

# Accessibility and Visualization

An introductory lecture: Concepts, history, and practice.



Frank Elavsky

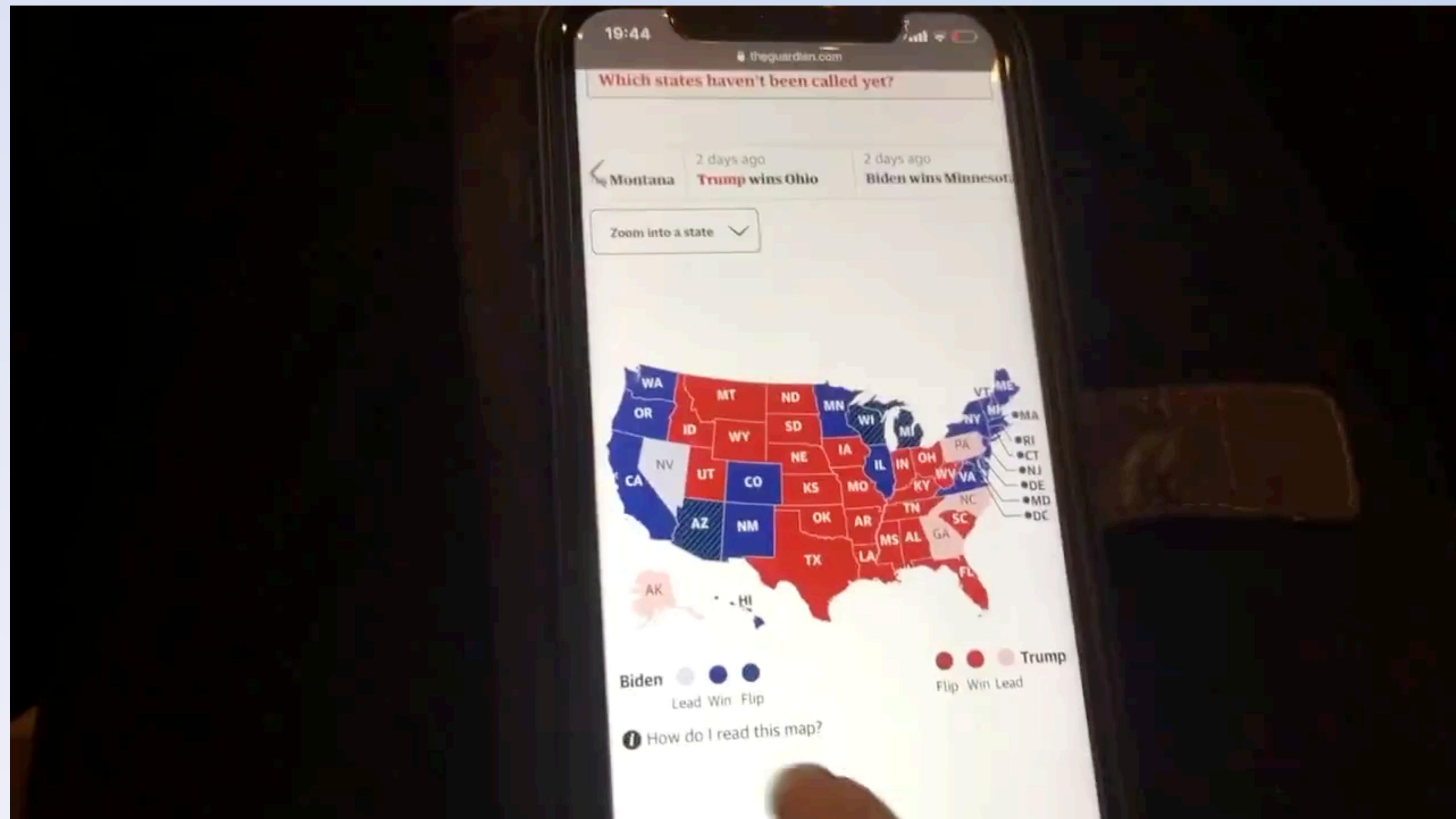


[hcii.cmu.edu](http://hcii.cmu.edu), [axle-lab.com](http://axle-lab.com), [dig.cmu.edu](http://dig.cmu.edu)



# What is an inaccessible experience like?

Credit: Sarah Fossheim [on twitter](#)



**So “accessibility:” What is it?**

# **Accessibility:**

1. The qualities that make an experience open or usable to all.

# **Accessibility:**

1. The qualities that make an experience open or usable to all.
2. **The qualities that make an experience open or usable specifically for people with disabilities.**

**Discuss:** Why do people do this work?

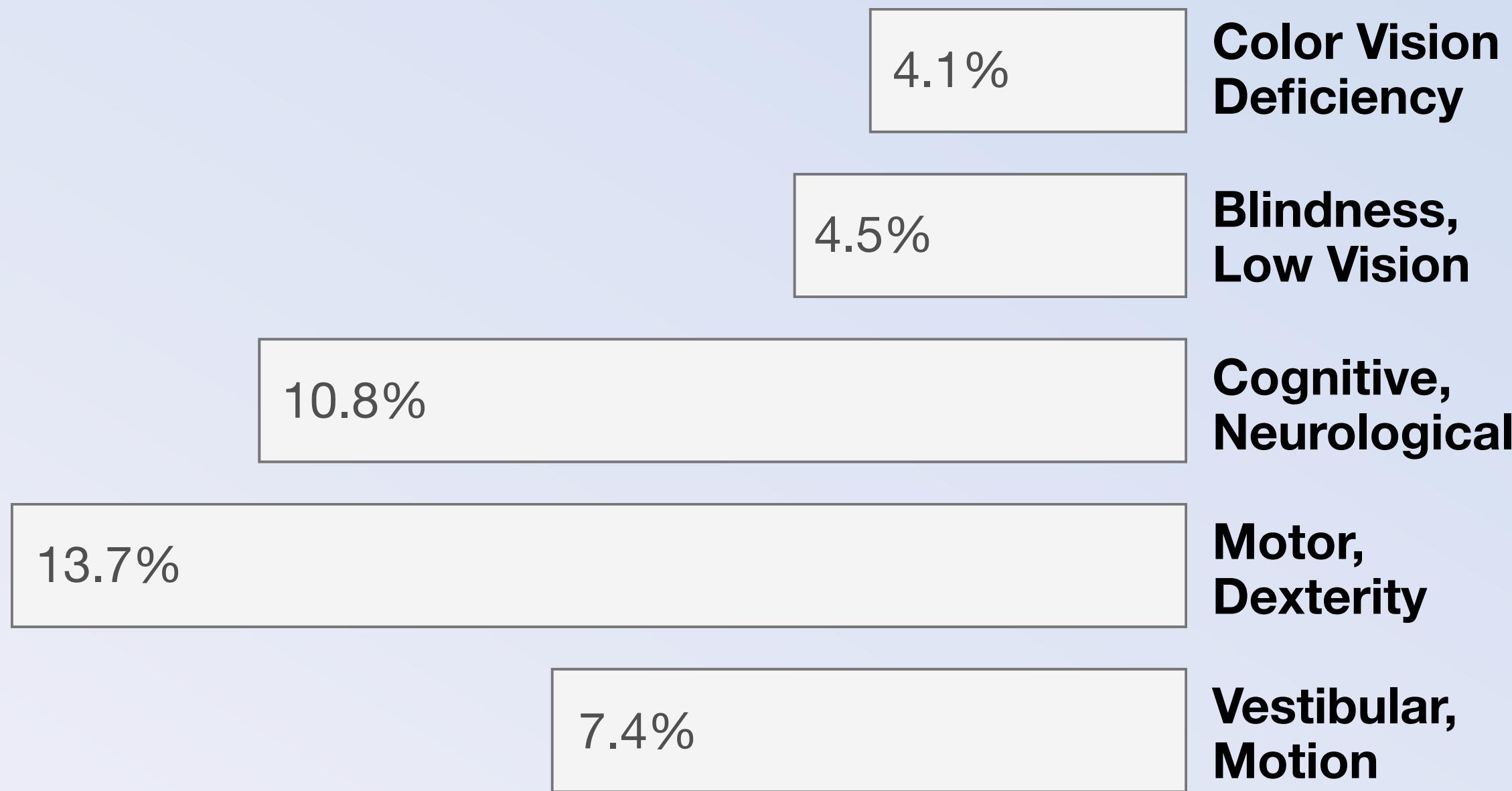
# Access is a human right

Accessibility is an internationally recognized human right.

It is the morally and ethically correct thing to do.



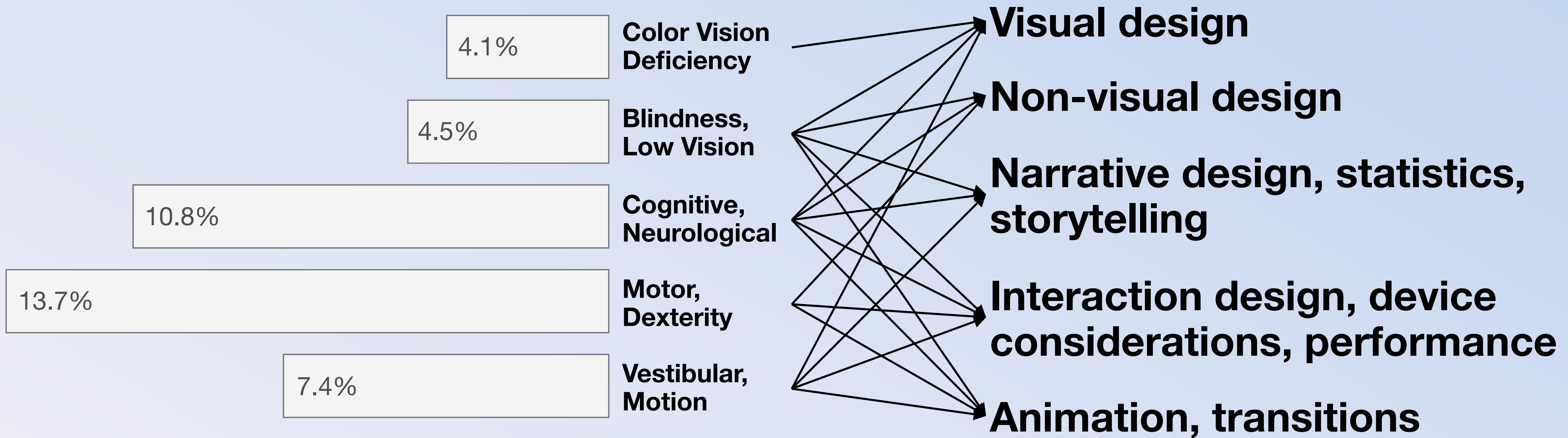
UN CRPD Article 9: Accessibility, UN CRPD Article 10: Right to Life

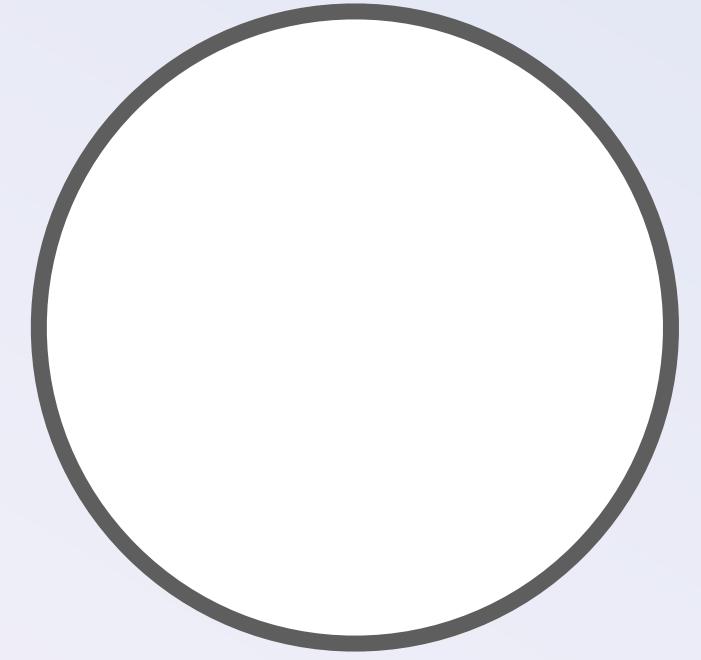


Source: Okoro et al. "Prevalence of Disabilities and Health Care Access by Disability Status and Type Among Adults"

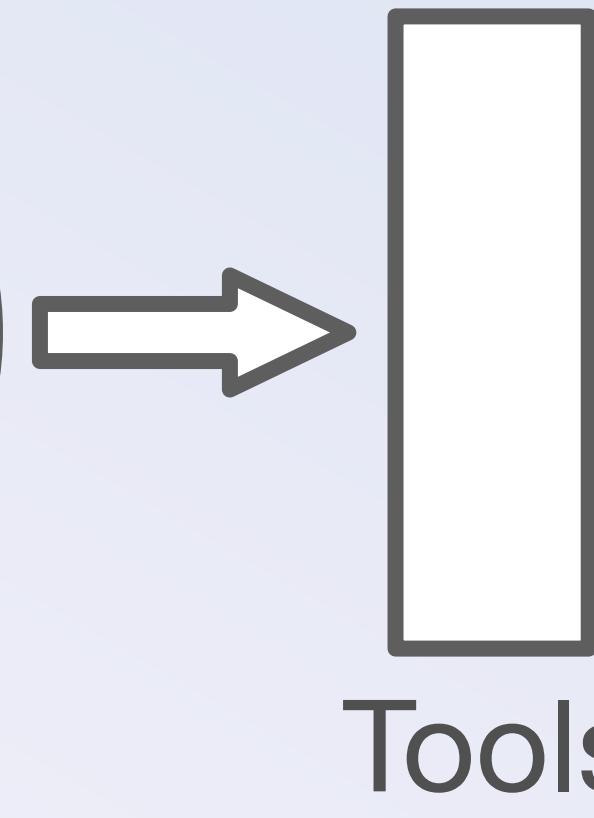
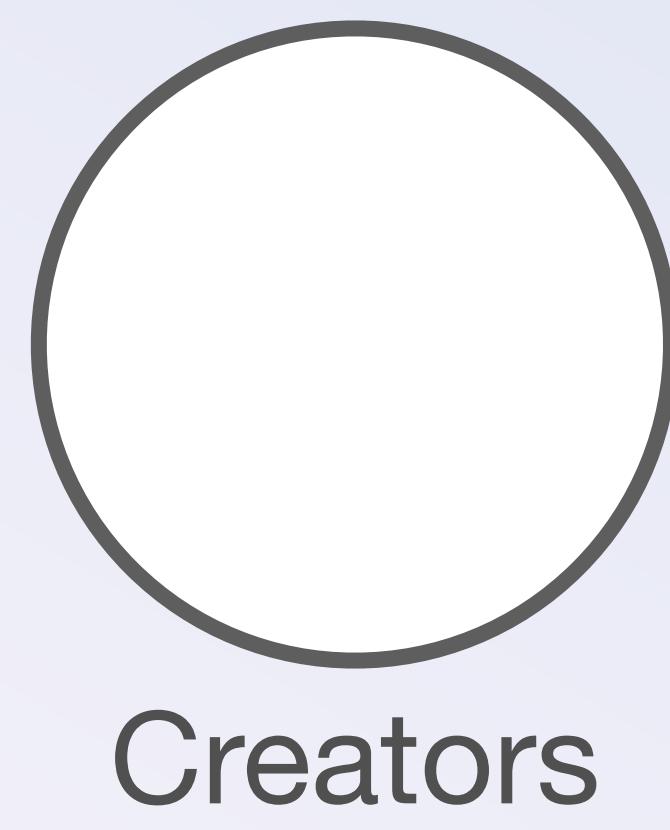
**~27% of people living in the United States self-report living with a disability that affects their daily life.**

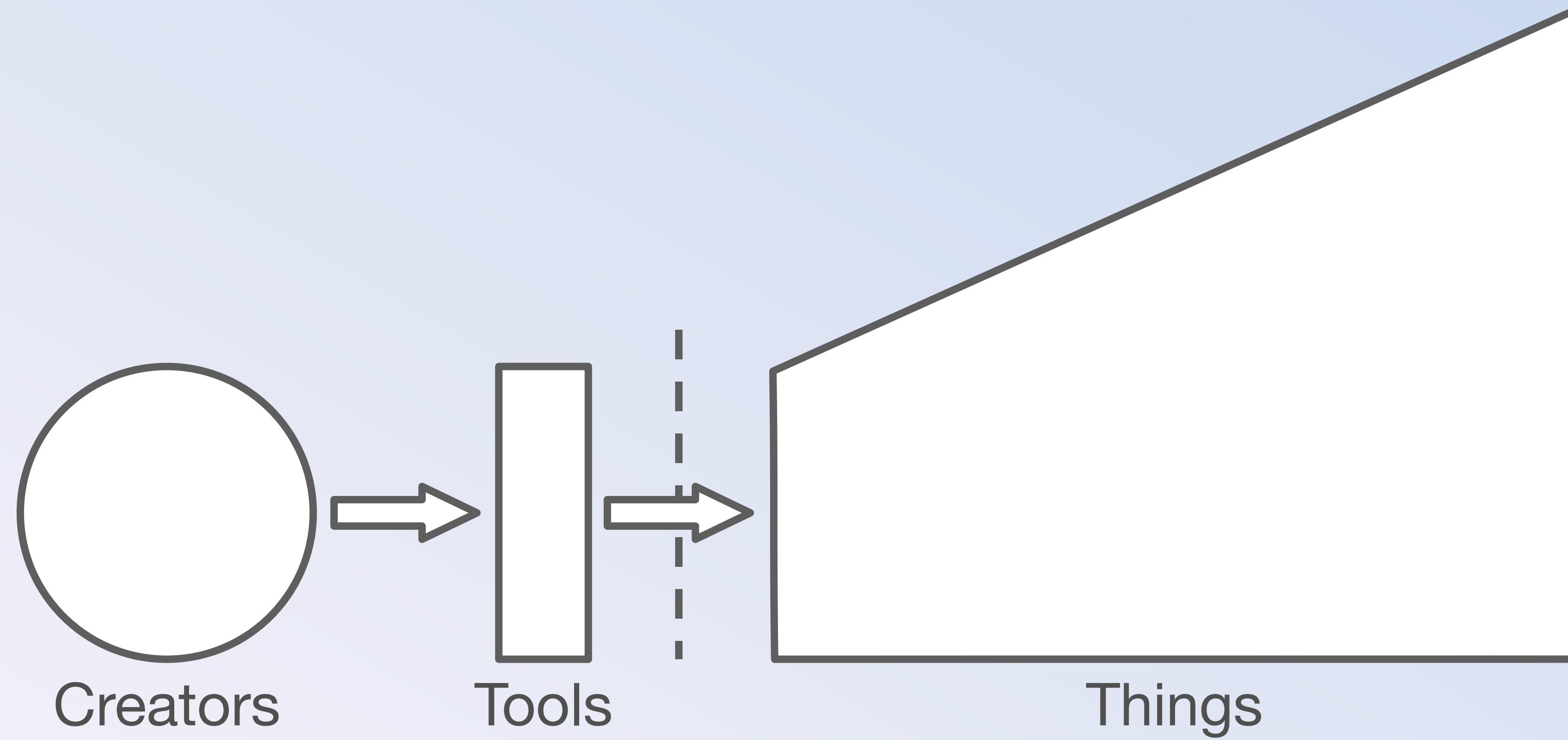
# Accessibility affects every aspect of visualization work

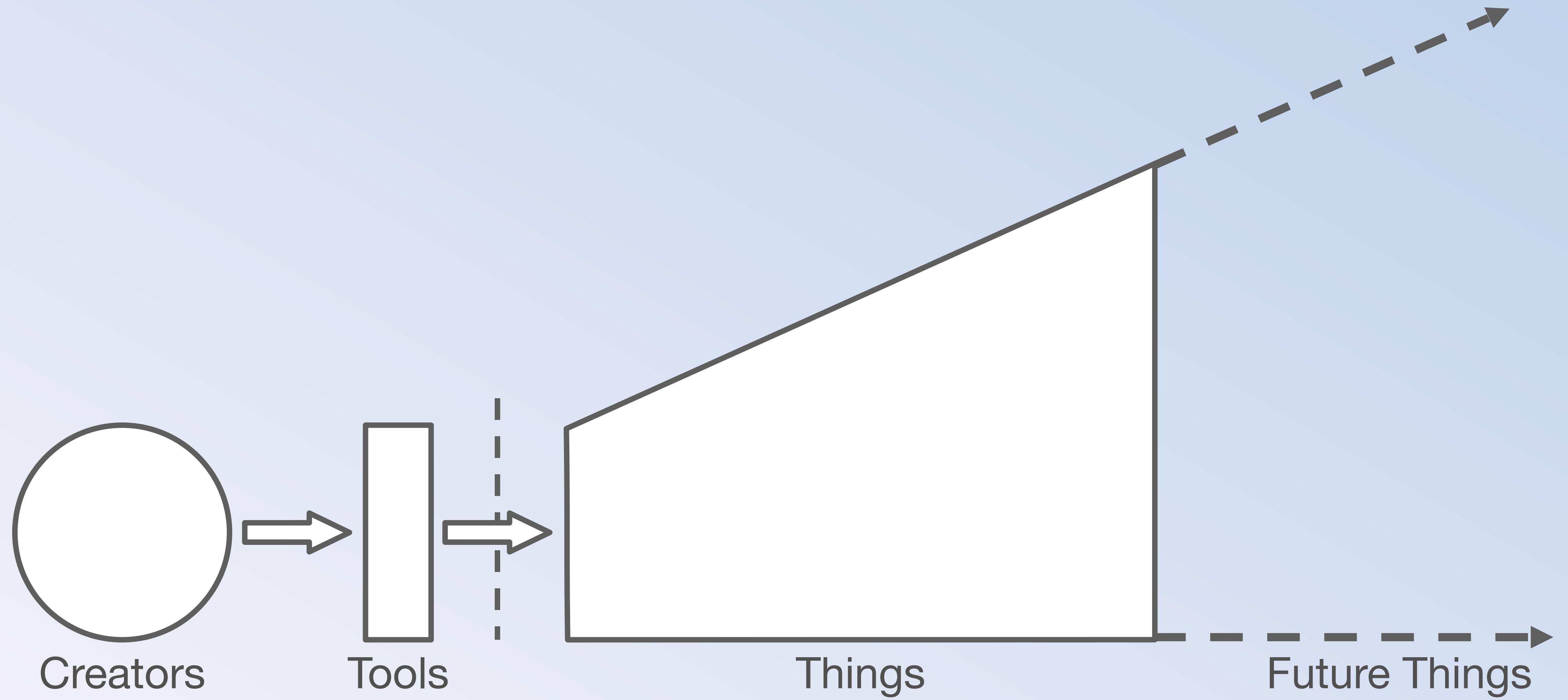




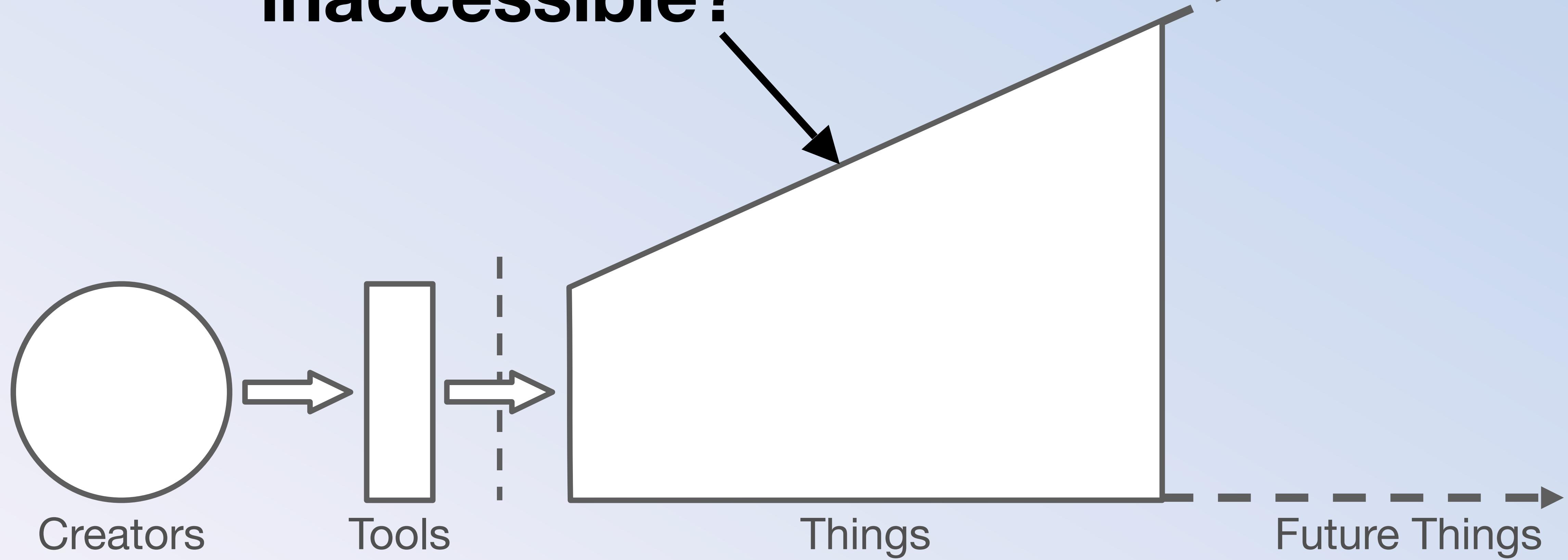
Creators





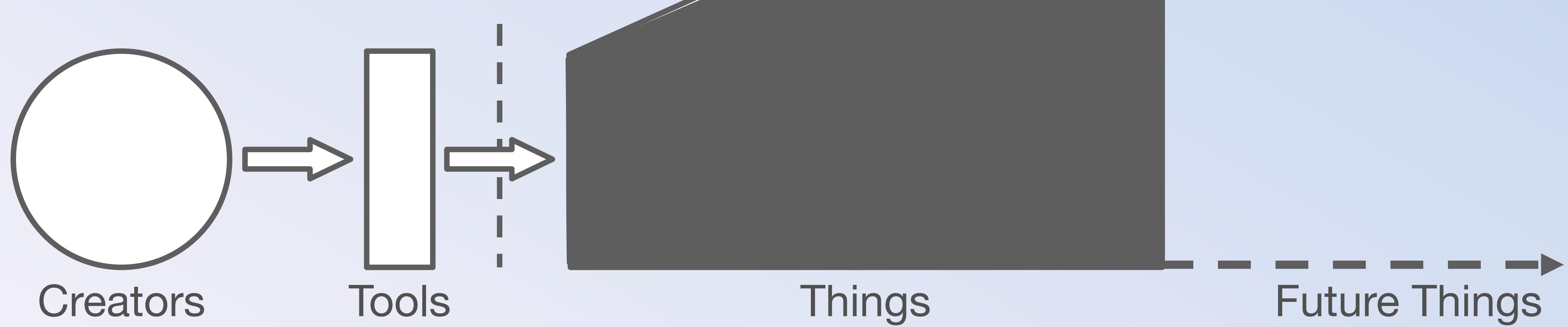


# But how much of this is inaccessible?



# 97-99%

Source: World Wide Web Consortium. "The WebAIM Million Report." 2019-2022



# Concept(s): social vs medical models of disability

*a “curb”*



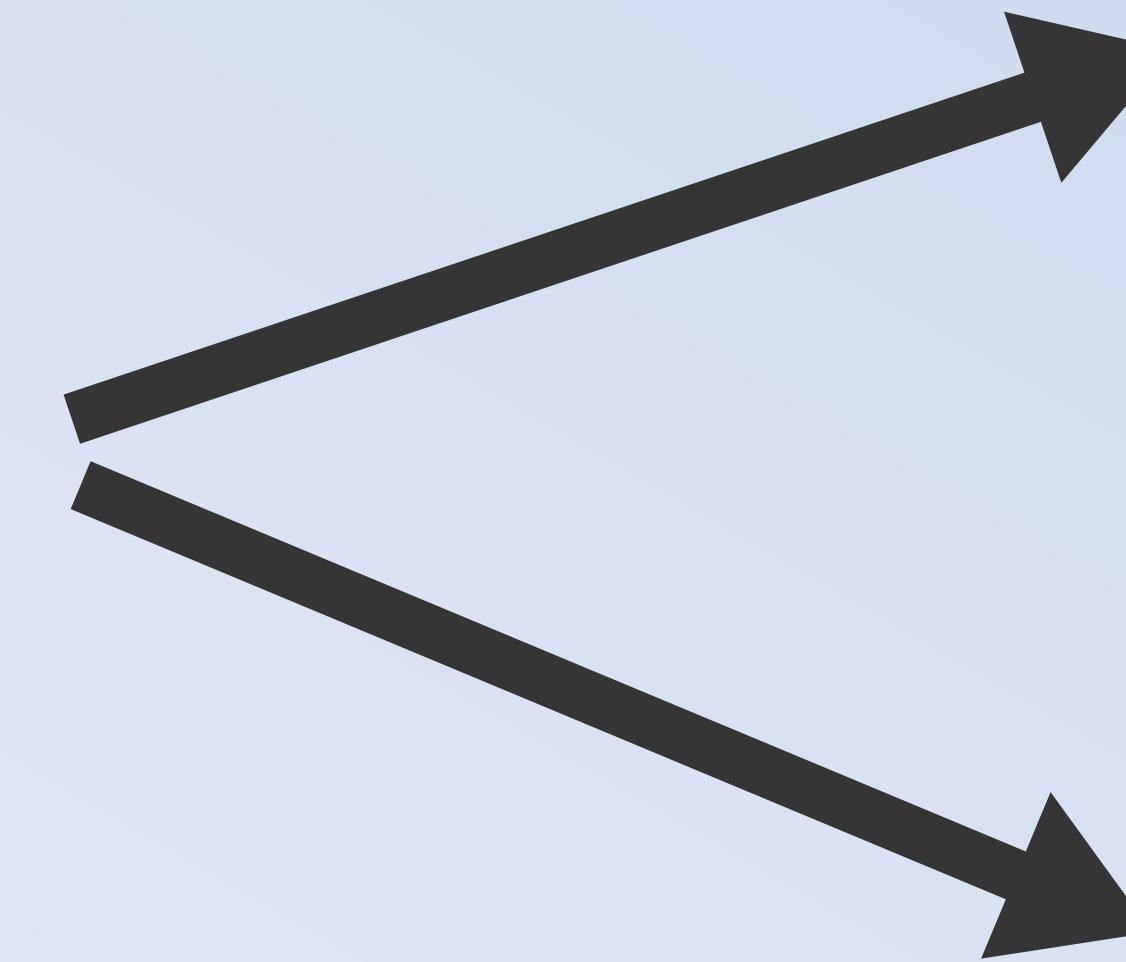
# What do we do about curbs in our cities?



**Medical model:** the body is the cause of disability (according to normative standards).



# Medical model: augment or “cure” the body.



**Social model:** The *curb* is the source of disability (a “barrier” to access).



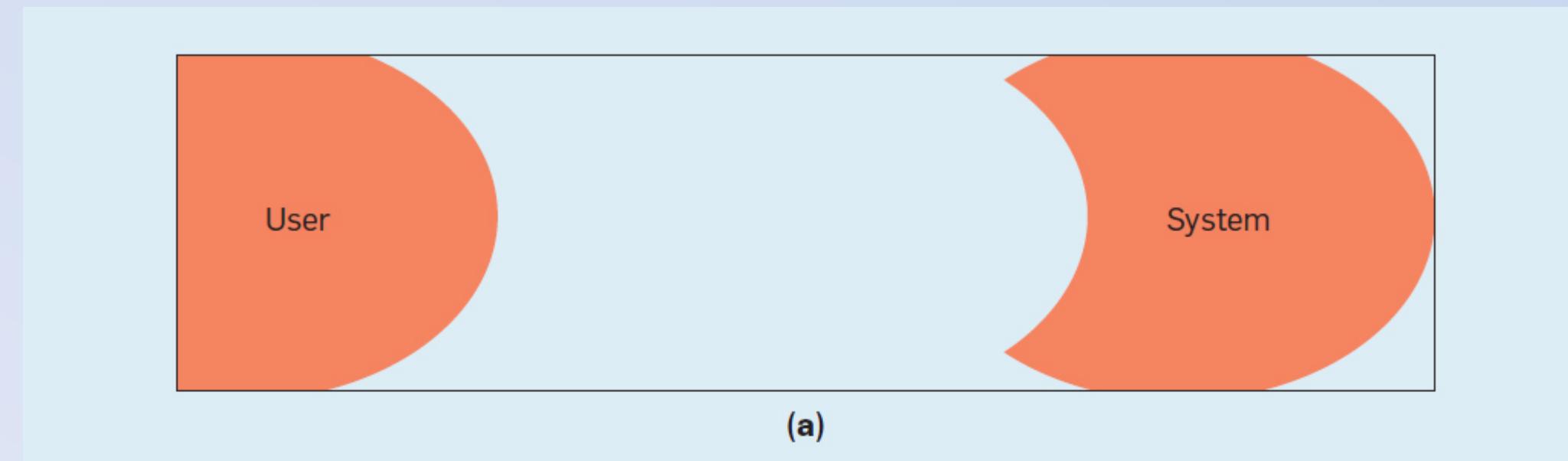
# Social model: Cut the curb and standardize.



# **Concept: Ability Assumptions**

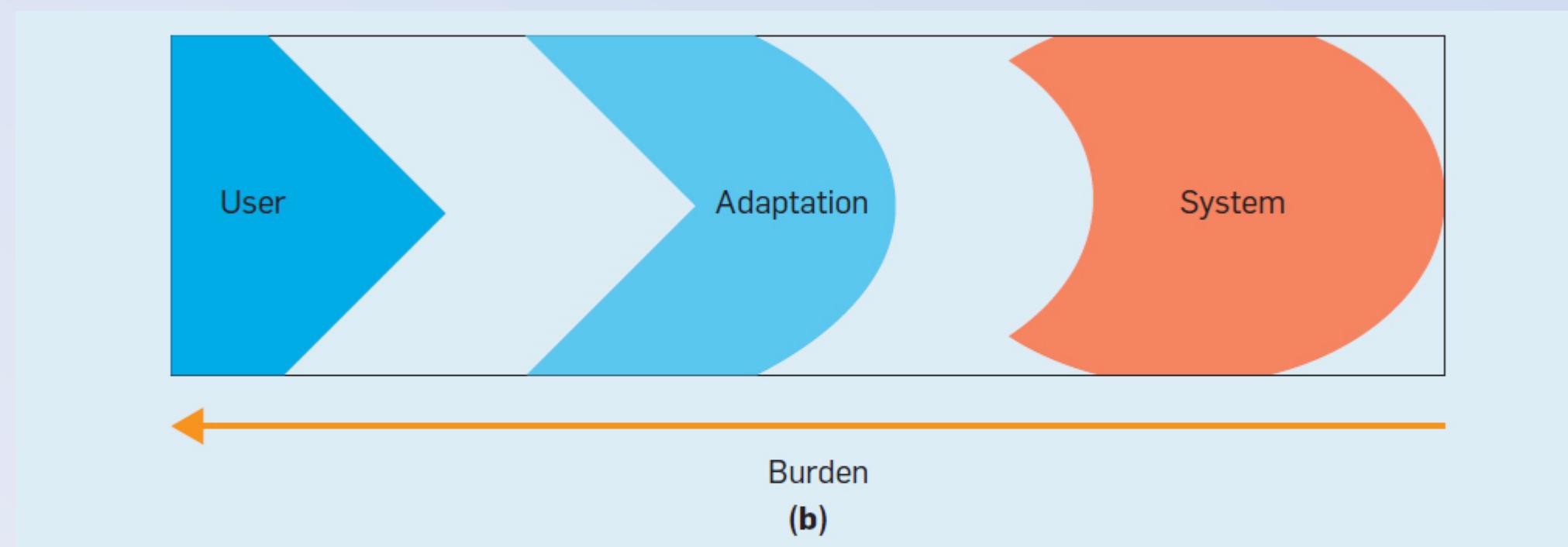
# Ability Assumptions

(Wobbrock et al) <https://cacm.acm.org/magazines/2018/6/228034-ability-based-design/fulltext>



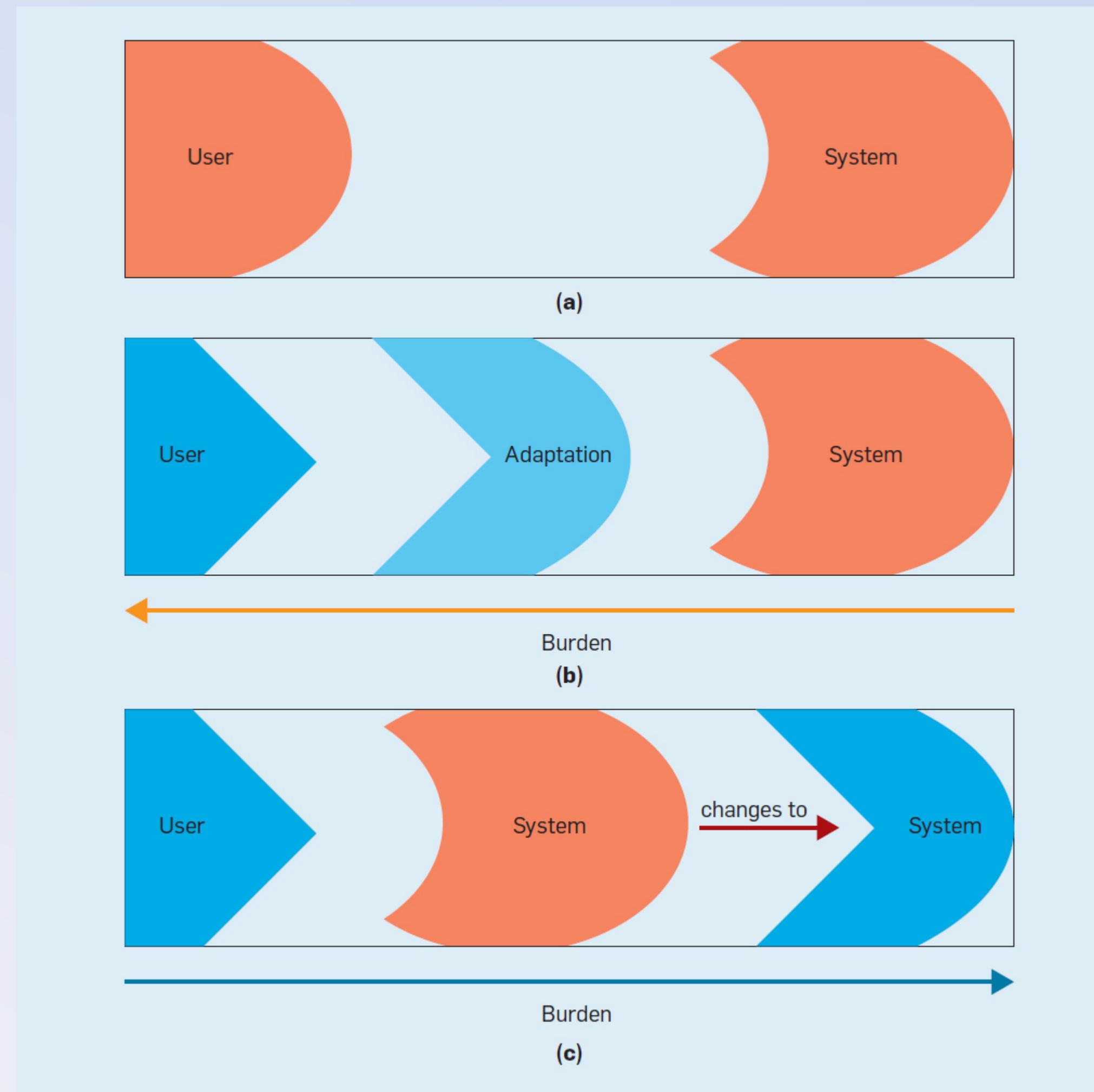
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(Wobbrock et al) <https://cacm.acm.org/magazines/2018/6/228034-ability-based-design/fulltext>



# A curb exclusively assumes the ability to step up



# A cut curb has fewer *exclusive* ability assumptions



# **Concept: Situational Impairment**

**Permanent**

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**Touch**



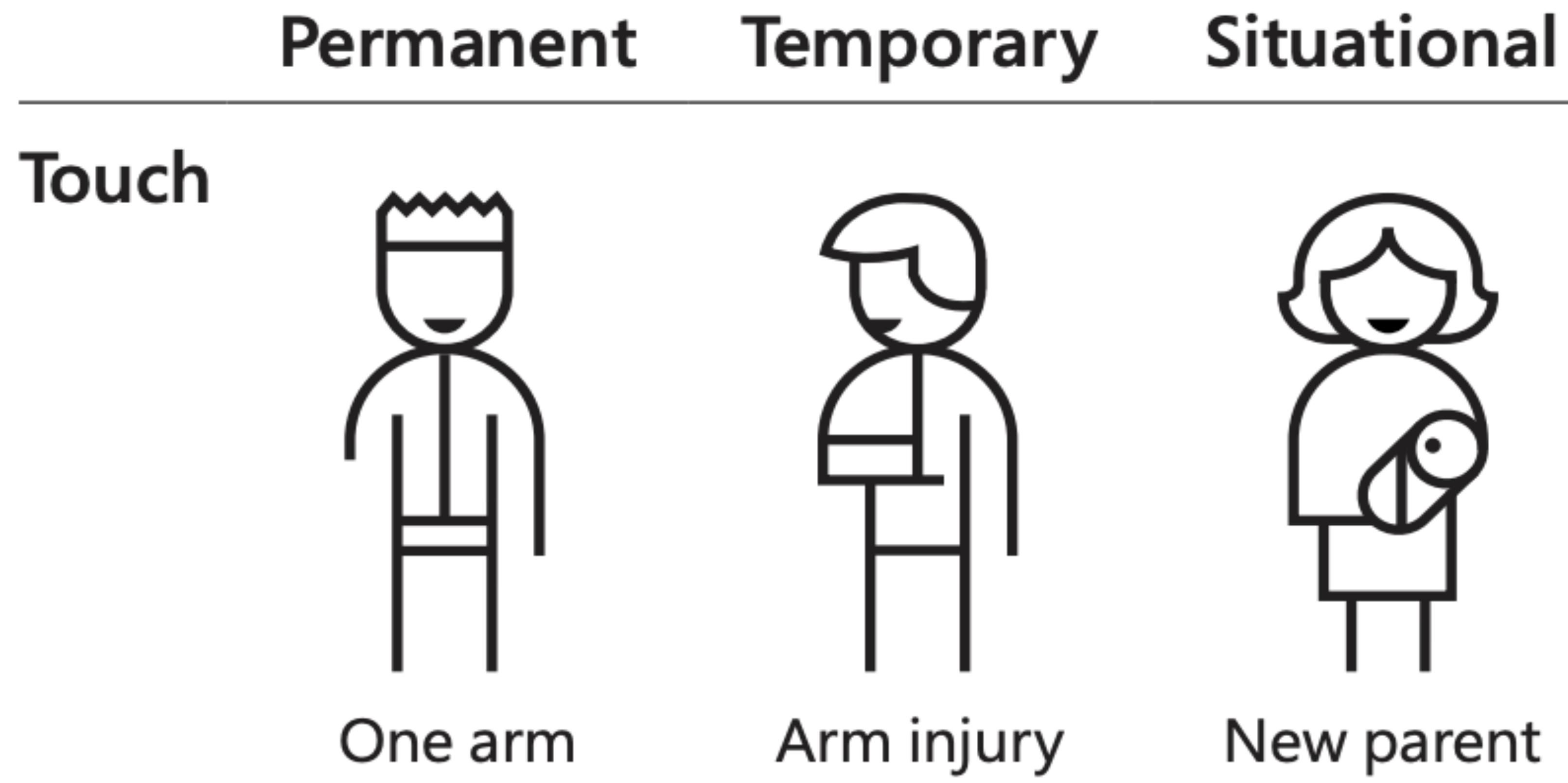
**One arm**

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	<b>Permanent</b>	<b>Temporary</b>
<b>Touch</b>		
		
<b>One arm</b>		<b>Arm injury</b>

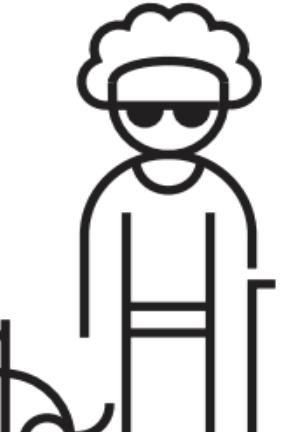
	<b>Permanent</b>	<b>Temporary</b>	<b>Situational</b>
<b>Touch</b>			
			
	<b>One arm</b>	<b>Arm injury</b>	<b>New parent</b>

We all experience situational impairment in our daily lives. **Accessibility benefits everyone!**



# “Design for One, Extend to All”

Microsoft’s Inclusive Design 101 Toolkit: [https://download.microsoft.com/download/b/0/d/b0d4bf87-09ce-4417-8f28-d60703d672ed/inclusive\\_toolkit\\_manual\\_final.pdf](https://download.microsoft.com/download/b/0/d/b0d4bf87-09ce-4417-8f28-d60703d672ed/inclusive_toolkit_manual_final.pdf)

	Permanent	Temporary	Situational
Touch			
	One arm	Arm injury	New parent
See			
	Blind	Cataract	Distracted driver
Hear			
	Deaf	Ear infection	Bartender
Speak			
	Non-verbal	Laryngitis	Heavy accent

**Discuss:** Share an example where you might be impaired in some way and how accessible technology or infrastructure helps you.

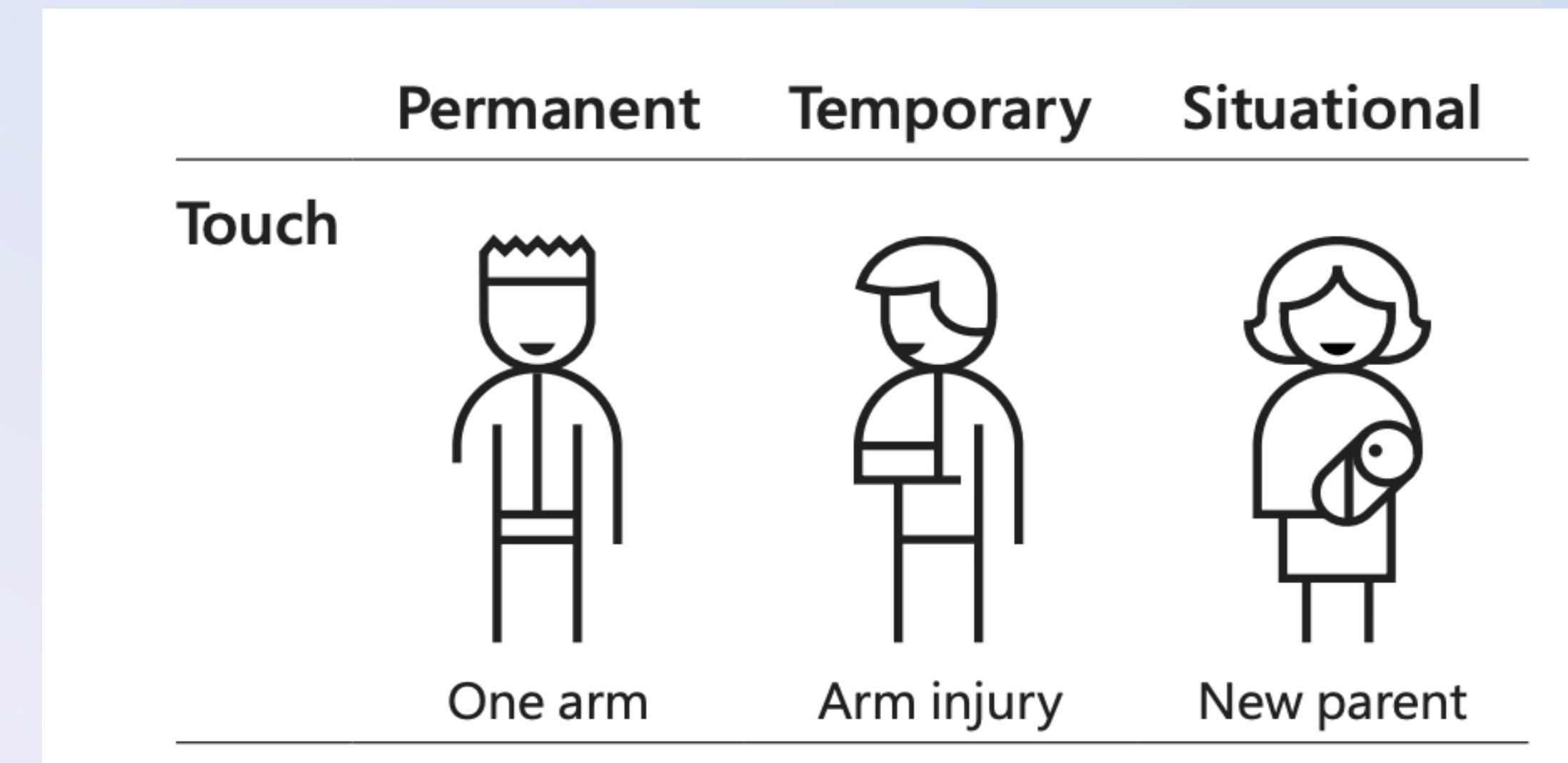
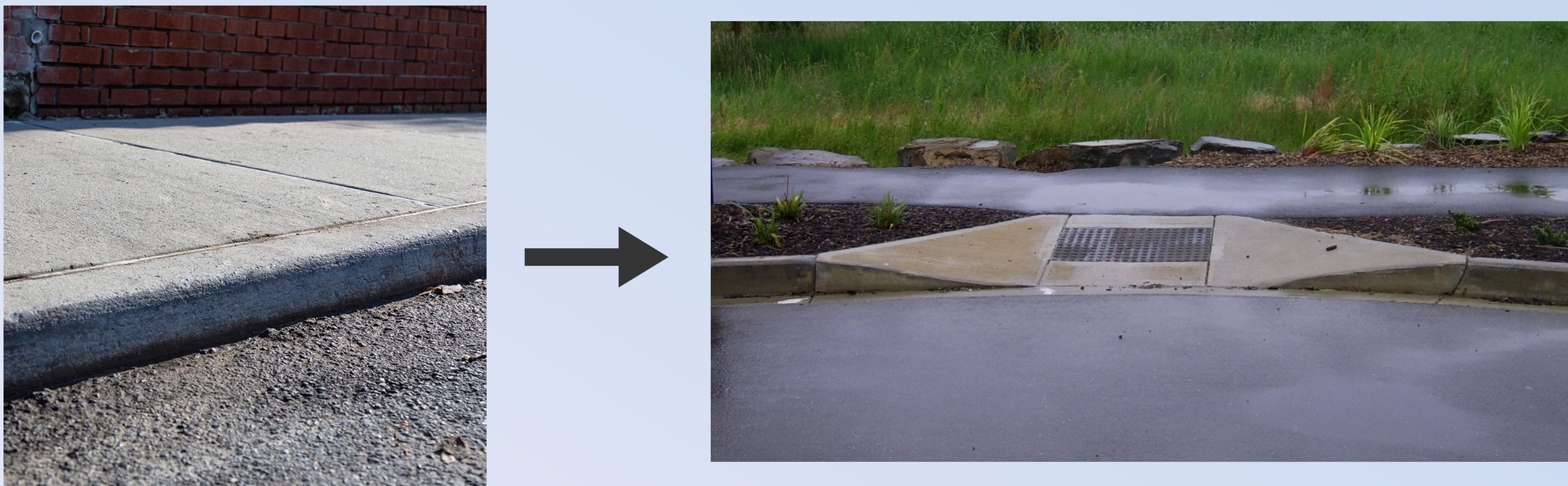
**Does “design for one, extend to all”  
have limits? Problems?**

# **Final Concept: Disability-Centered Design**

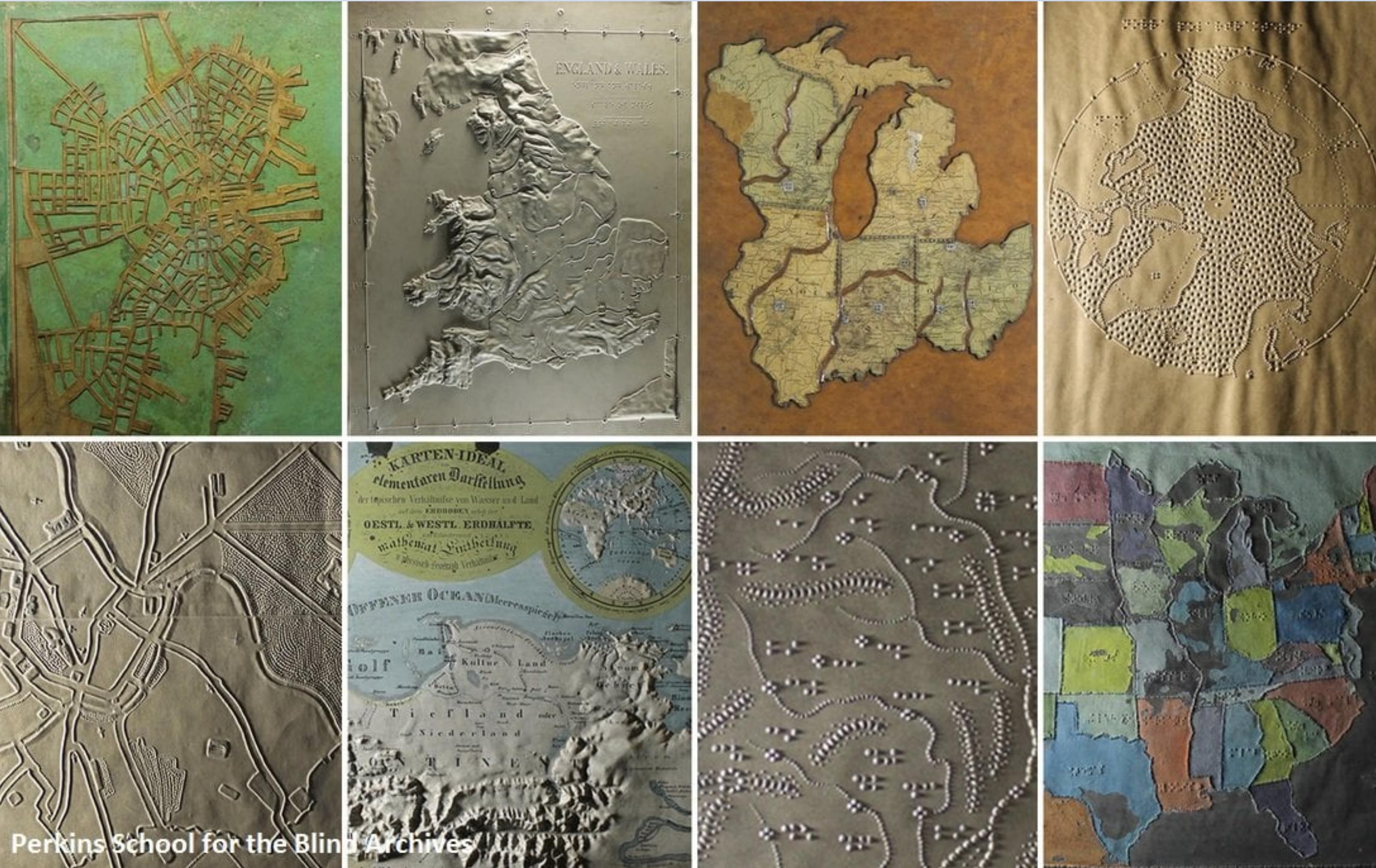
**“Nothing about us  
without us”**  
And the 1977 504 sit-in.



# In practice, “curb cut” work has been *prioritized*

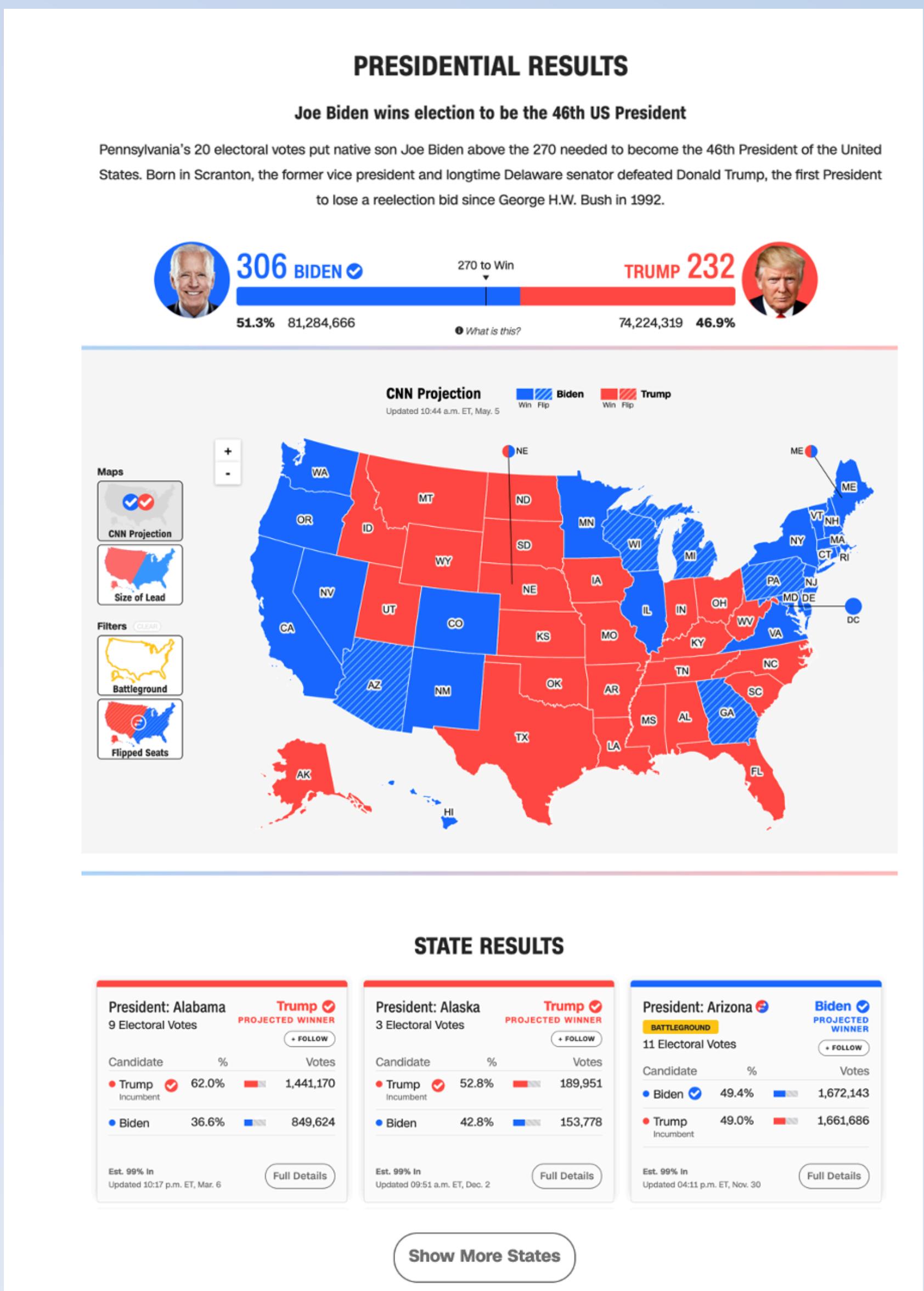


# The best work centers on people with disabilities



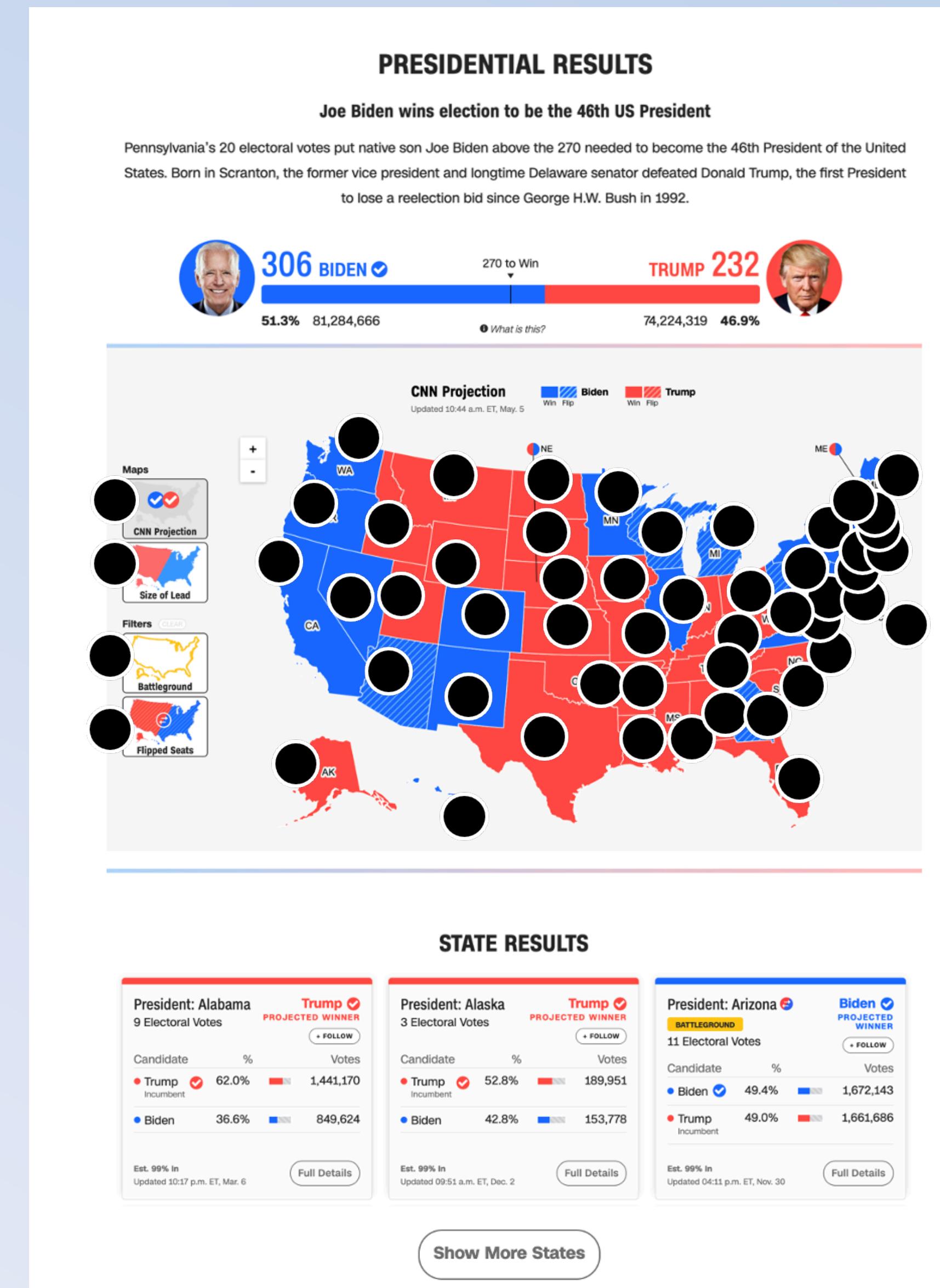
Perkins School for the Blind Archives, with tactile maps dating back to the early 1800s

# Evaluating accessibility



# 978 access barriers

Found in about an hour.



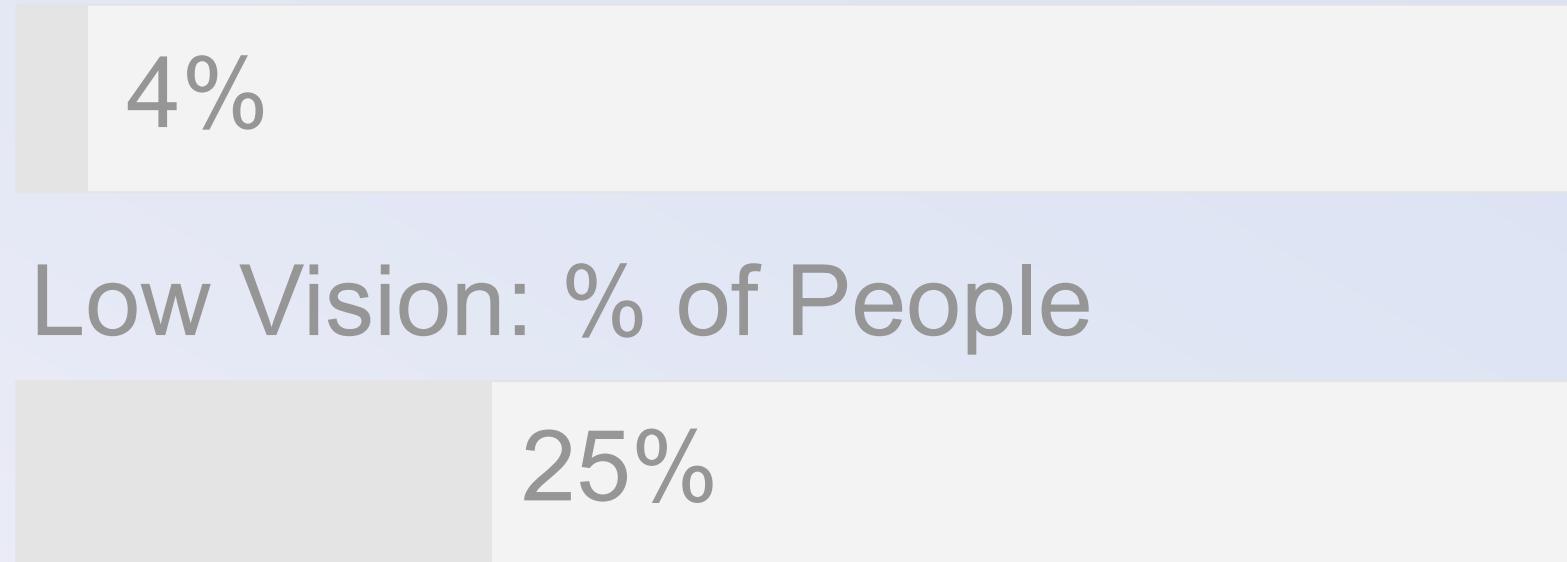
# **Perceivable**

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

# Design with high contrast

**Colorblindness Disproportionately Overrepresented in A11y Resources**

Colorblindness: % of People

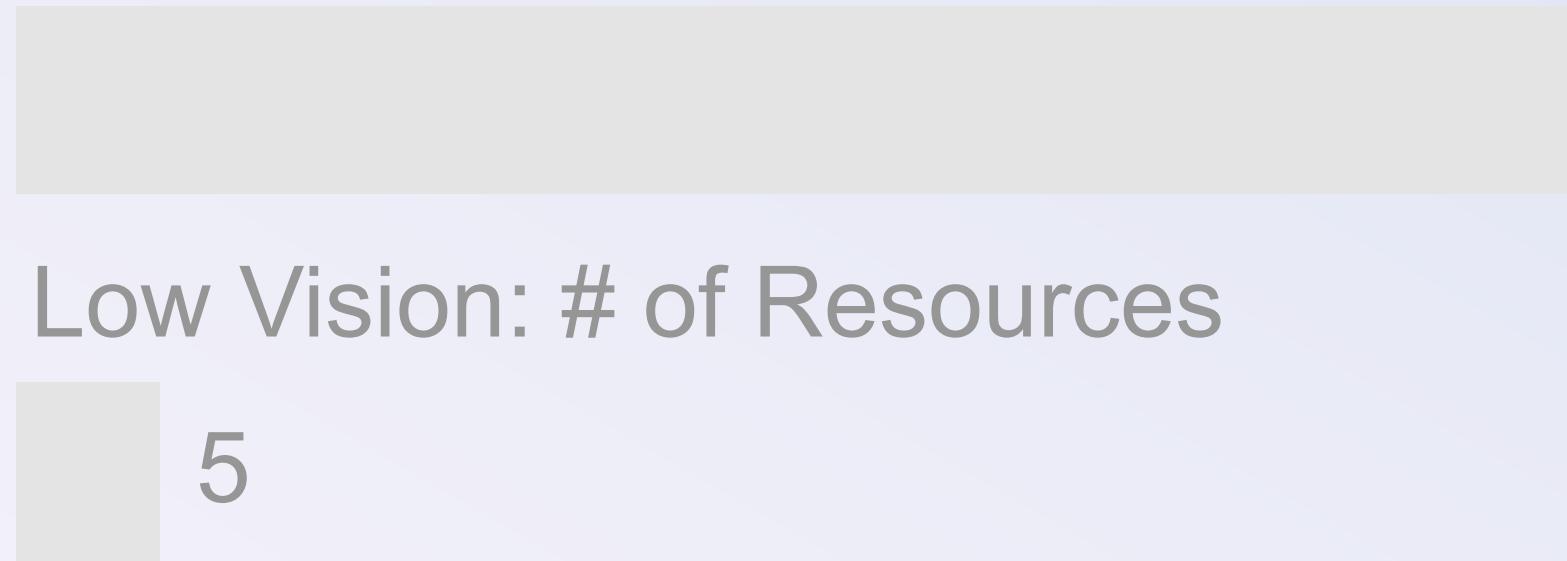


4%

Low Vision: % of People

25%

Colorblindness: # of Resources



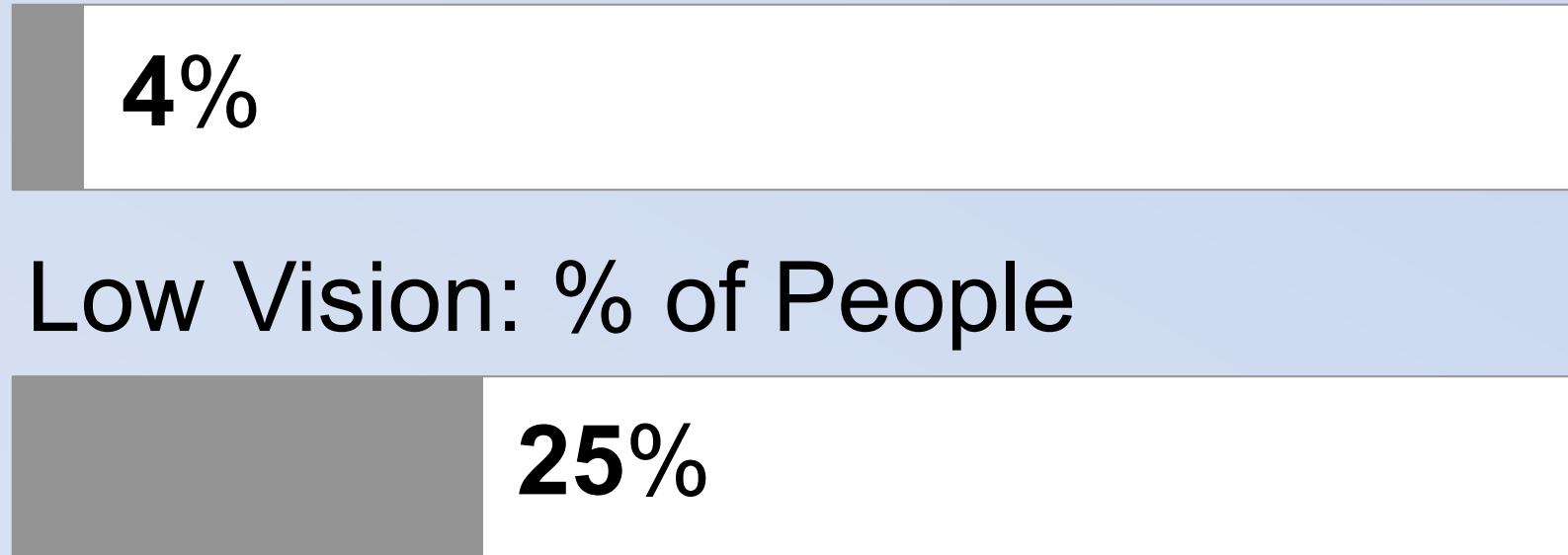
51

Low Vision: # of Resources

5

**Colorblindness Disproportionately Overrepresented in A11y Resources**

Colorblindness: % of People

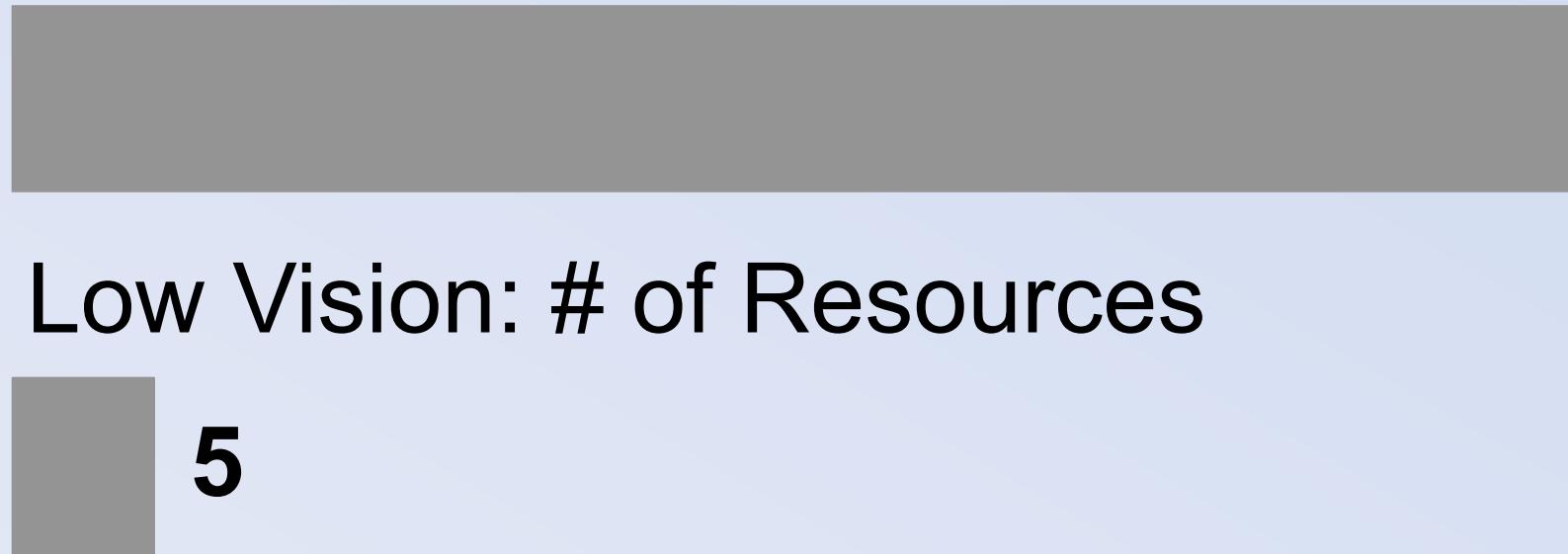


4%

Low Vision: % of People

25%

Colorblindness: # of Resources



51

Low Vision: # of Resources

5

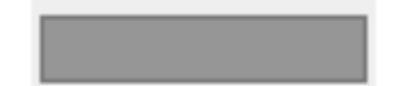
# Check your contrasts

**Text** needs at least **4.5:1** contrast against its background.

**Large text** and **geometries** must be **3:1** or higher.

## Contrast Checker

[Home](#) > [Resources](#) > Contrast Checker

Foreground Color  
#969696 

Lightness 

Background Color  
#FFFFFF 

Lightness 

Contrast Ratio  
**2.95:1**  
[permalink](#)

### Normal Text

WCAG AA: **Fail**

WCAG AAA: **Fail**

The five boxing wizards jump quickly.

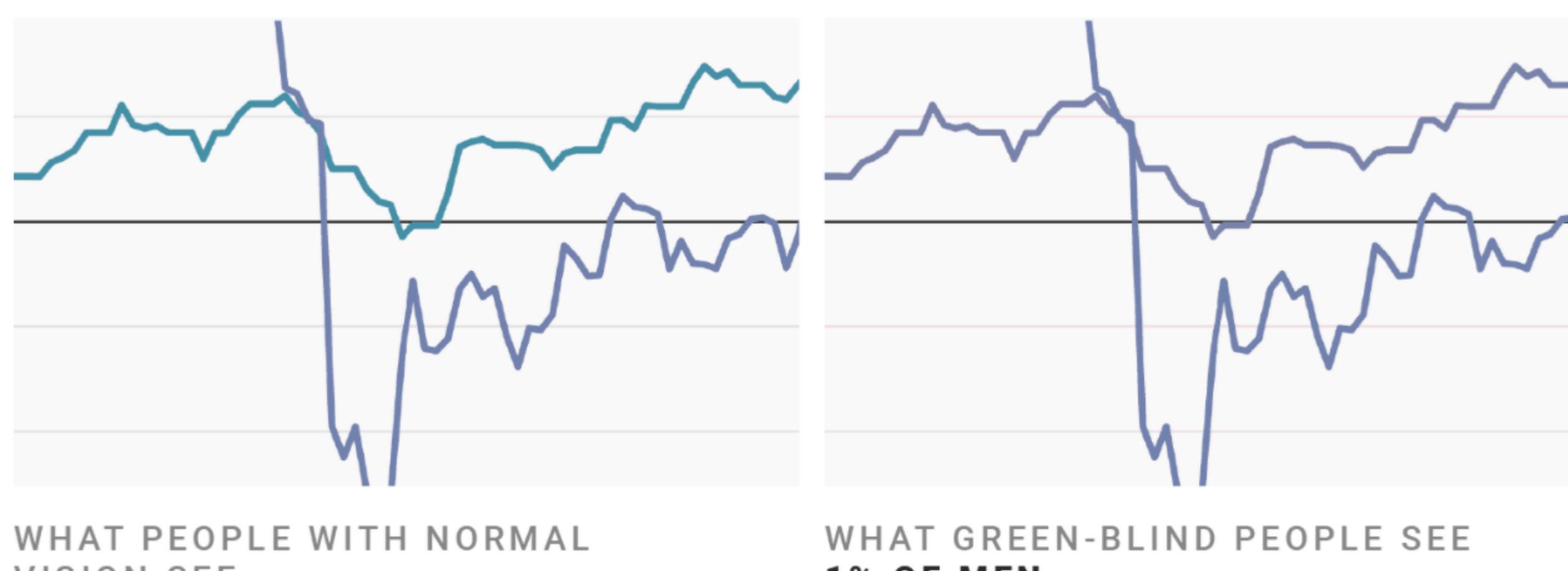
### Large Text

WCAG AA: **Fail**

WCAG AAA: **Fail**

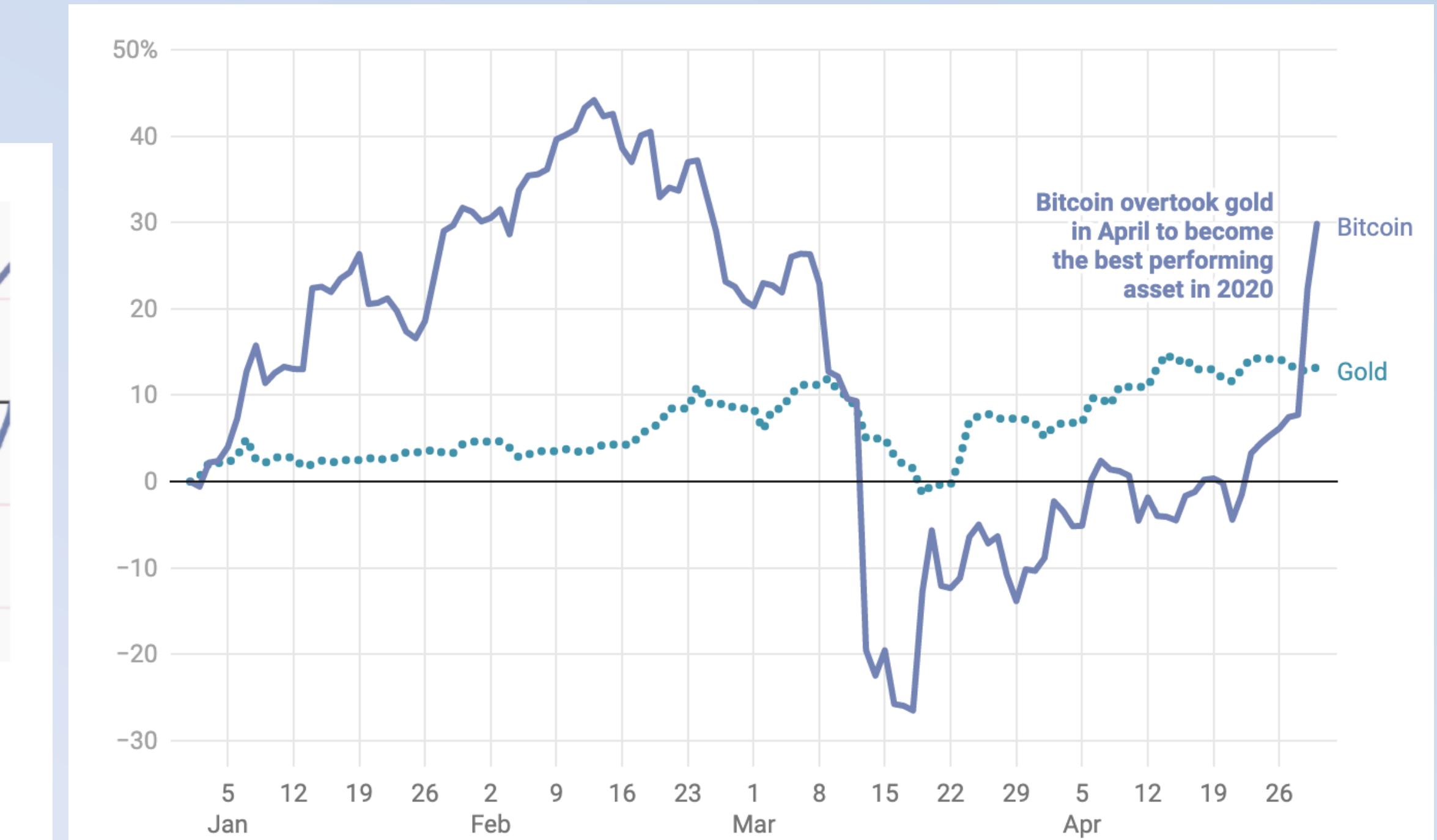
The five boxing wizards jump quickly.

# Don't rely on color alone!



WHAT PEOPLE WITH NORMAL  
VISION SEE

WHAT GREEN-BLIND PEOPLE SEE  
1% OF MEN



Bitcoin and gold price change (%) between January and May 2020

Chart: Based on [Anthony Cuthbertson](#) • Source: [CoinMarketCap](#), Nasdaq, Gold Price • Get the data

[Data Wrapper's color guide](#)

# Add alt text

There is great research on alt text, but the most important thing to know is that you should add it to every image you post online (including twitter), in a document, or presentation.

Guidance: <https://medium.com/nightingale/writing-alt-text-for-data-visualization-2a218ef43f81>

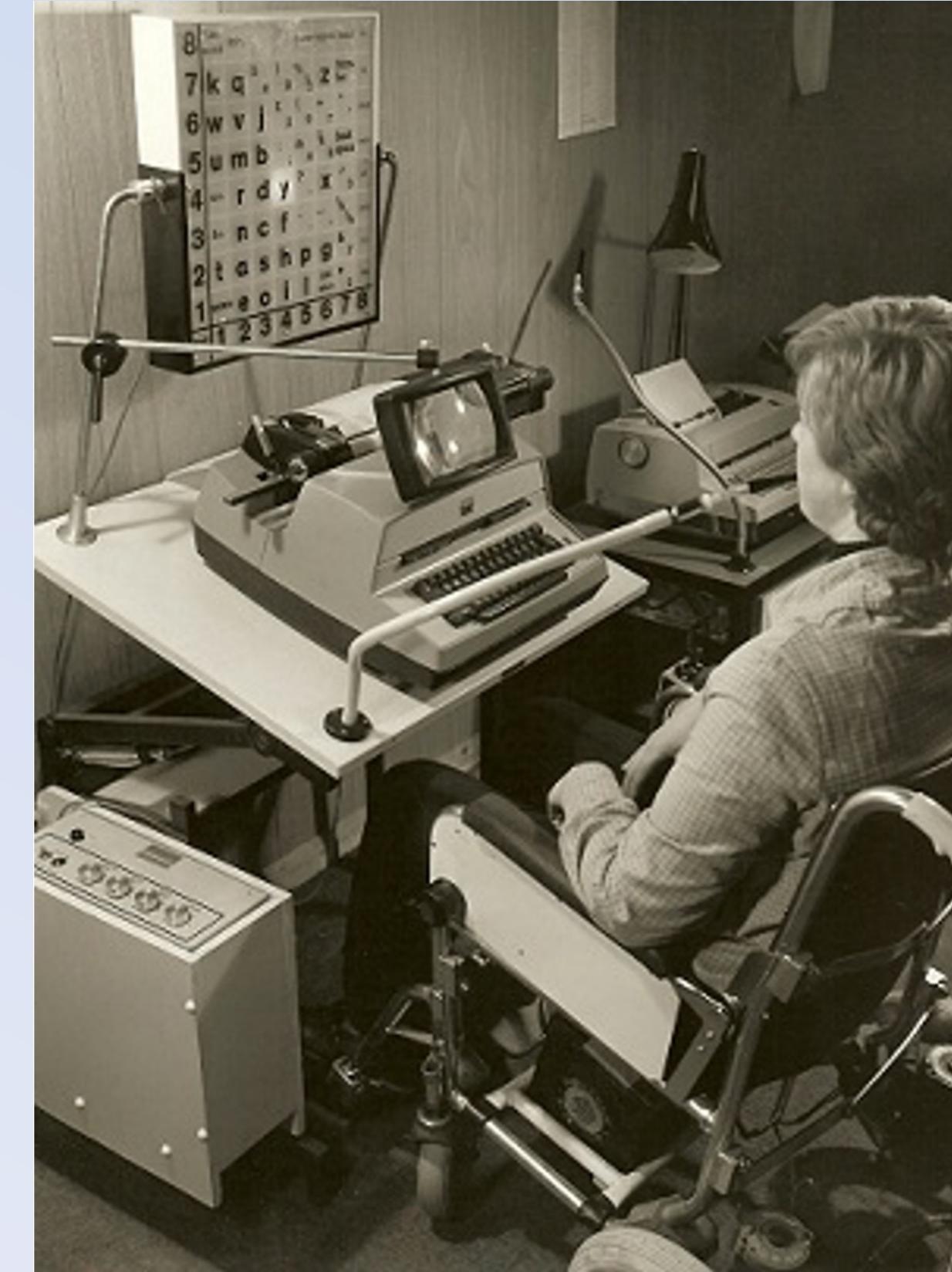
alt= "**Chart type** of **type of data**  
where **reason for including chart**"

Include a **link to data source**  
somewhere in the text

# **Operable**

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

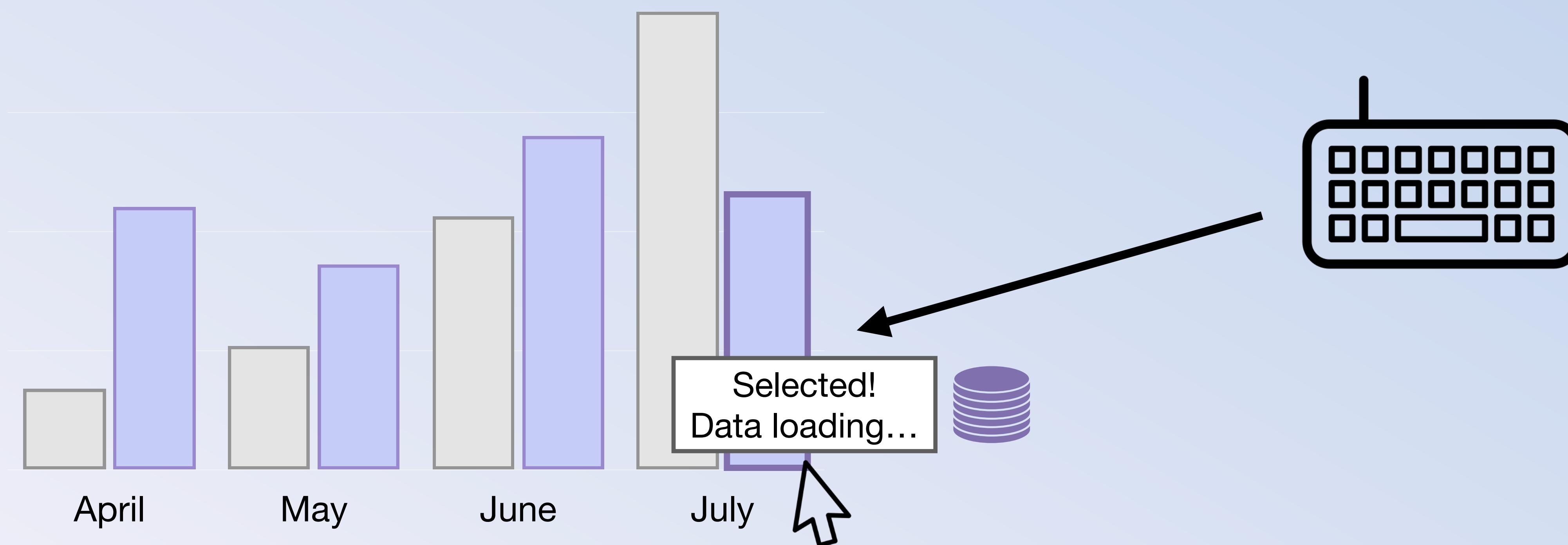
# Many assistive input technologies “navigate”



A person in a wheelchair operating an old computer using a desk-mounted sip and puff device called the POSSUM.

Image credit: [Wikipedia](#), Public Domain, 1960. Photographer: Possum Ltd.

# A keyboard should be able to do everything a mouse can



WAI. “Understanding success criterion 2.1.1: keyboard.” *WCAG standard*, W3C, 2017.

# **Understandable**

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

# Keep summaries as non-technical as possible

Measured in EF units (non-normalized). EF units are valuable for catching egregious oversimulation in models that use randomized data decimation techniques. This particular evaluation findings demonstrate that the randomization models are significantly overproducing 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.

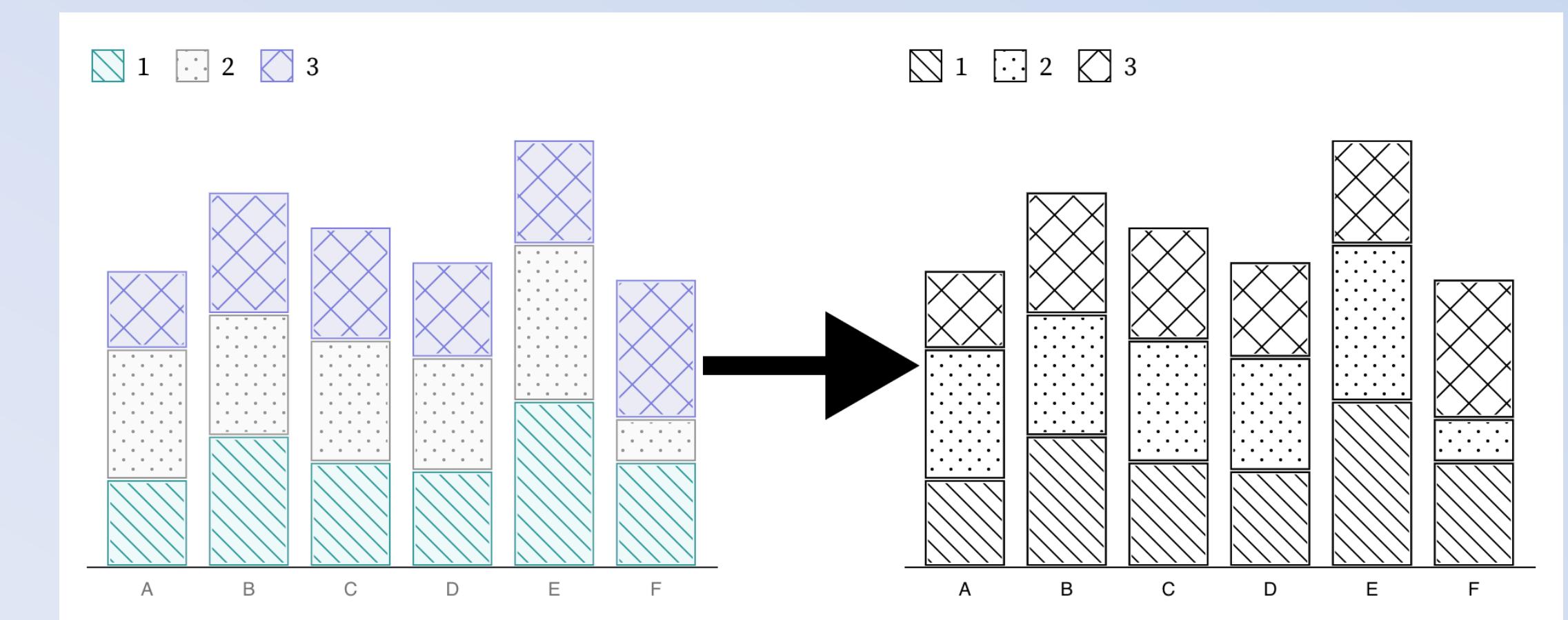
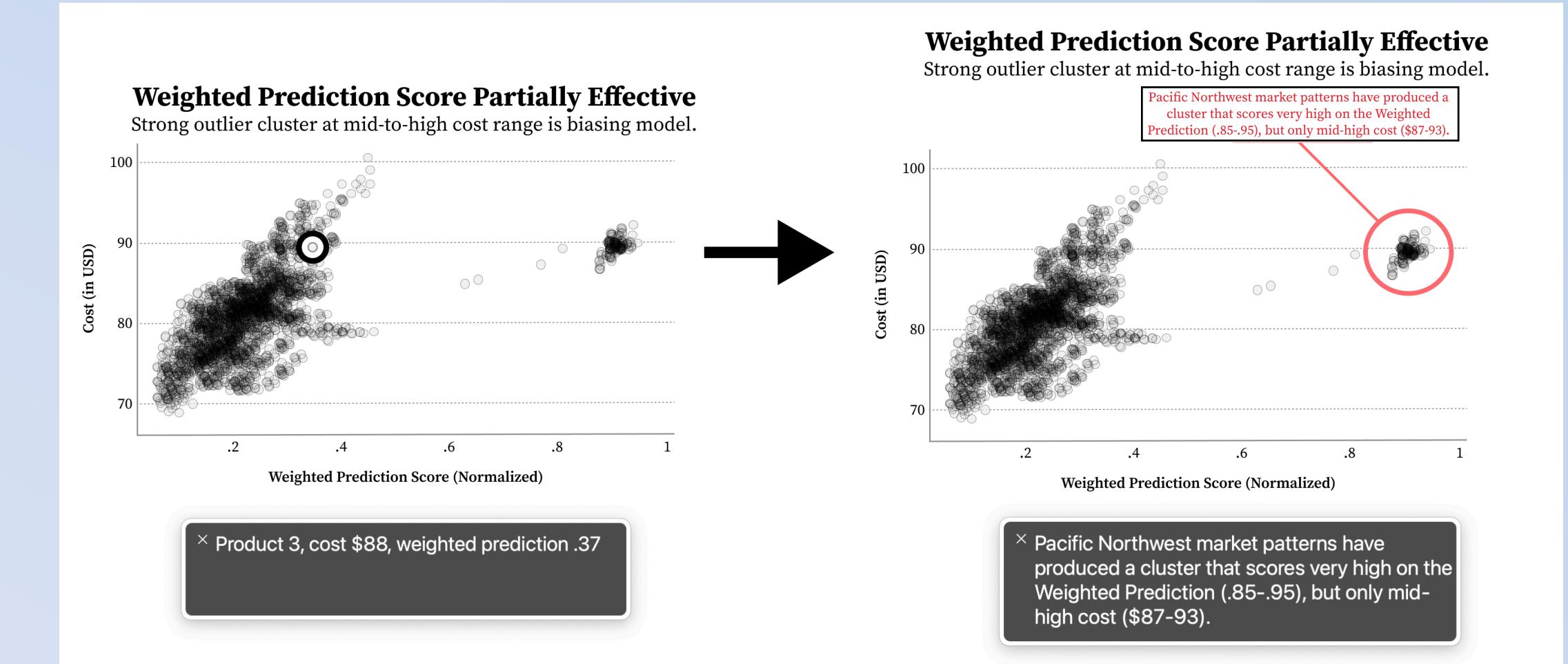
0 phrases have simpler alternatives.

0 of 3 sentences are hard to read.

0 of 3 sentences are very hard to read.

# Check out Chartability for more

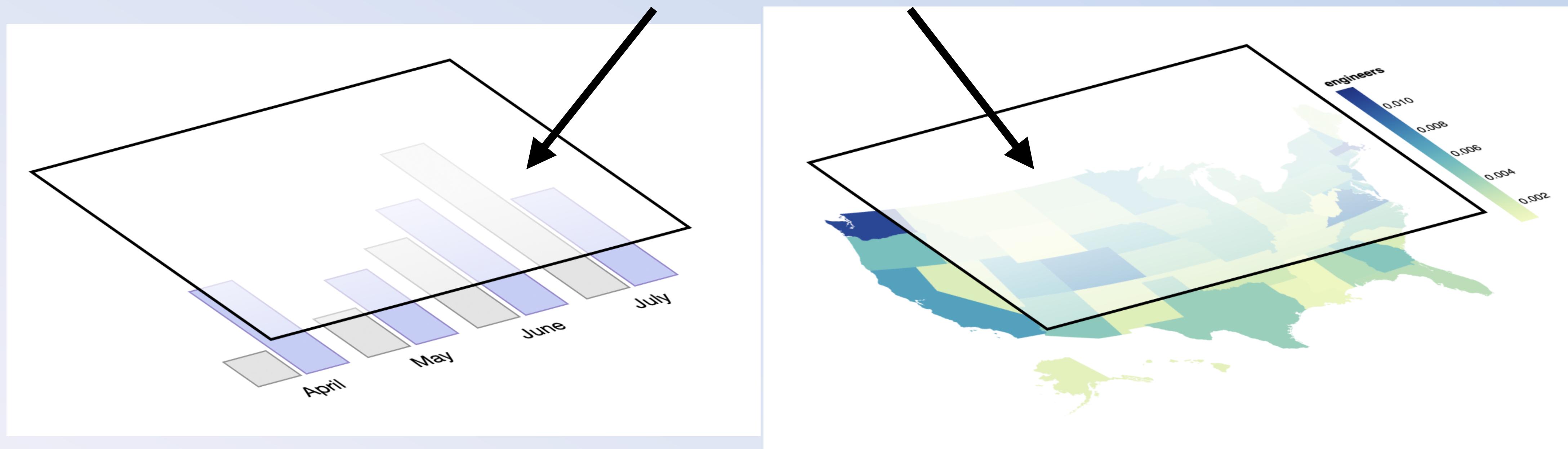
- Perceivable
- Operable
- Understandable
- Robust
- Compromising
- Assistive
- Flexible



Chartability

# Also try Data Navigator

An interactive layer that interfaces between data structures and assistive technologies



[Data Navigator](#)

**Exercise! <https://tinyurl.com/1302-access-critique>**

Get into groups (up to 4 groups)



# Counterpoint: navigating animations

## Sivaraman's *Counterpoint* (2024)

★Slides here

# Accessibility and Visualization

An introductory lecture: Concepts, history, and practice.



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