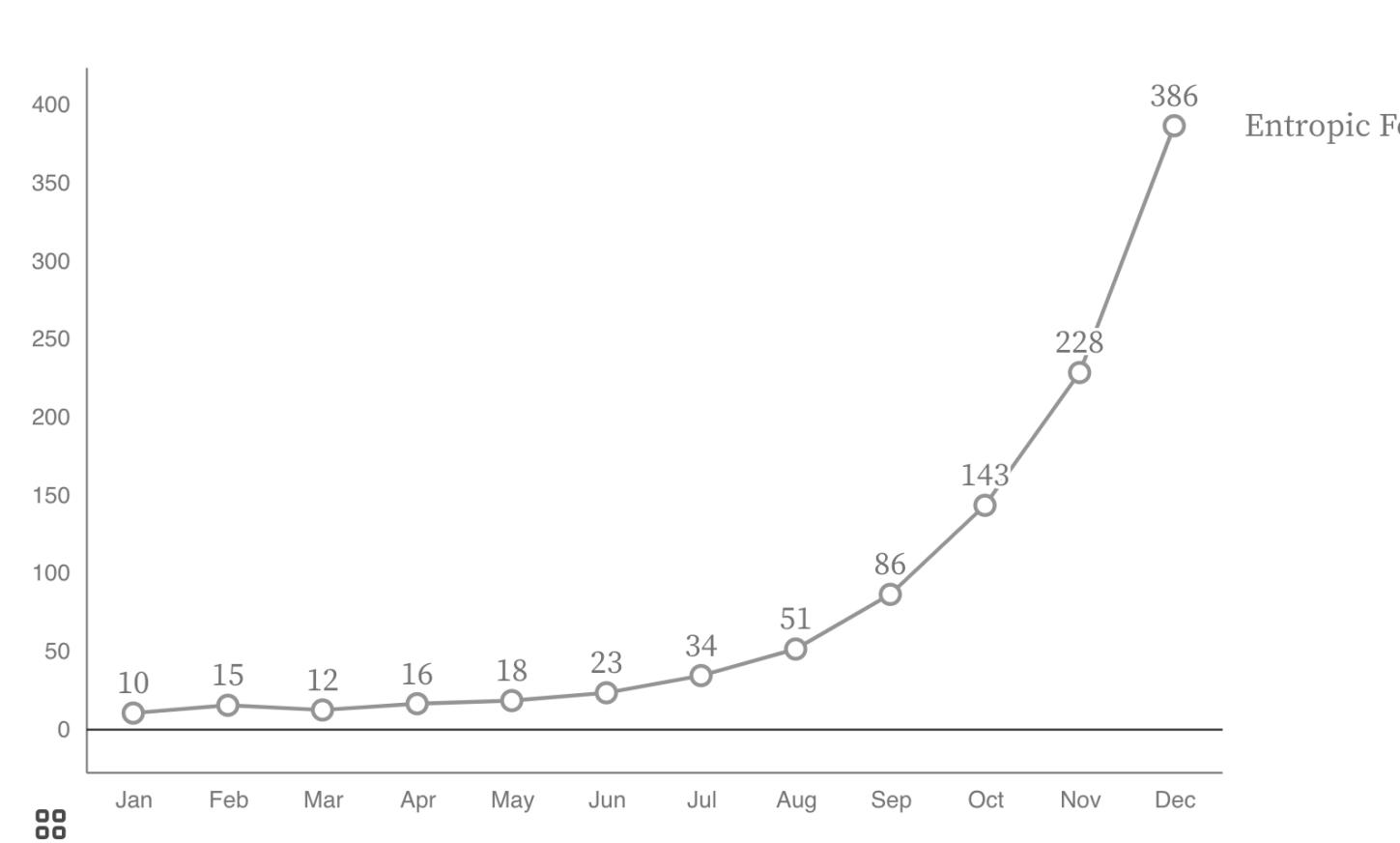


Understandable

Can someone understand this in multiple ways? Is each way easy?

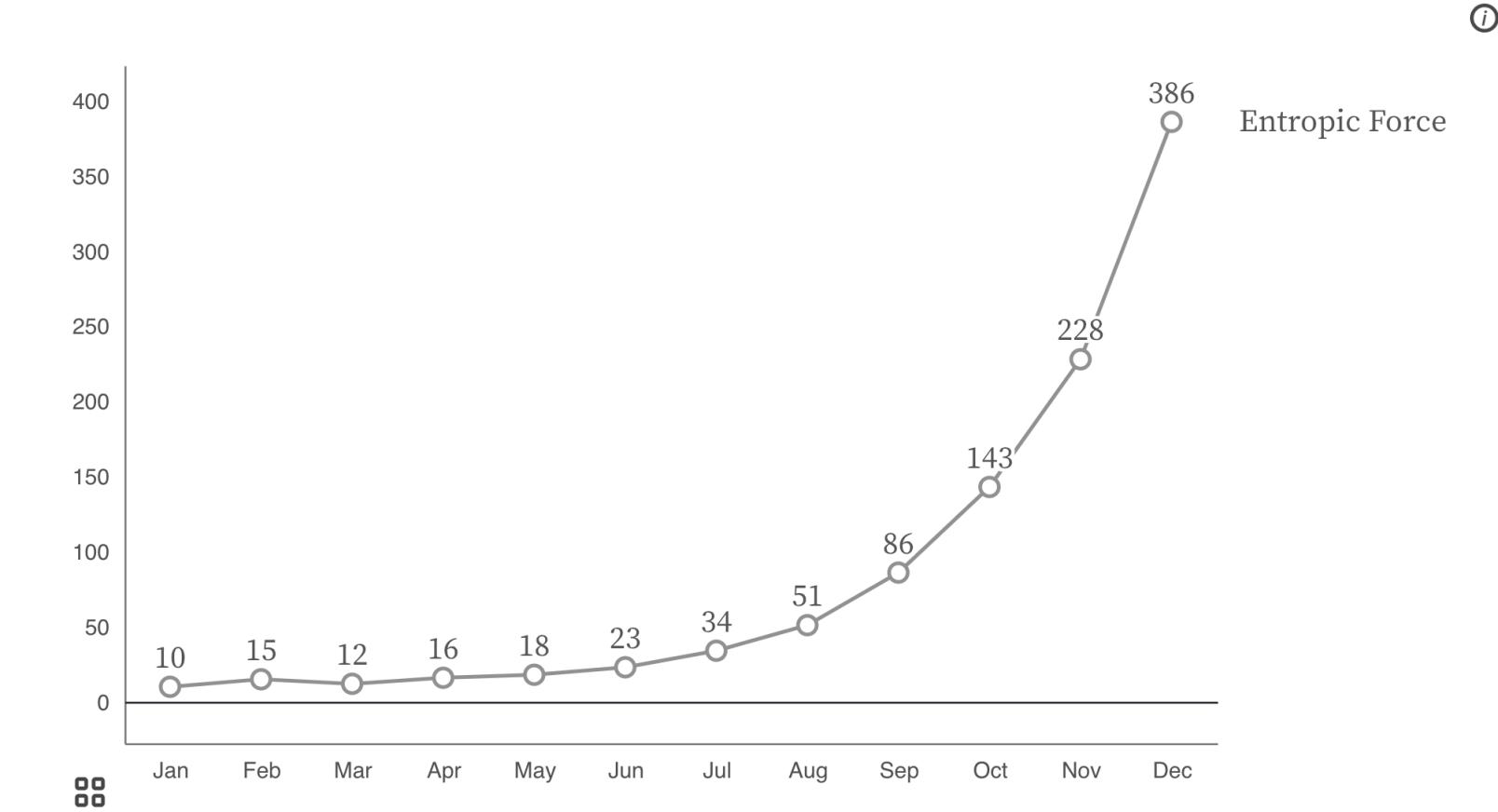
Entropic Force

In EF units (non-normalized)



Entropic Force has Increased Exponentially

Measured in EF units (non-normalized)

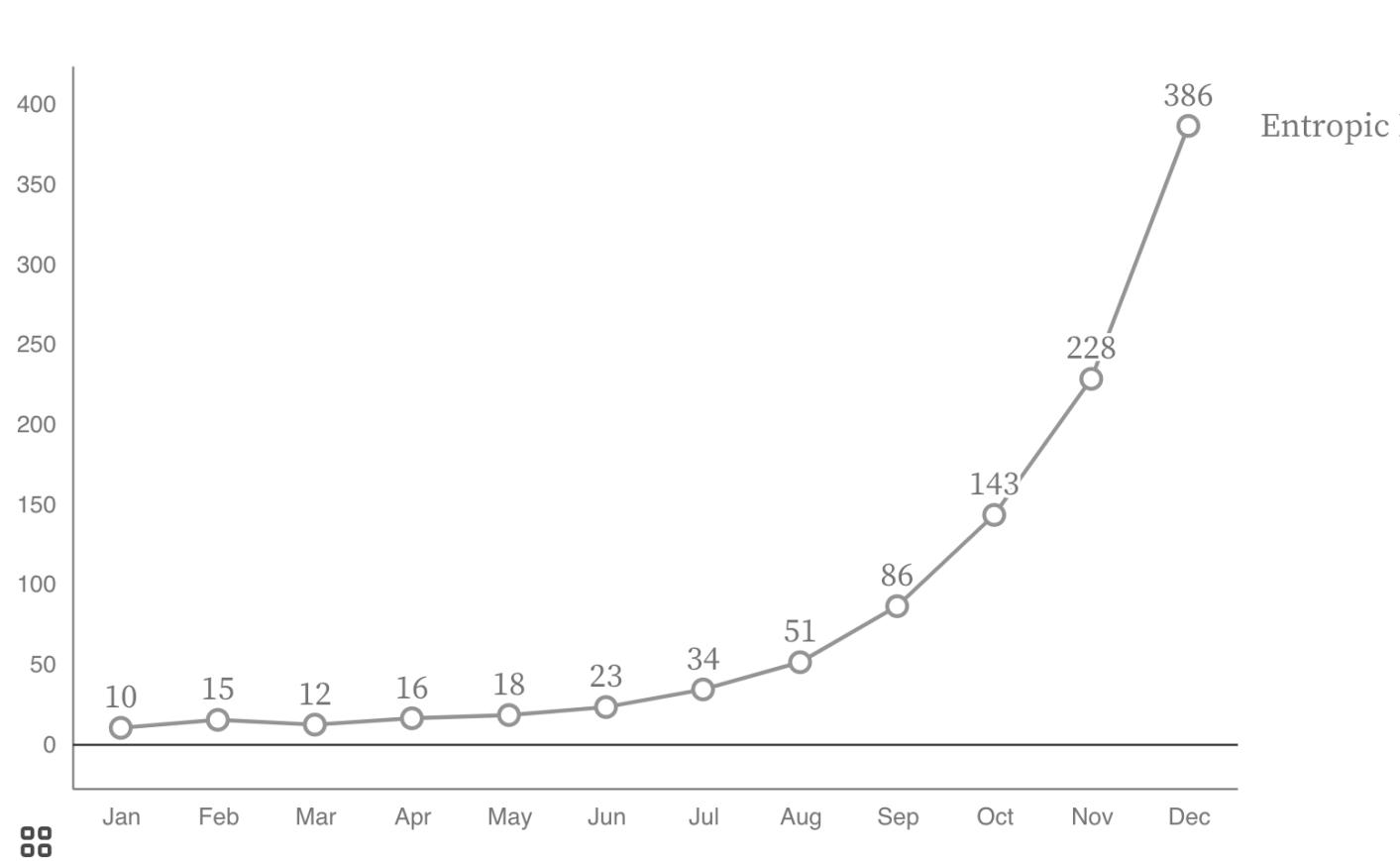


Understandable

Can someone understand this in multiple ways? Is each way easy?

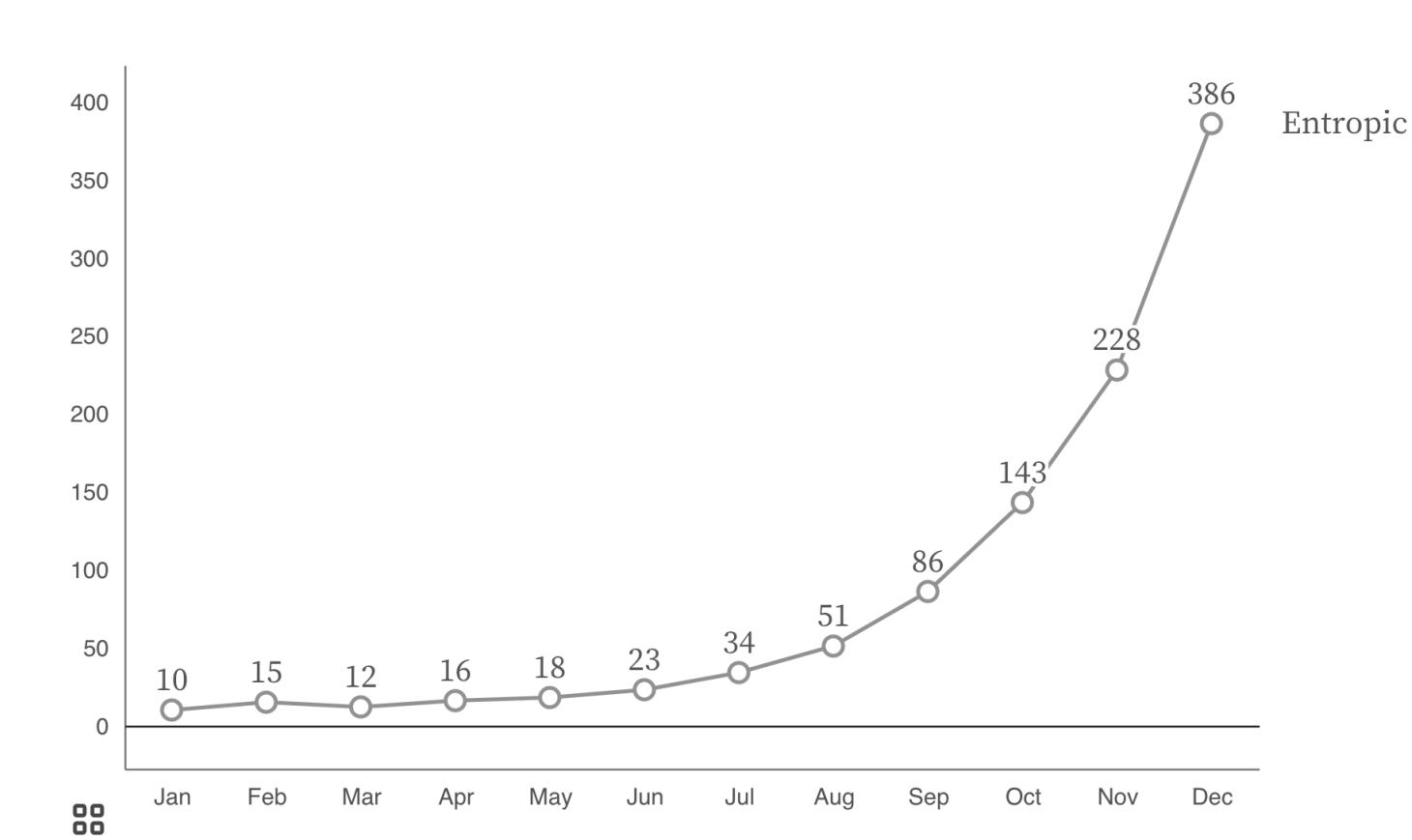
Entropic Force

In EF units (non-normalized)



Entropic Force has Increased Exponentially

Measured in EF units (non-normalized)



Understandable

Can someone understand this in multiple ways? Is each way easy?

Measured in EF units (non-normalized). EF units are valuable for catching egregious over-simulation in models that use randomized data decimation techniques. This particular evaluation findings demonstrate that the randomization models are significantly over-producing entropy in our latest force simulations.

Hemingway

Editor

Readability

Post-graduate

Poor. Aim for 14.

Words: 39

Show More ▾

1 adverb. Aim for 0 or fewer.

0 uses of passive voice. Nice work.

1 phrase has a simpler alternative.

0 of 3 sentences are hard to read.

2 of 3 sentences are very hard to read.

Measured in EF units (non-normalized). These units are helpful for catching bad data loss when we remove our data at random. We are producing too much entropic force in our latest models.

Hemingway

Editor

Readability

Grade 6

Good

Words: 32

Show More ▾

0 adverbs. Well done.

0 uses of passive voice. Nice work.

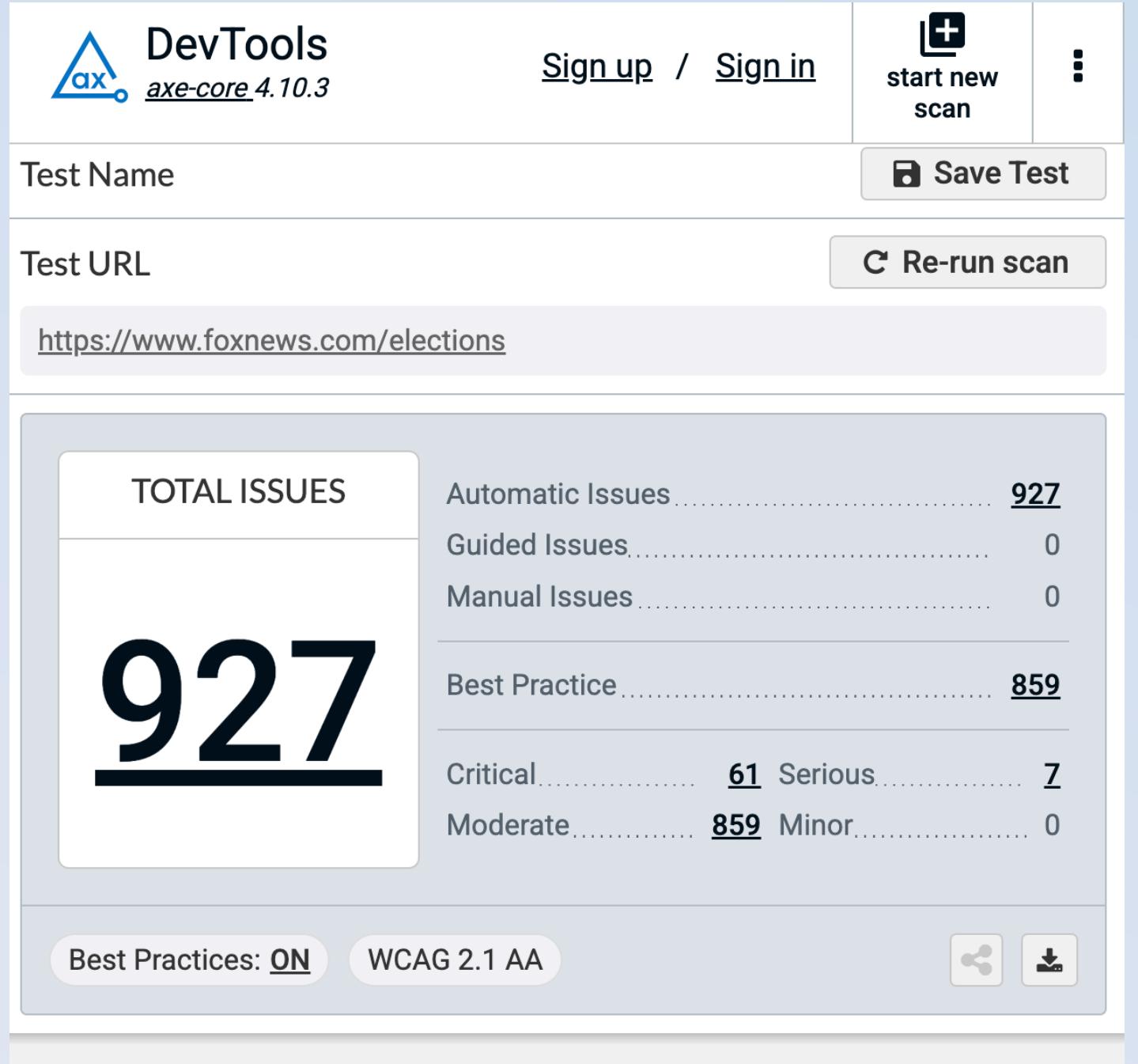
0 phrases have simpler alternatives.

0 of 3 sentences are hard to read.

0 of 3 sentences are very hard to read.

Robust

Is this design compliant with existing standards and works with the user's assistive technologies of choice?



Robust

Is this design compliant with existing standards and works with the user's assistive technologies of choice?

Compromising

Have multiple user flows been provided to reach each outcome or purpose provided?

Compromising

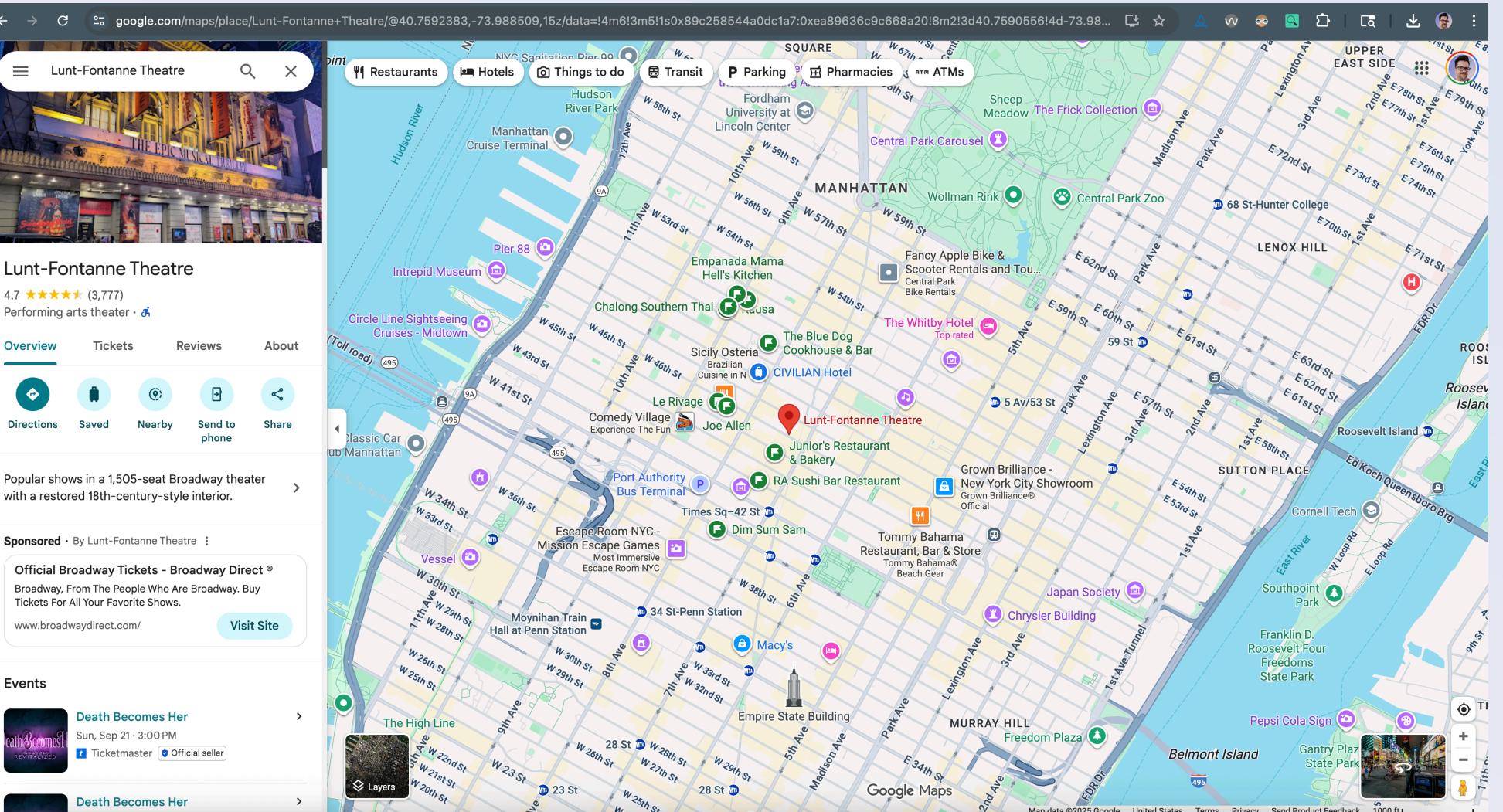
Have multiple user flows been provided to reach each outcome or purpose provided?

Line	Date	Value	Note
Entropic Force	Jan	10	Lowest Value
Entropic Force	Feb	15	
Entropic Force	Mar	12	
Entropic Force	Apr	16	
Entropic Force	May	18	
Entropic Force	Jun	23	
Entropic Force	Jul	34	
Entropic Force	Aug	51	
Entropic Force	Sep	86	
Entropic Force	Oct	143	
Entropic Force	Nov	228	
Entropic Force	Dec	386	Highest Value

Compromising

Have multiple user flows been provided to reach each outcome or purpose provided?

Line	Date	Value	Note
Entropic Force	Jan	10	Lowest Value
Entropic Force	Feb	15	
Entropic Force	Mar	12	
Entropic Force	Apr	16	
Entropic Force	May	18	
Entropic Force	Jun	23	
Entropic Force	Jul	34	
Entropic Force	Aug	51	
Entropic Force	Sep	86	
Entropic Force	Oct	143	
Entropic Force	Nov	228	
Entropic Force	Dec	386	Highest Value

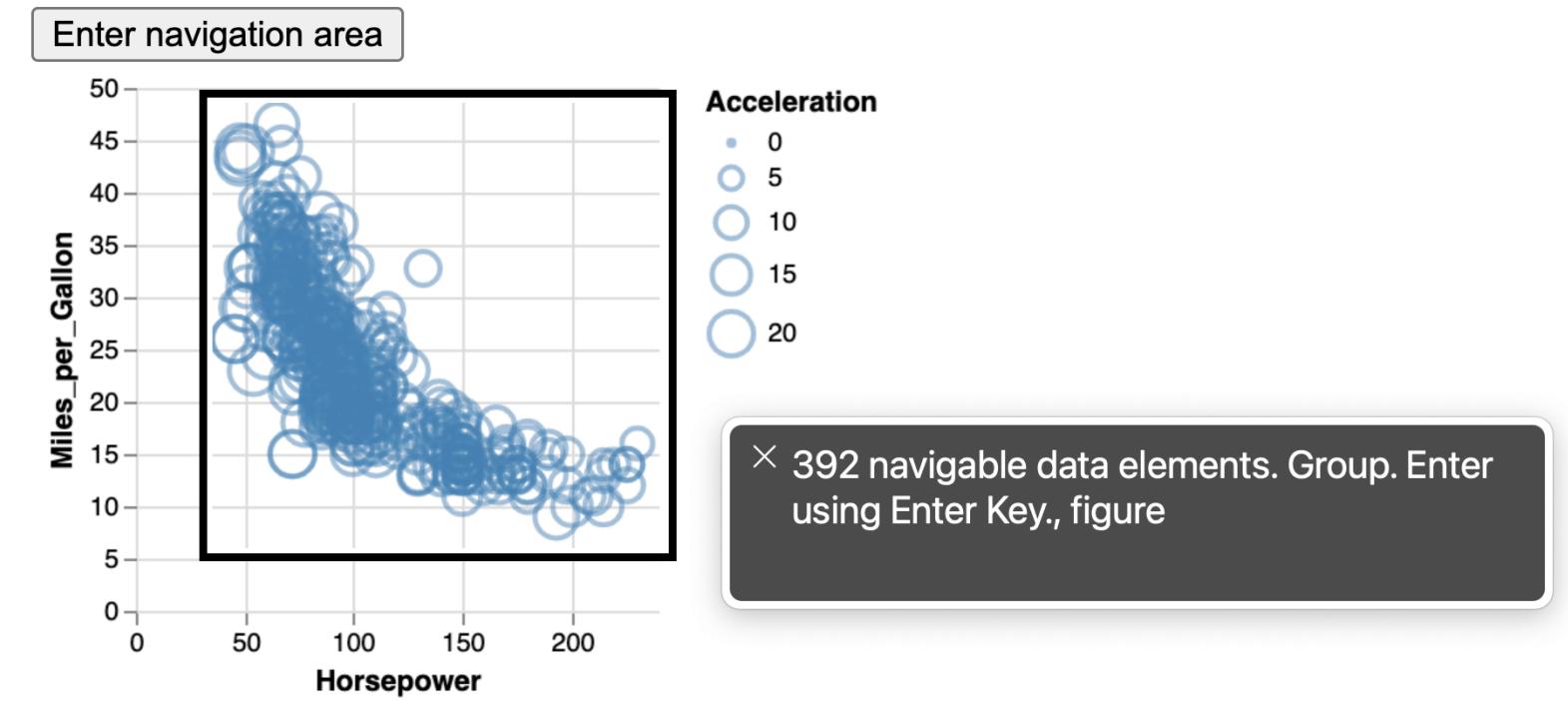


Assistive

Does the user have ways to reduce tedium as-needed, without losing informational fidelity, data signal, and ground truth?

Data Navigator Vega-Lite Examples

Hi! Welcome to our testing area :)

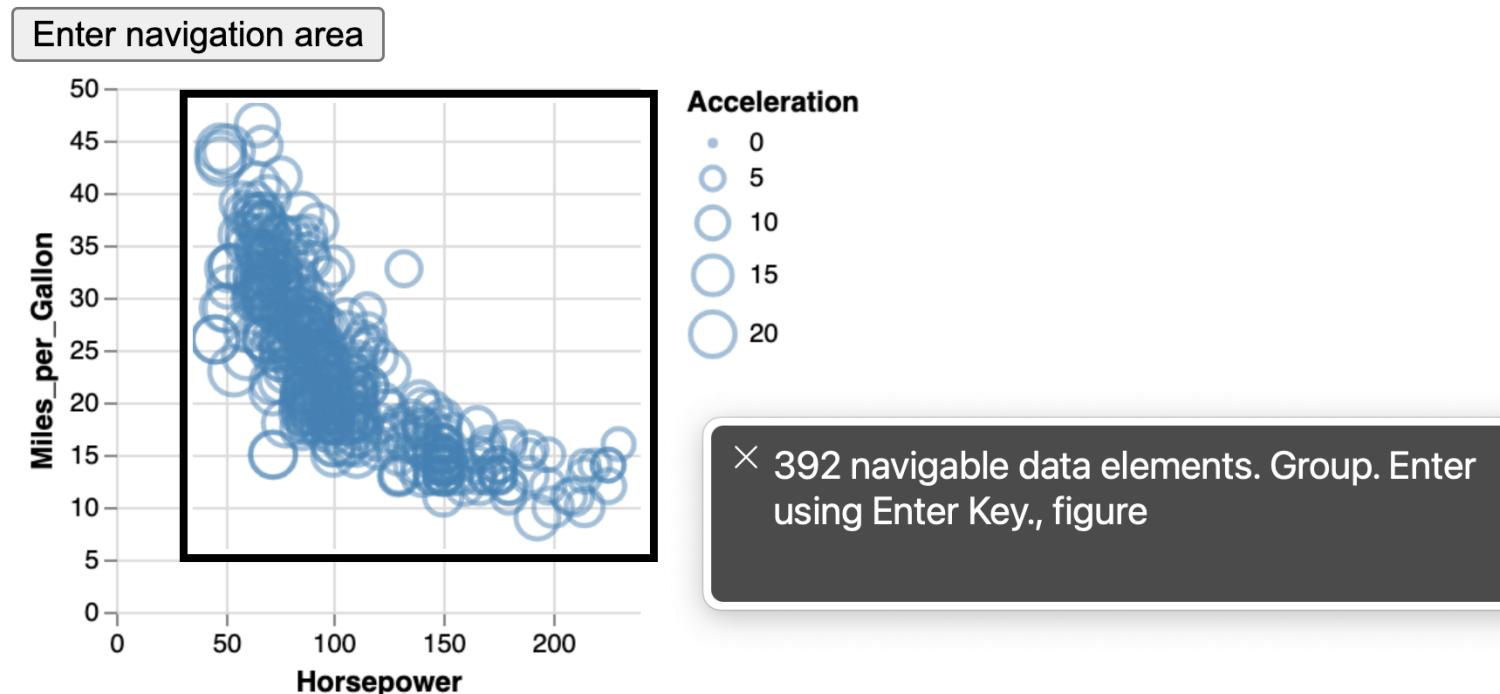


Assistive

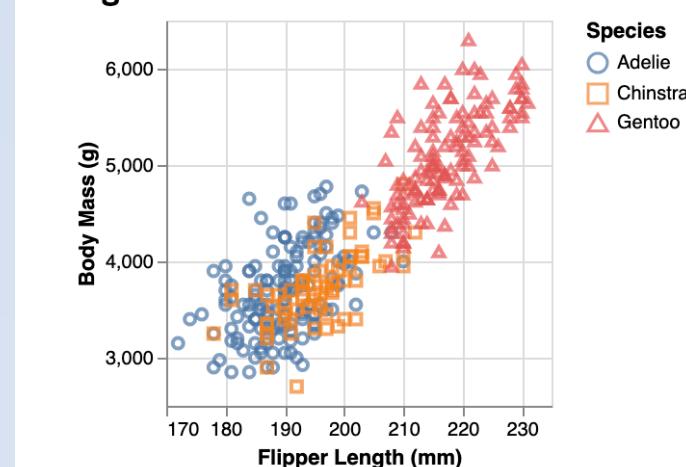
Does the user have ways to reduce tedium as-needed, without losing informational fidelity, data signal, and ground truth?

Data Navigator Vega-Lite Examples

Hi! Welcome to our testing area :)



Vega-Lite Visualization:



Olli tree view:

A scatterplot. With axes Flipper Length (mm) and Body Mass (g).

X-axis titled Flipper Length (mm). For a quantitative scale. With values from 172 to 231. The average value for the Flipper Length (mm) field is 201, the maximum is 231, and the minimum is 172.

Y-axis titled Body Mass (g). For a quantitative scale. With values from 2700 to 6300. The average value for the Body Mass (g) field is 4202, the maximum is 6300, and the minimum is 2700.

Legend titled Species. For a nominal scale. With 3 values from Adelie to Gentoo. The average value for the Flipper Length (mm) field is 201, the maximum is 231, and the minimum is 172.

1 of 3. Species equals Adelie. 151 values. The average value for the Flipper Length (mm) field is 190, the maximum is 210, and the minimum is 172. Press t to open table.

2 of 3. Species equals Chinstrap. 68 values. The average value for the Flipper Length (mm) field is 196, the maximum is 212, and the minimum is 178. Press t to open table.

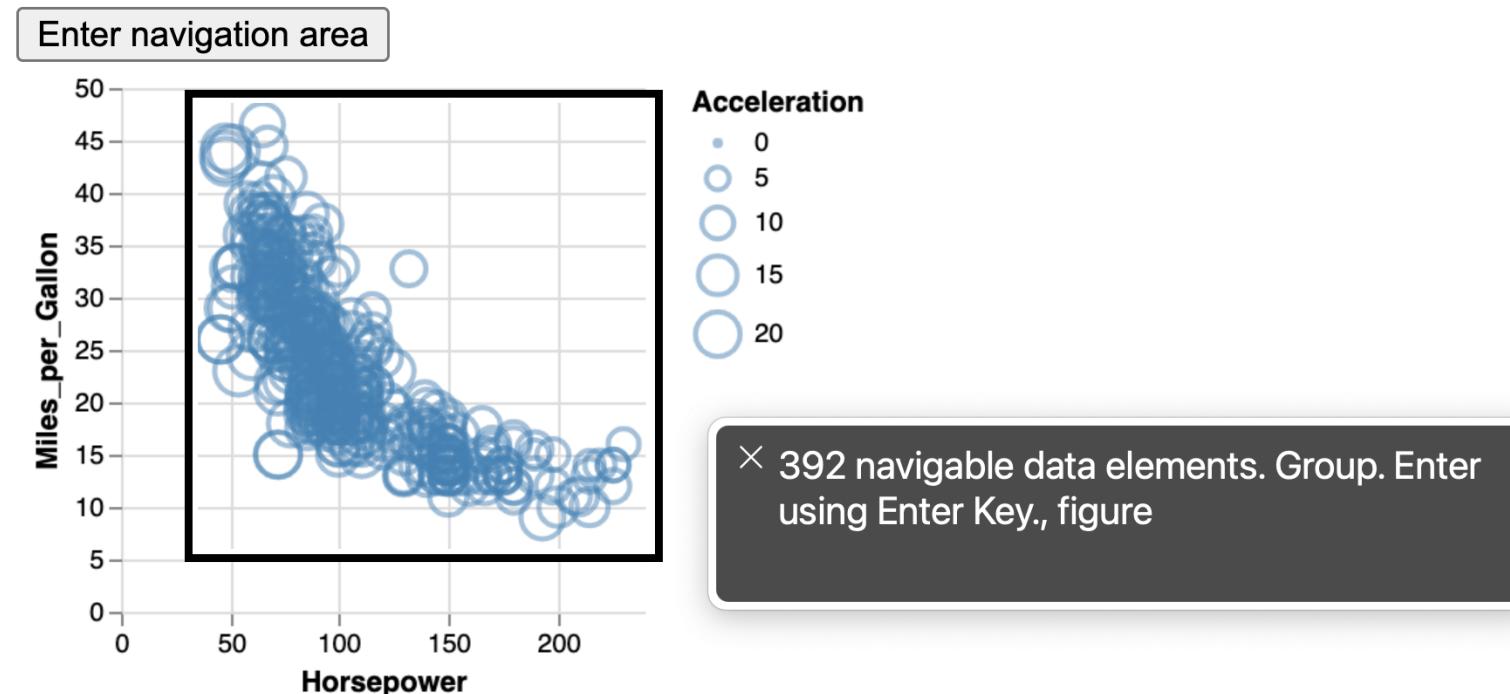
3 of 3. Species equals Gentoo. 123 values. The average value for the Flipper Length (mm) field is 217, the maximum is 231, and the minimum is 203. Press t to open table.

Assistive

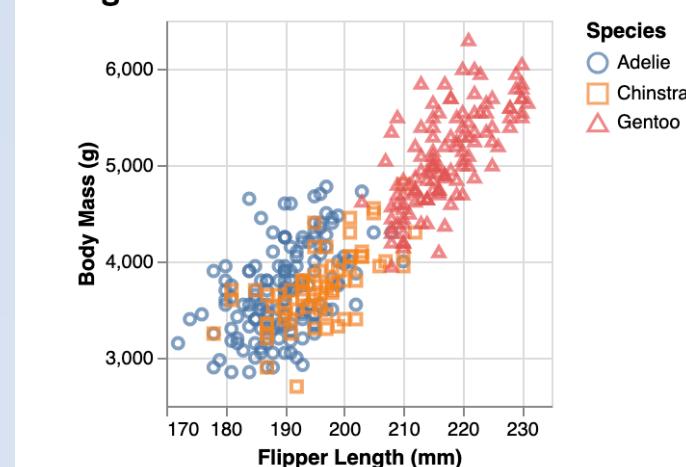
Does the user have ways to reduce tedium as-needed, without losing informational fidelity, data signal, and ground truth?

Data Navigator Vega-Lite Examples

Hi! Welcome to our testing area :)



Vega-Lite Visualization:



Olli tree view:

A scatterplot. With axes Flipper Length (mm) and Body Mass (g).

X-axis titled Flipper Length (mm). For a quantitative scale. With values from 172 to 231. The average value for the Flipper Length (mm) field is 201, the maximum is 231, and the minimum is 172.

Y-axis titled Body Mass (g). For a quantitative scale. With values from 2700 to 6300. The average value for the Body Mass (g) field is 4202, the maximum is 6300, and the minimum is 2700.

Legend titled Species. For a nominal scale. With 3 values from Adelie to Gentoo. The average value for the Flipper Length (mm) field is 201, the maximum is 231, and the minimum is 172.

1 of 3. Species equals Adelie. 151 values. The average value for the Flipper Length (mm) field is 190, the maximum is 210, and the minimum is 172. Press t to open table.

2 of 3. Species equals Chinstrap. 68 values. The average value for the Flipper Length (mm) field is 196, the maximum is 212, and the minimum is 178. Press t to open table.

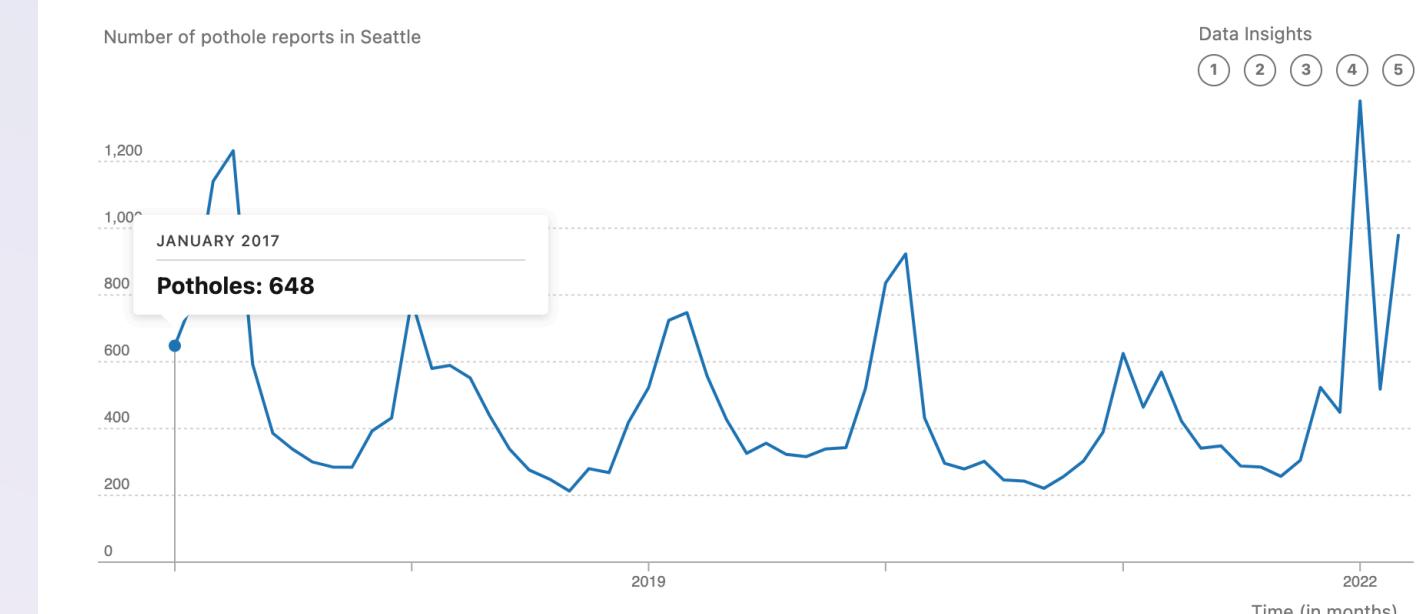
3 of 3. Species equals Gentoo. 123 values. The average value for the Flipper Length (mm) field is 217, the maximum is 231, and the minimum is 203. Press t to open table.

Assistive

Does the user have ways to reduce tedium as-needed, without losing informational fidelity, data signal, and ground truth?

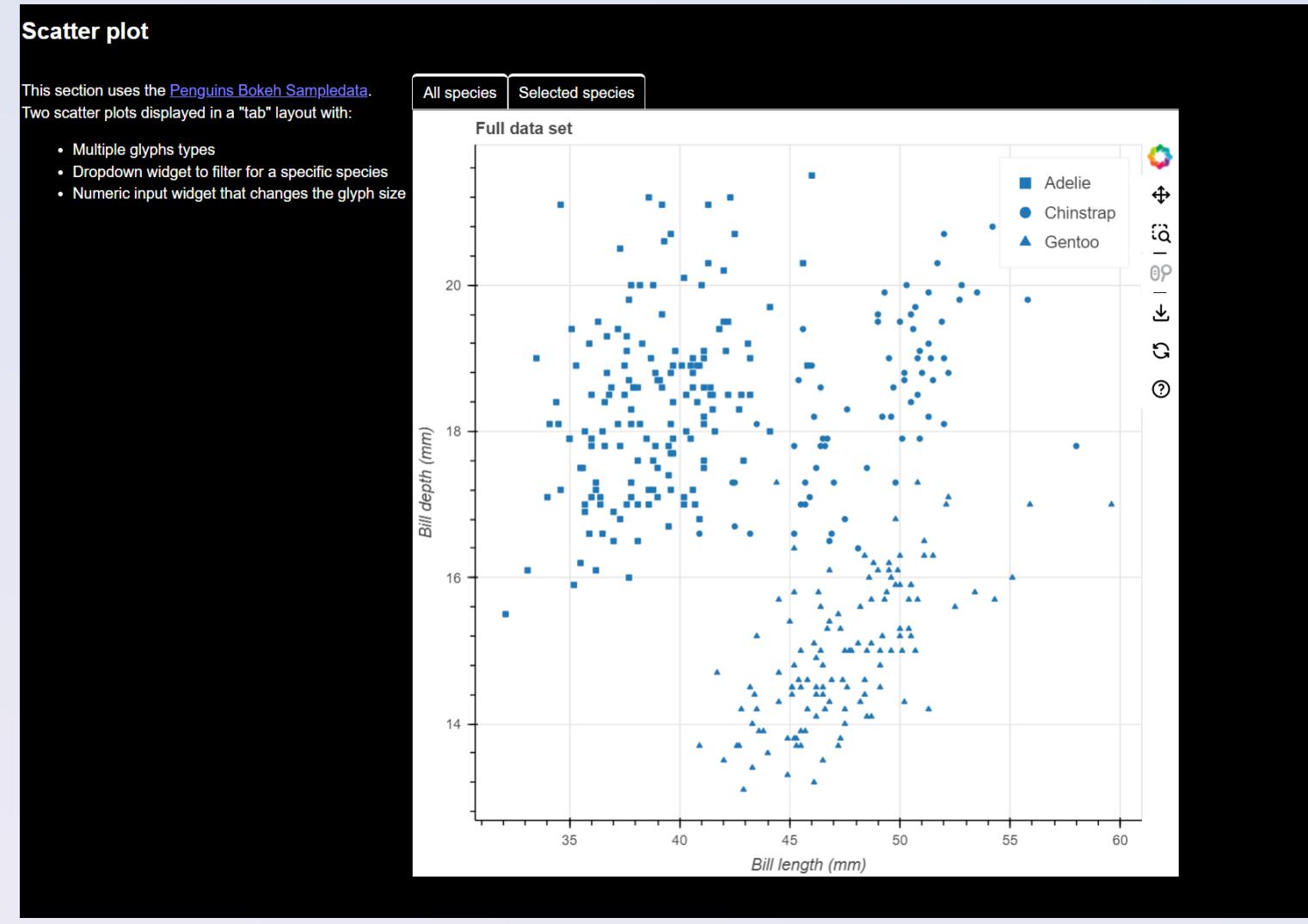
Pothole Reports in Seattle

This line chart displays reported potholes in Seattle, Washington. The original dataset comes from the Seattle Open Data Portal, the [complete dataset](#) shows the records of Customer Services Request in Seattle since January 1, 2017.



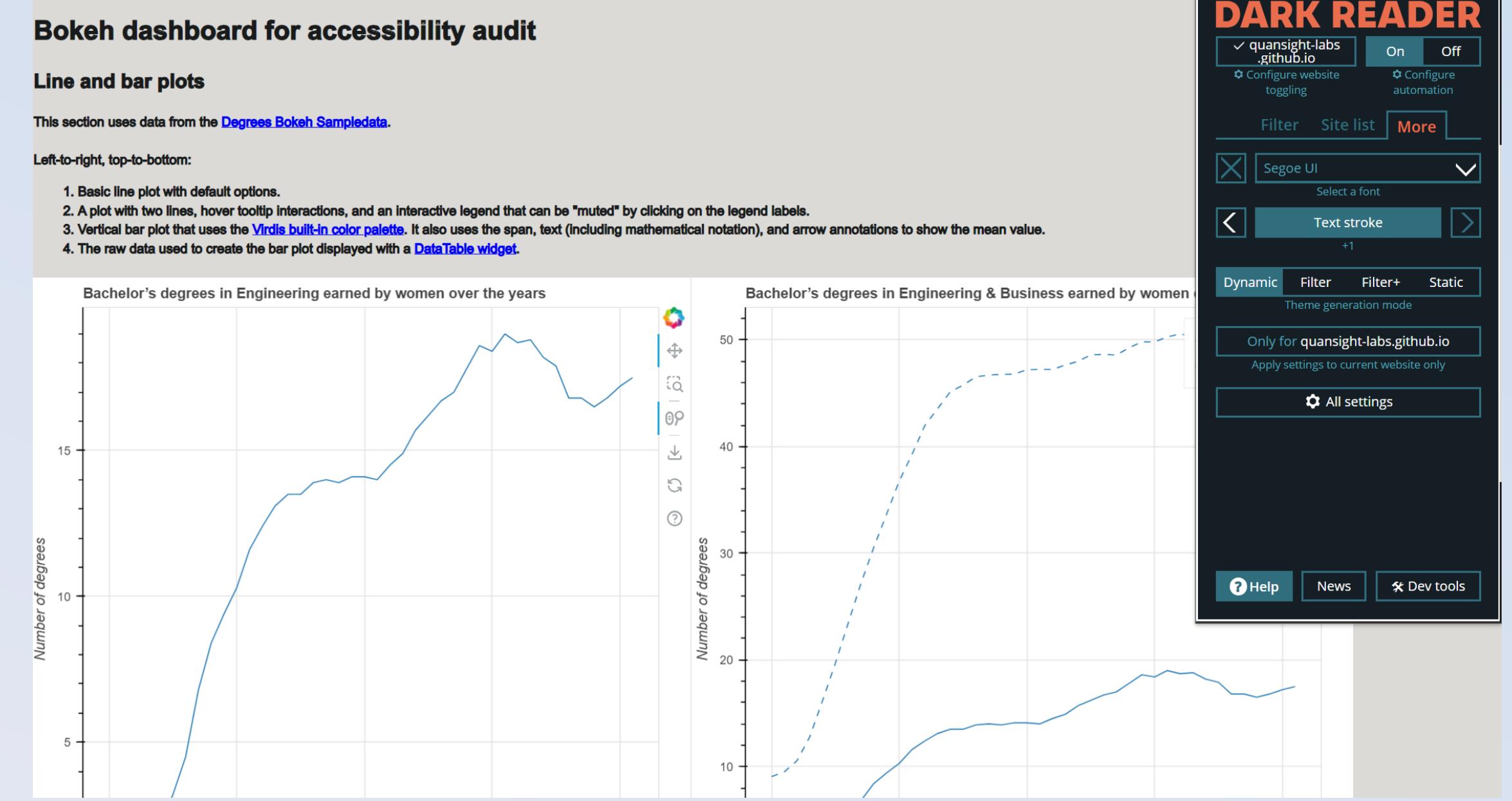
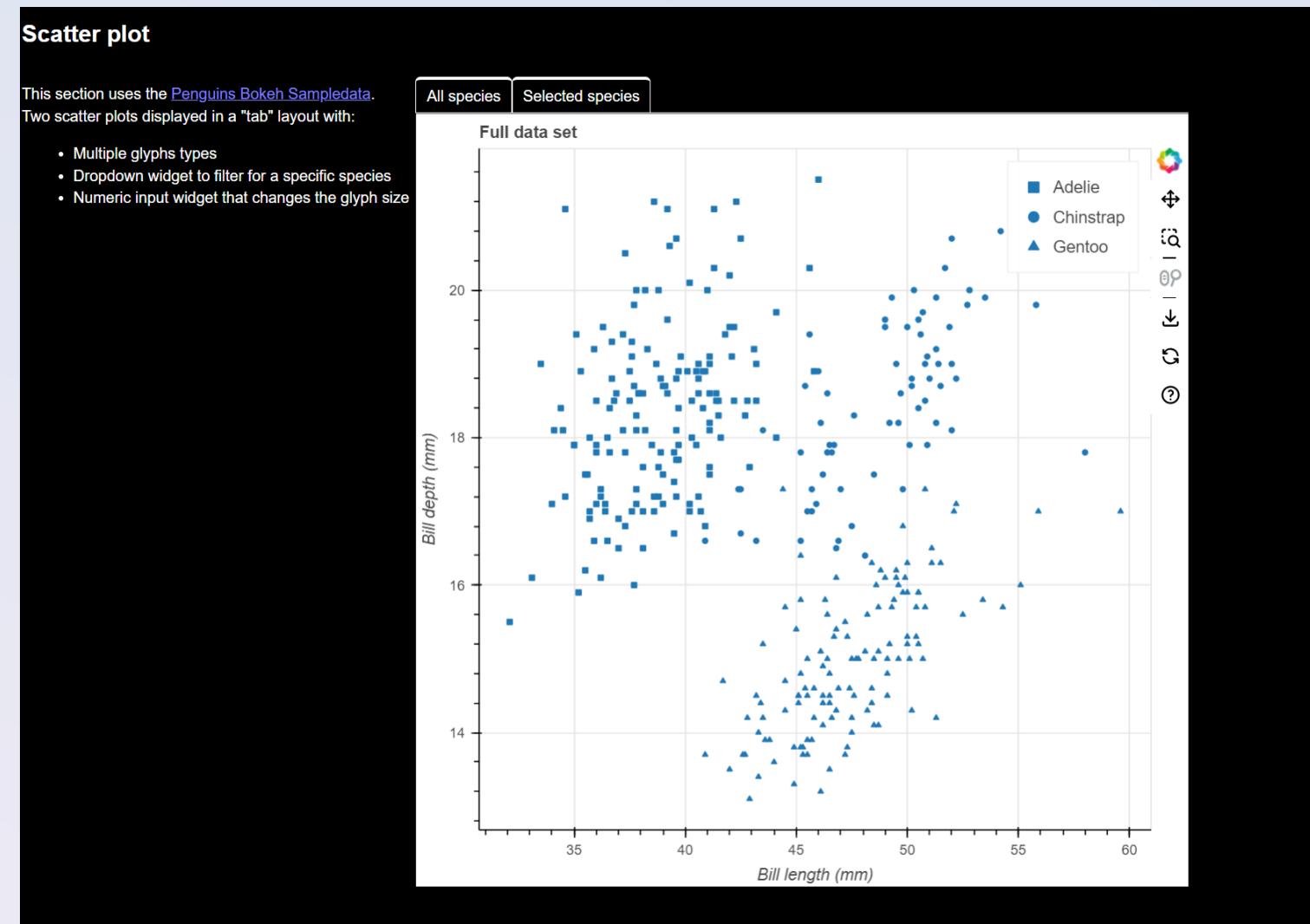
Flexible

Does the user have ways to change or adjust presentational and operational aspects of this design, according to their needs and preferences?



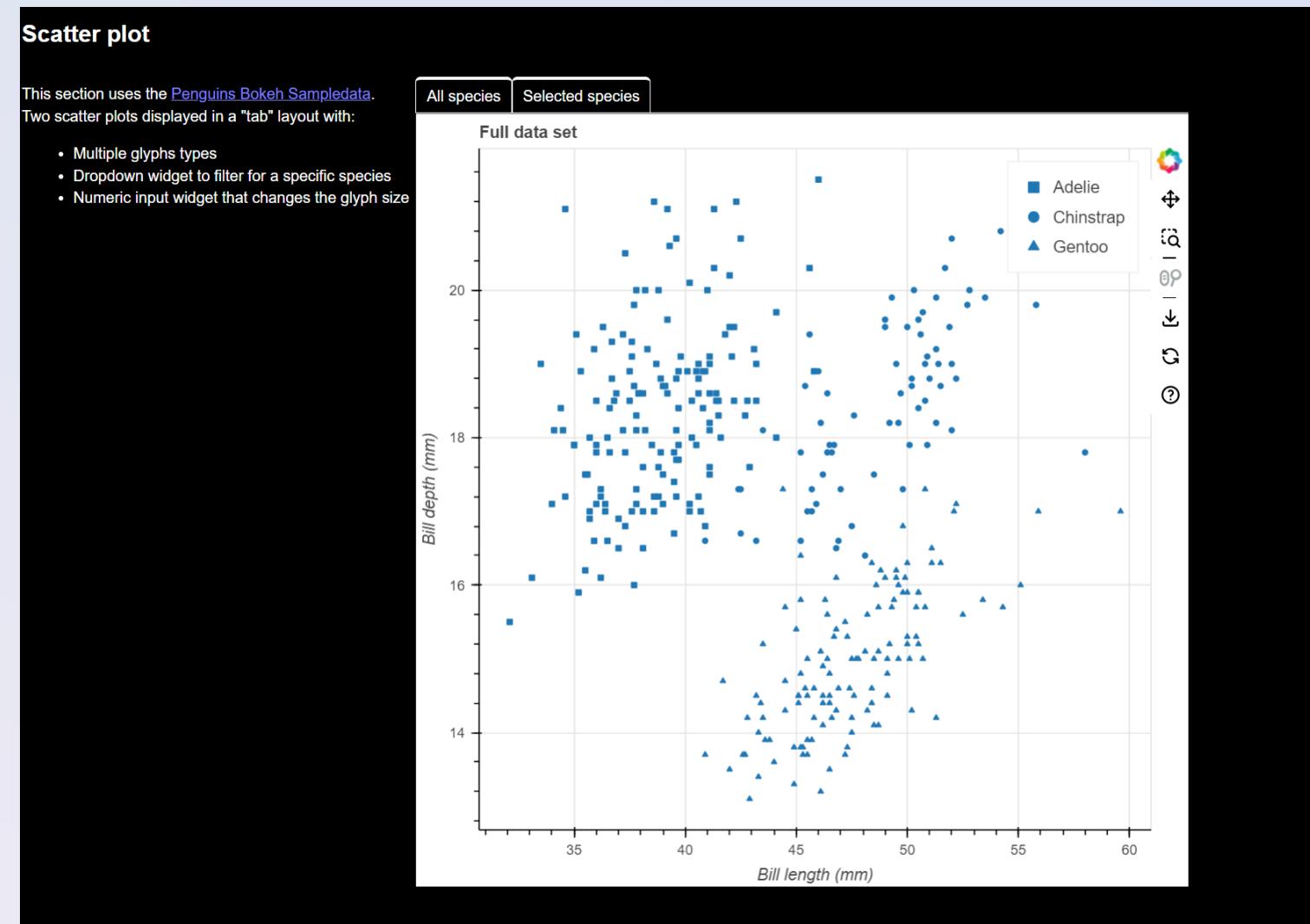
Flexible

Does the user have ways to change or adjust presentational and operational aspects of this design, according to their needs and preferences?



Flexible

Does the user have ways to change or adjust presentational and operational aspects of this design, according to their needs and preferences?



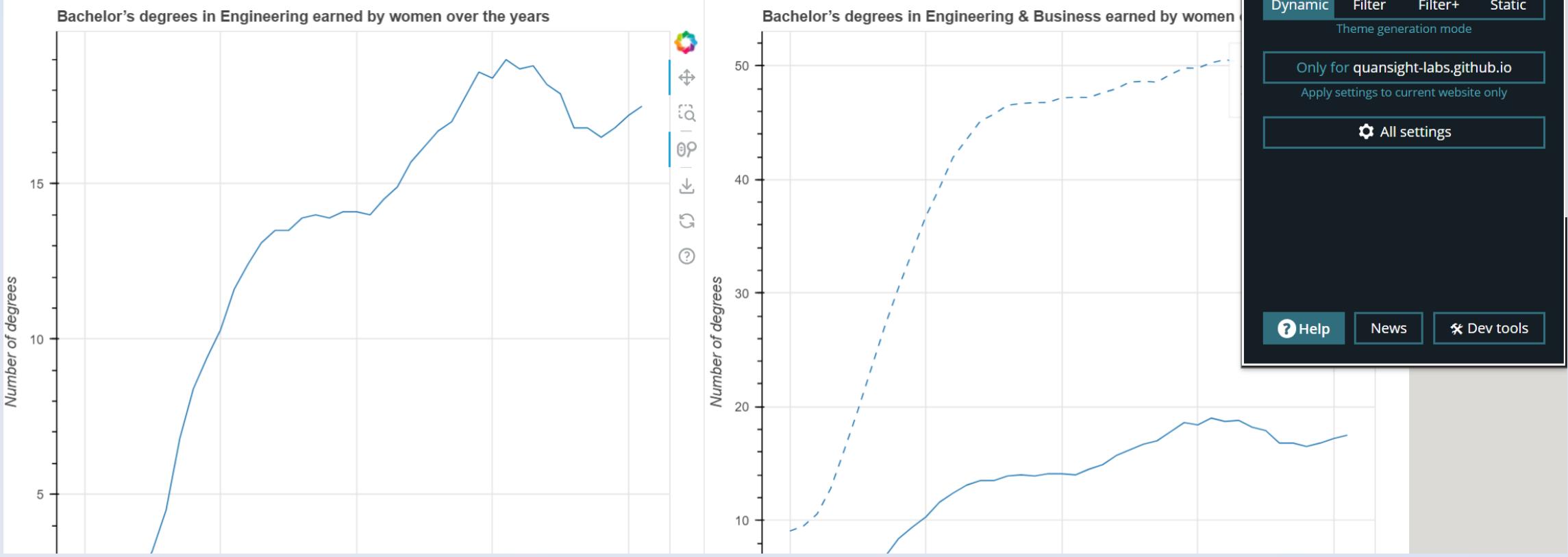
Bokeh dashboard for accessibility audit

Line and bar plots

This section uses data from the [Degrees Bokeh Sampledata](#).

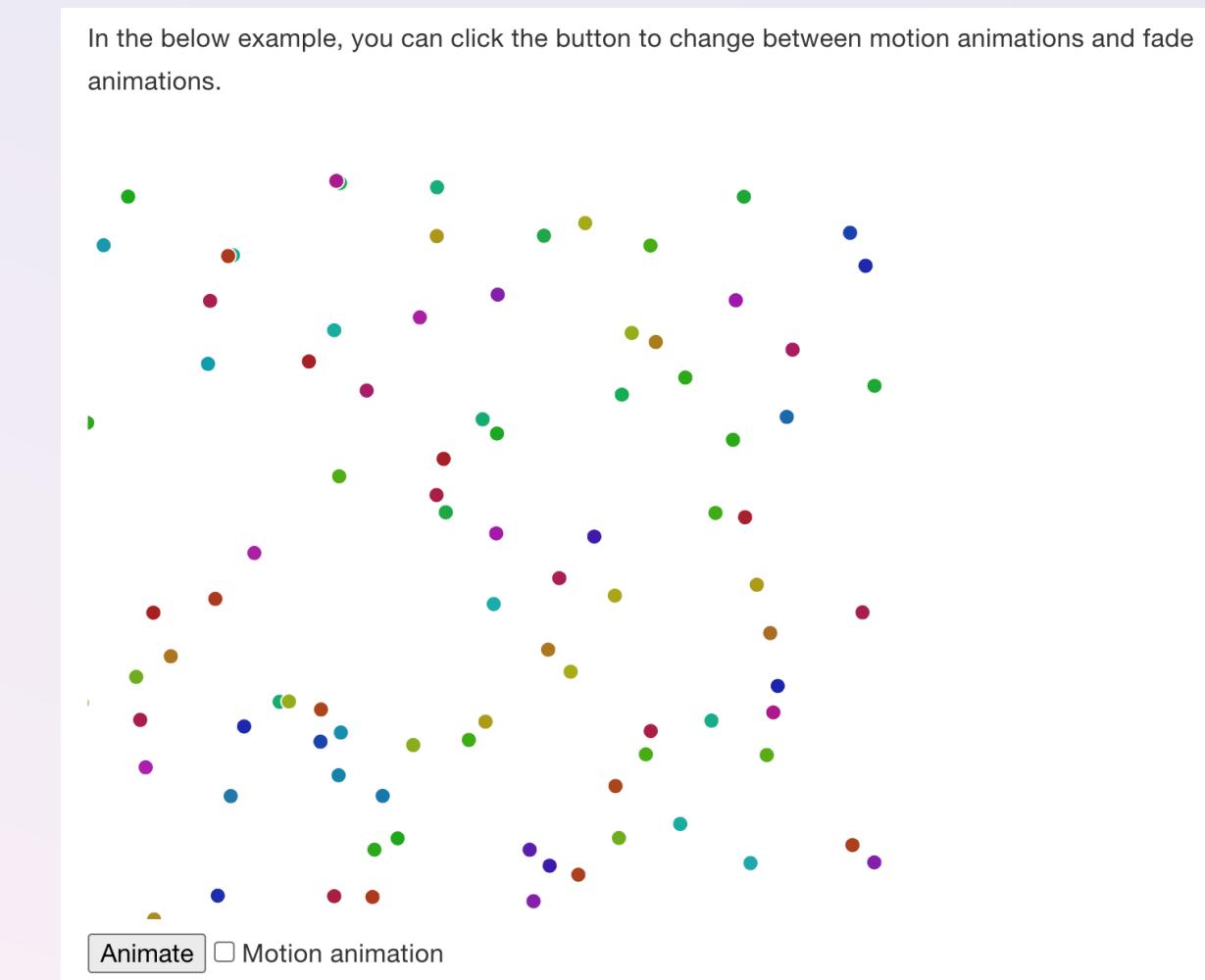
Left-to-right, top-to-bottom:

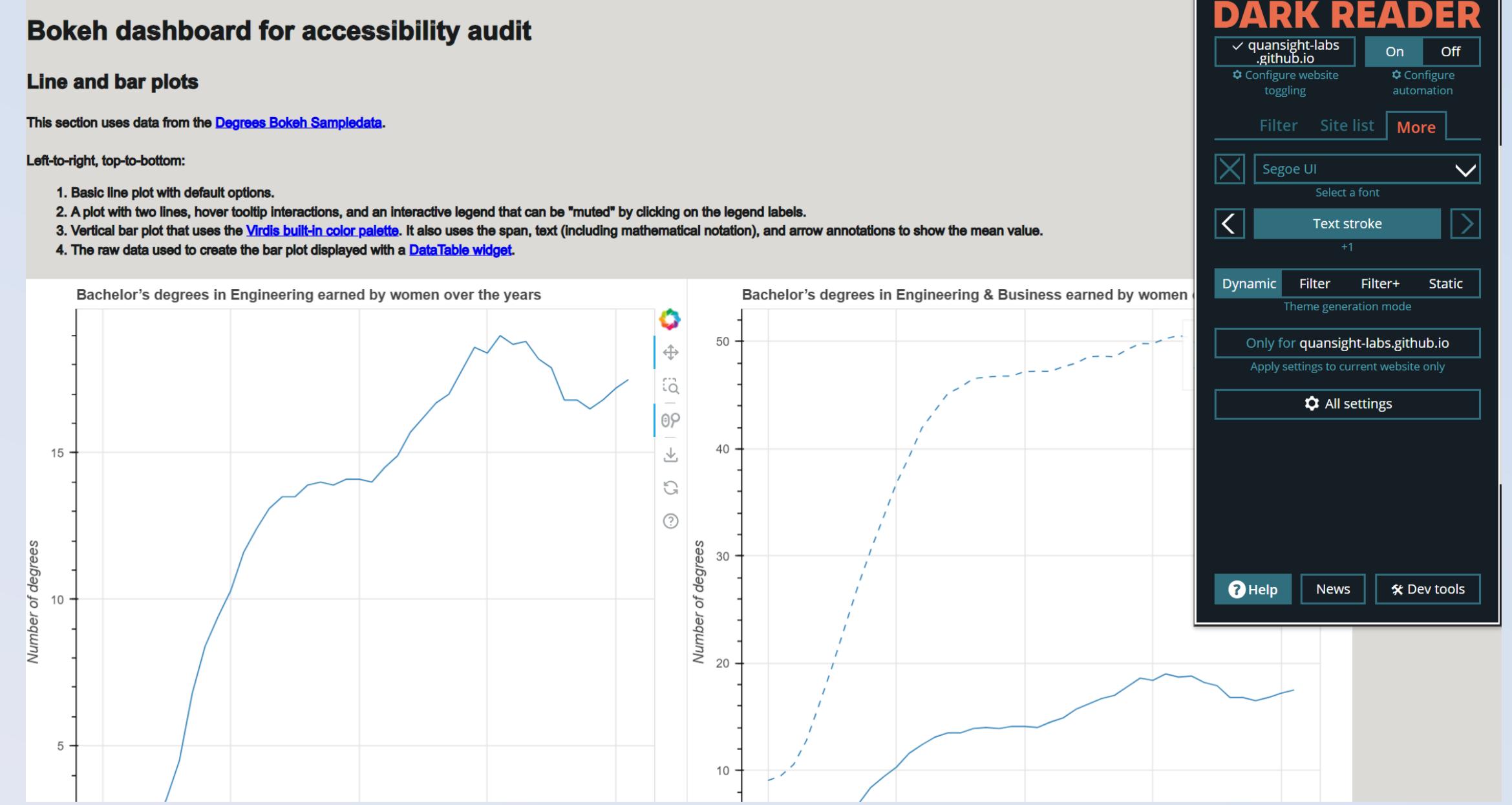
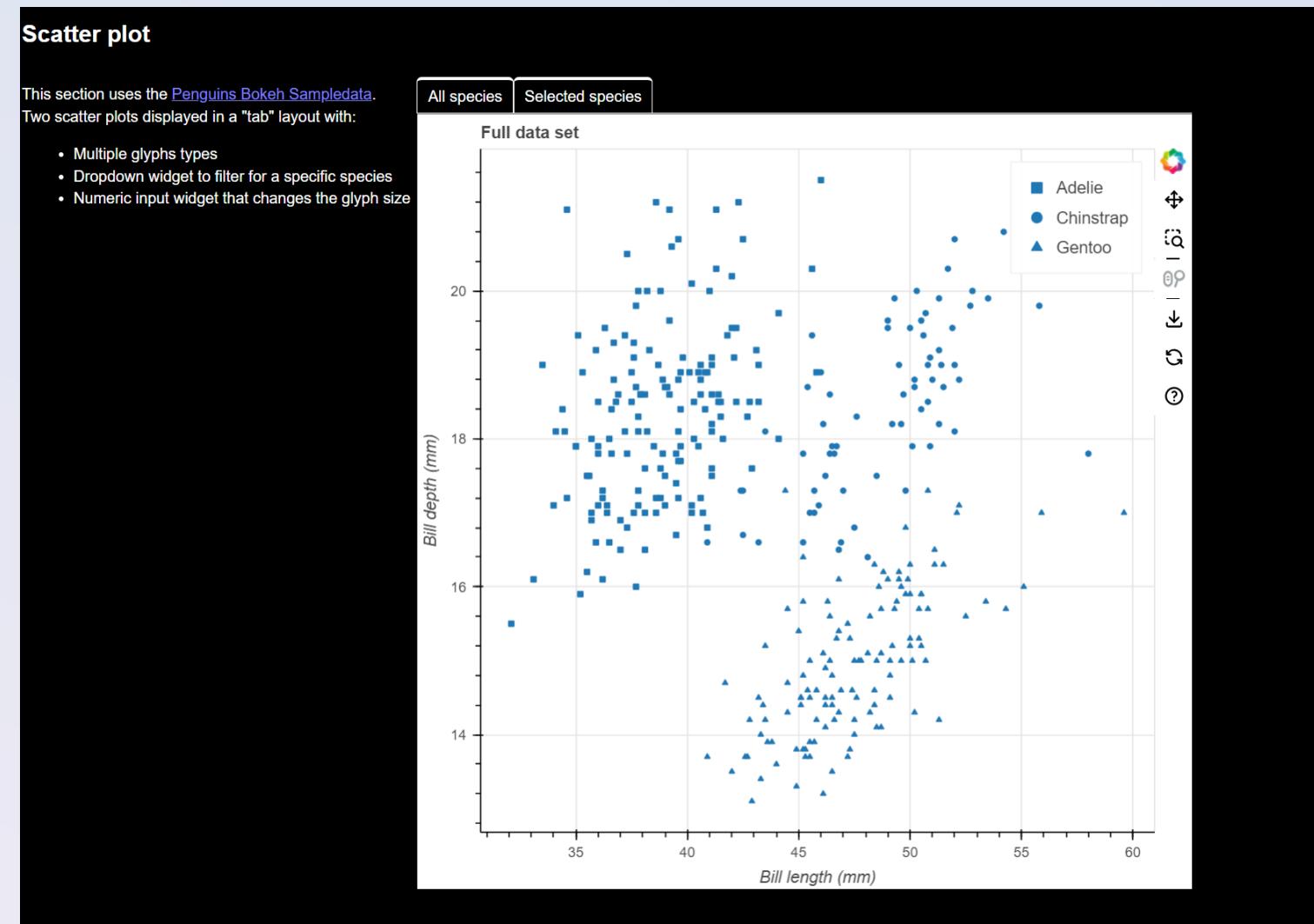
1. Basic line plot with default options.
2. A plot with two lines, hover tooltip interactions, and an interactive legend that can be "muted" by clicking on the legend labels.
3. Vertical bar plot that uses the [Viridis built-in color palette](#). It also uses the `span`, `text` (including mathematical notation), and arrow annotations to show the mean value.
4. The raw data used to create the bar plot displayed with a [DataTable](#) widget.



Flexible

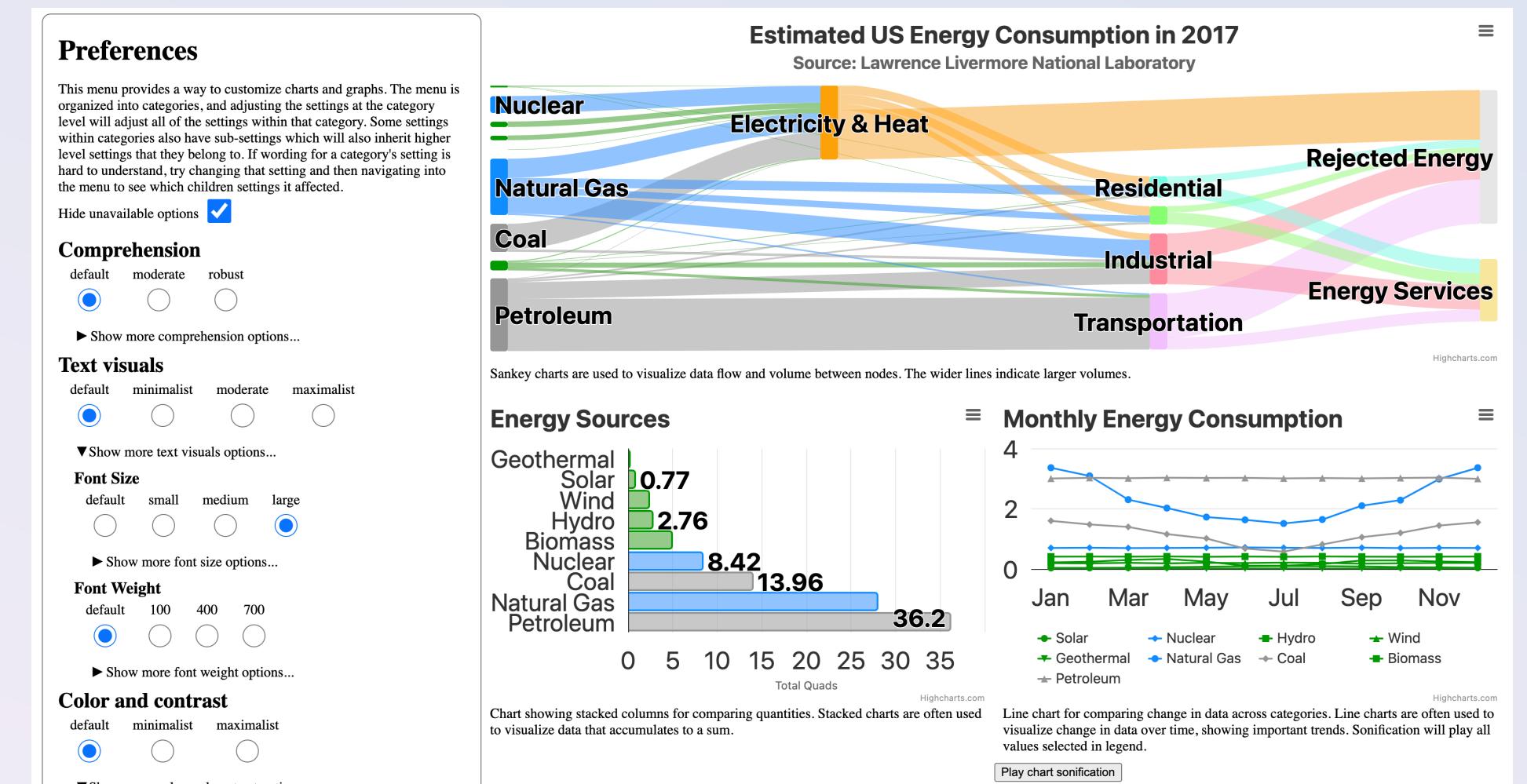
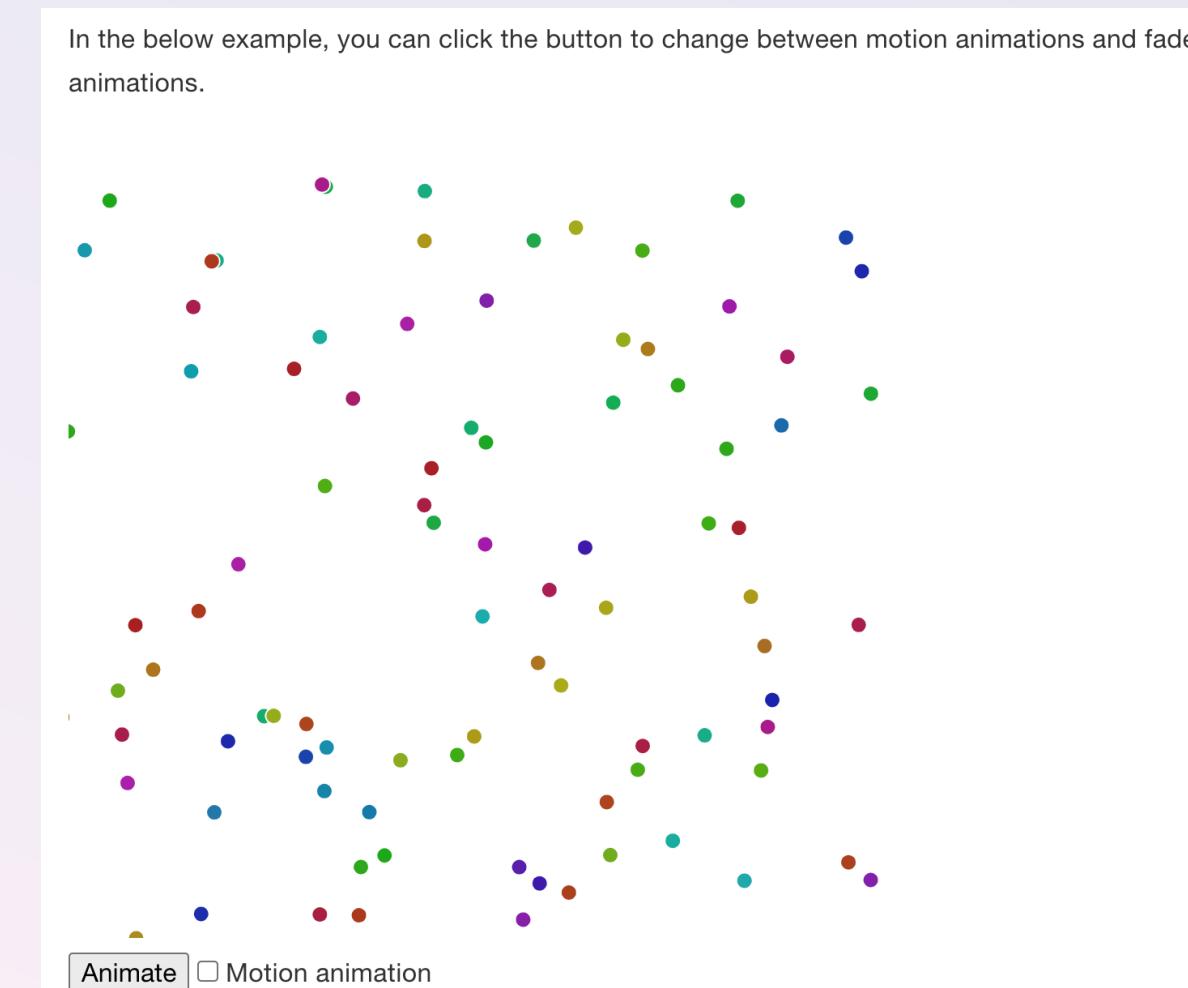
Does the user have ways to change or adjust presentational and operational aspects of this design, according to their needs and preferences?





Flexible

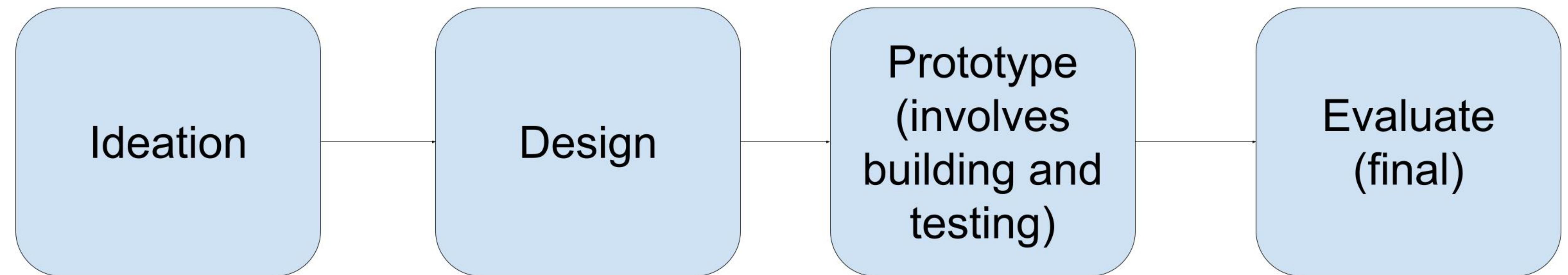
Does the user have ways to change or adjust presentational and operational aspects of this design, according to their needs and preferences?



**Remember: do *not* ask for free labor from
people with disabilities.**

Pay them for their knowledge and expertise.

You can get feedback *and* collaborate at any stage of design



Source: [“How not to make bad AT” by Iman et al](#)

Data is for everyone



Credit: ["Let's play with data kit" by easydataviz](#)

My work and curated resources

Chartability workbook

Chartability paper

Chartability super audit

Data Navigator demo

Data Navigator paper

Softerware demo

Softerware paper (pre-print)

Our repo of visualization + accessibility resources