Designing for Low Vision

Input, Interaction, and Accessibility
Spring 2019

Housekeeping

- Project 1 due in one week (2/25)
  - We’ll have time this Weds to work on it
- Screen reader assignment due next Weds (2/27)
- No new assignment this week

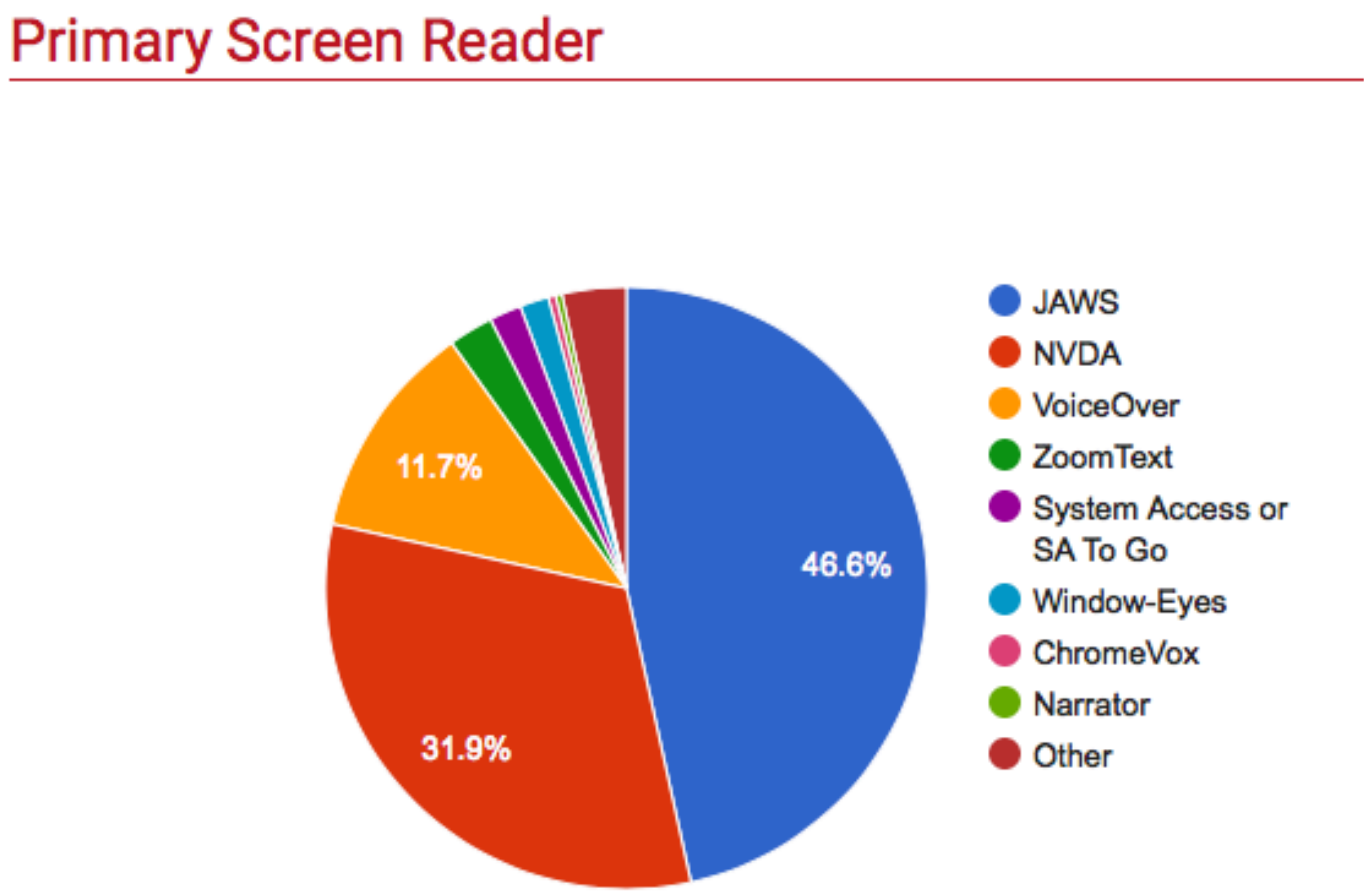
Course feedback

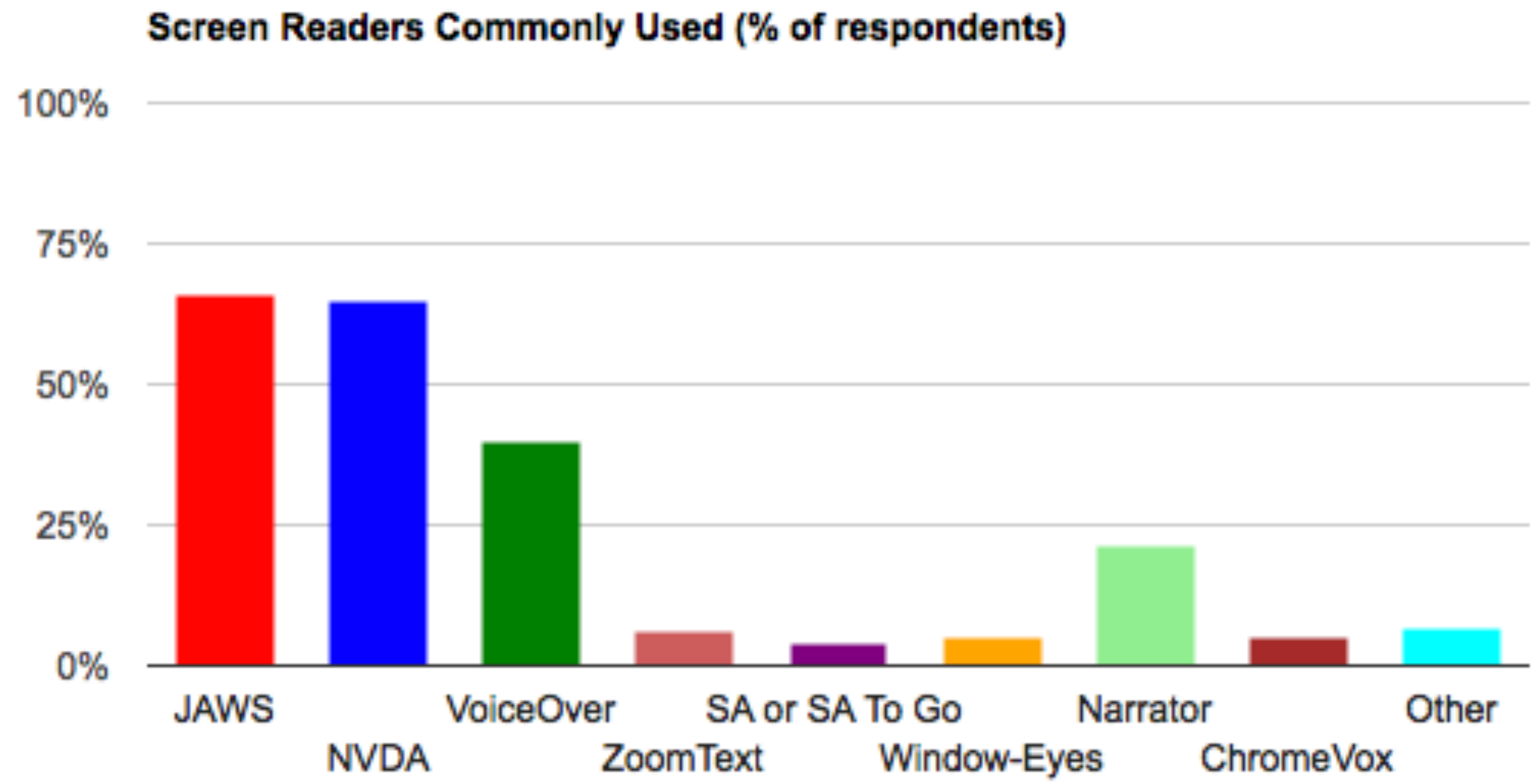
- shaun.cat/feedback

Key points from last week

- Be familiar with different types of assistive technology used by blind people
- Primary challenges: computer access, independent navigation & many others
- Captioning is an open problem
- Best way to understand audio interaction is through experiencing it

What screen readers do people actually use? (2017)





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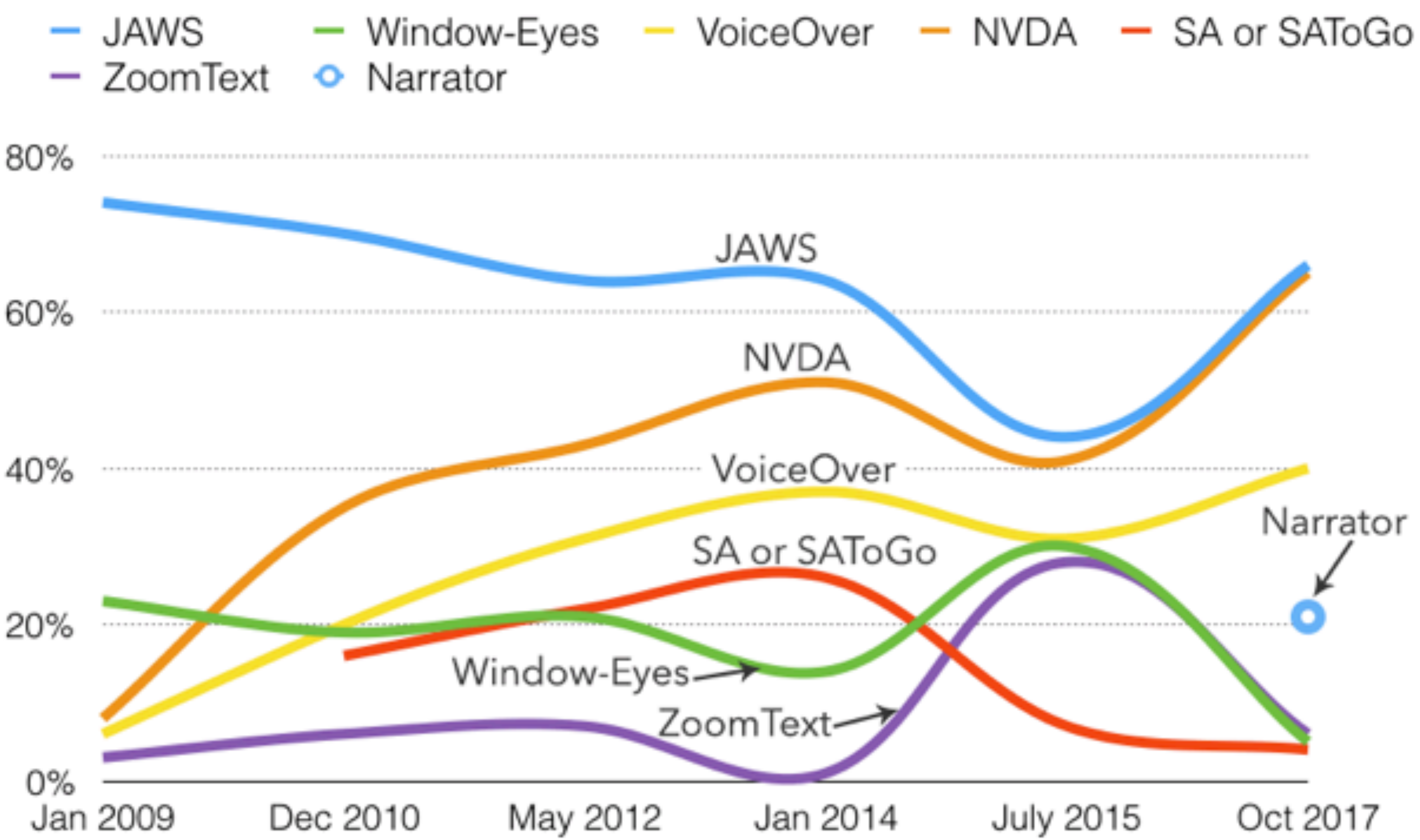

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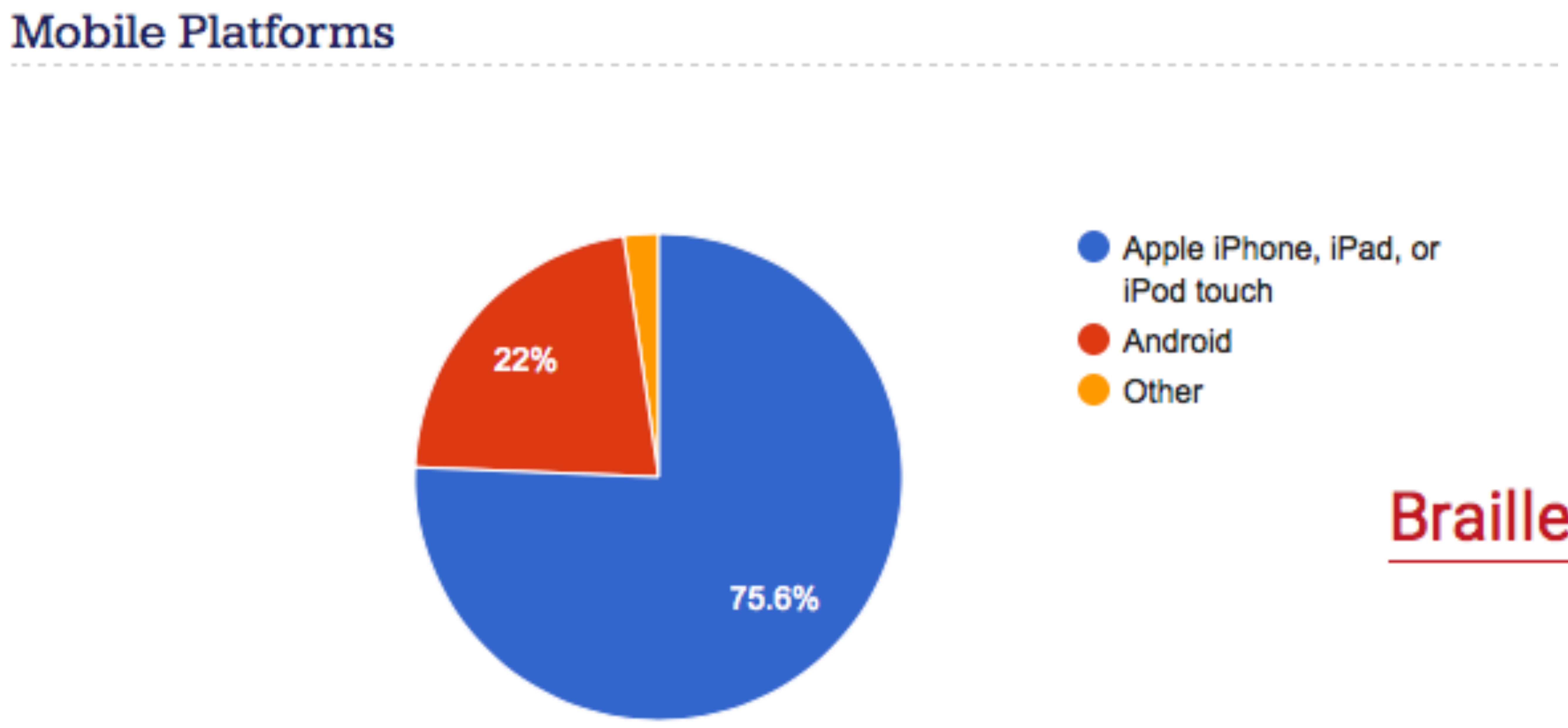

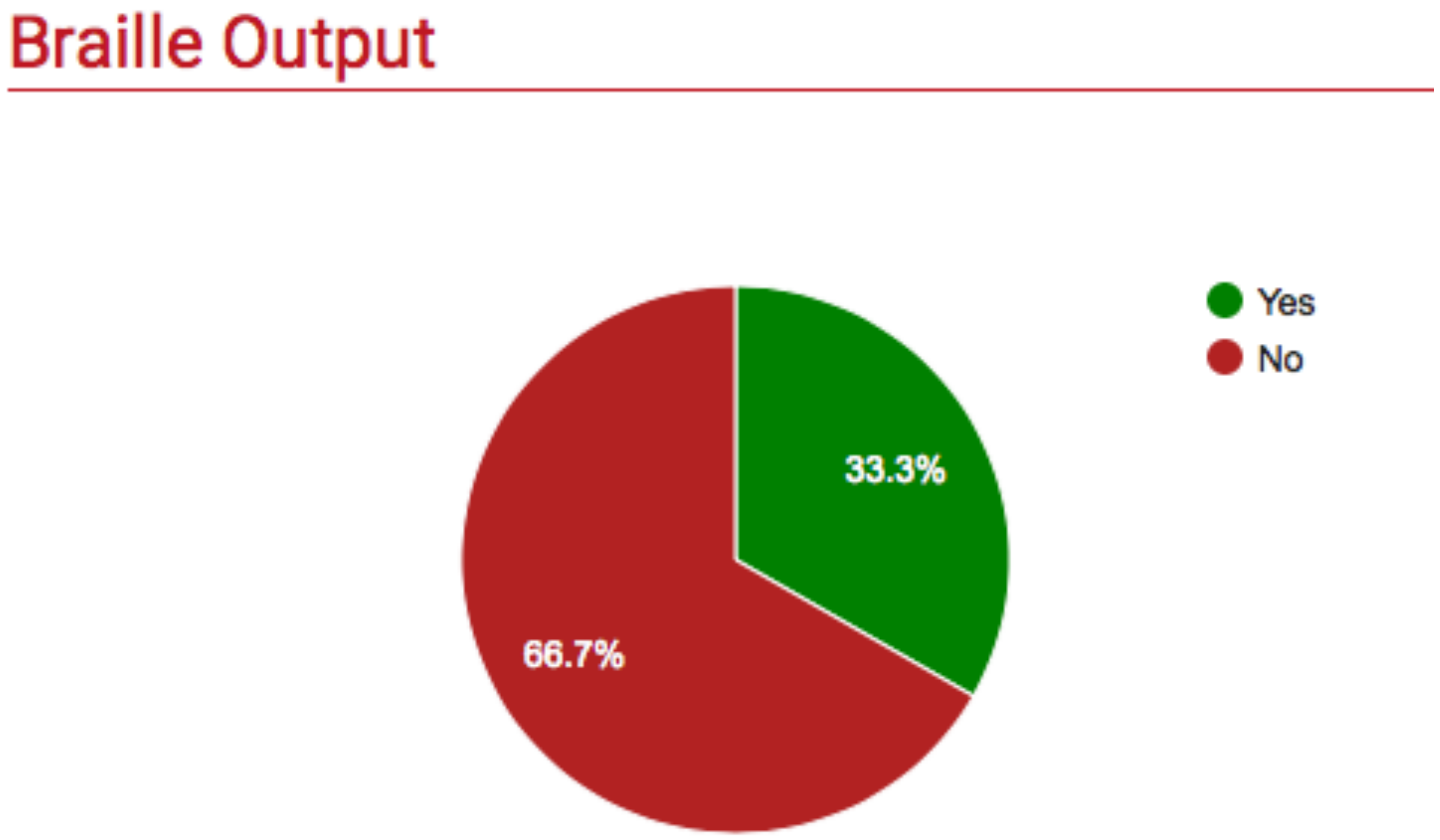

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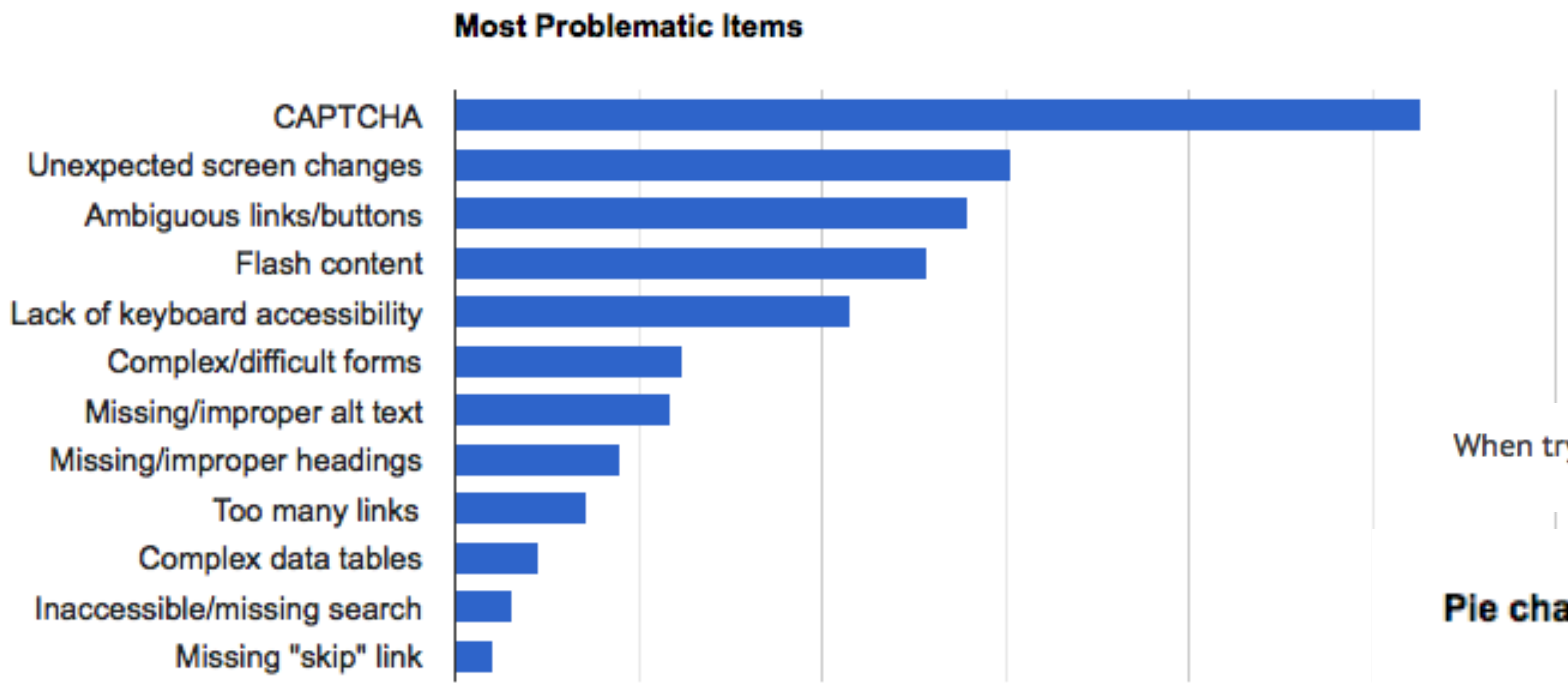
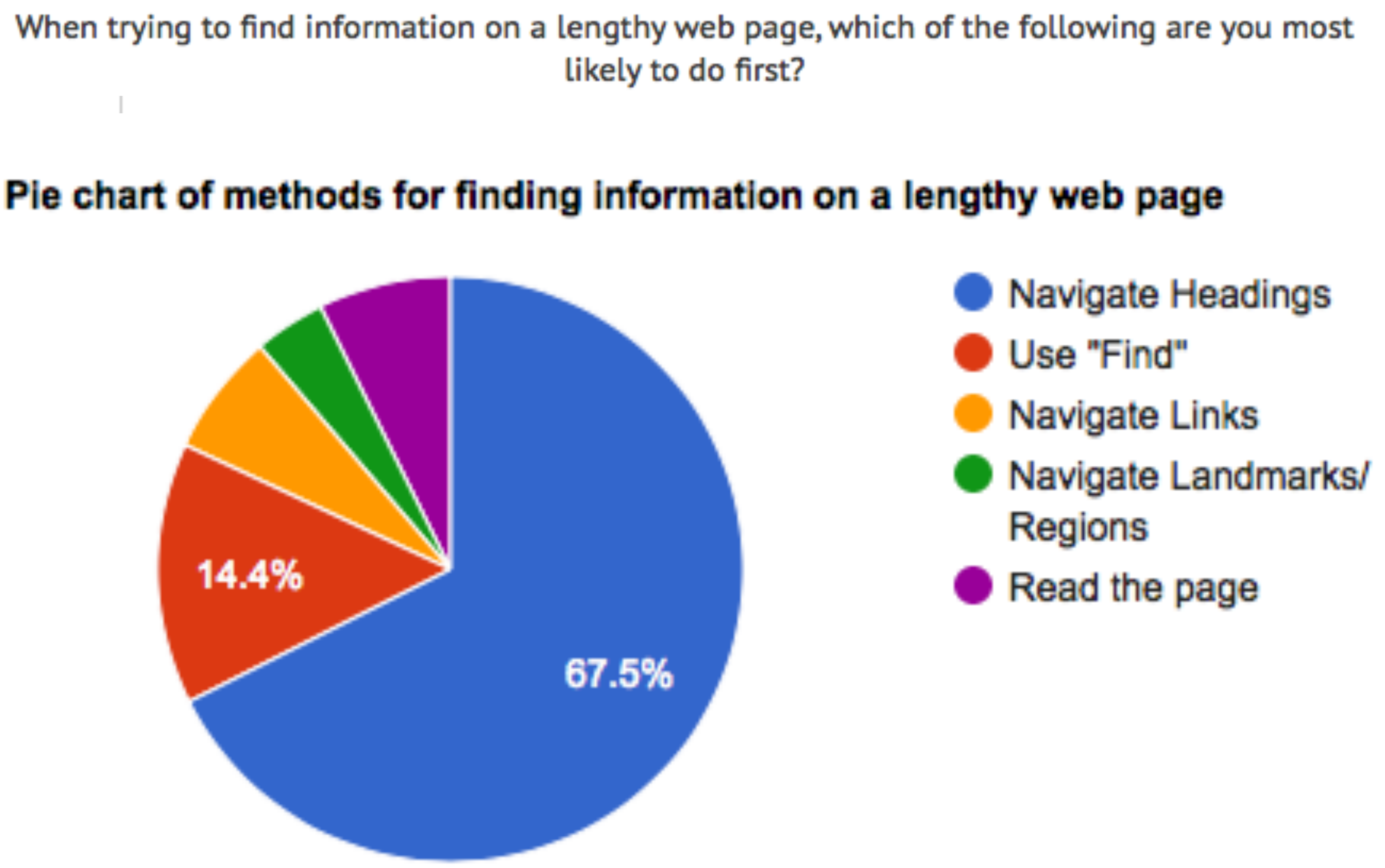




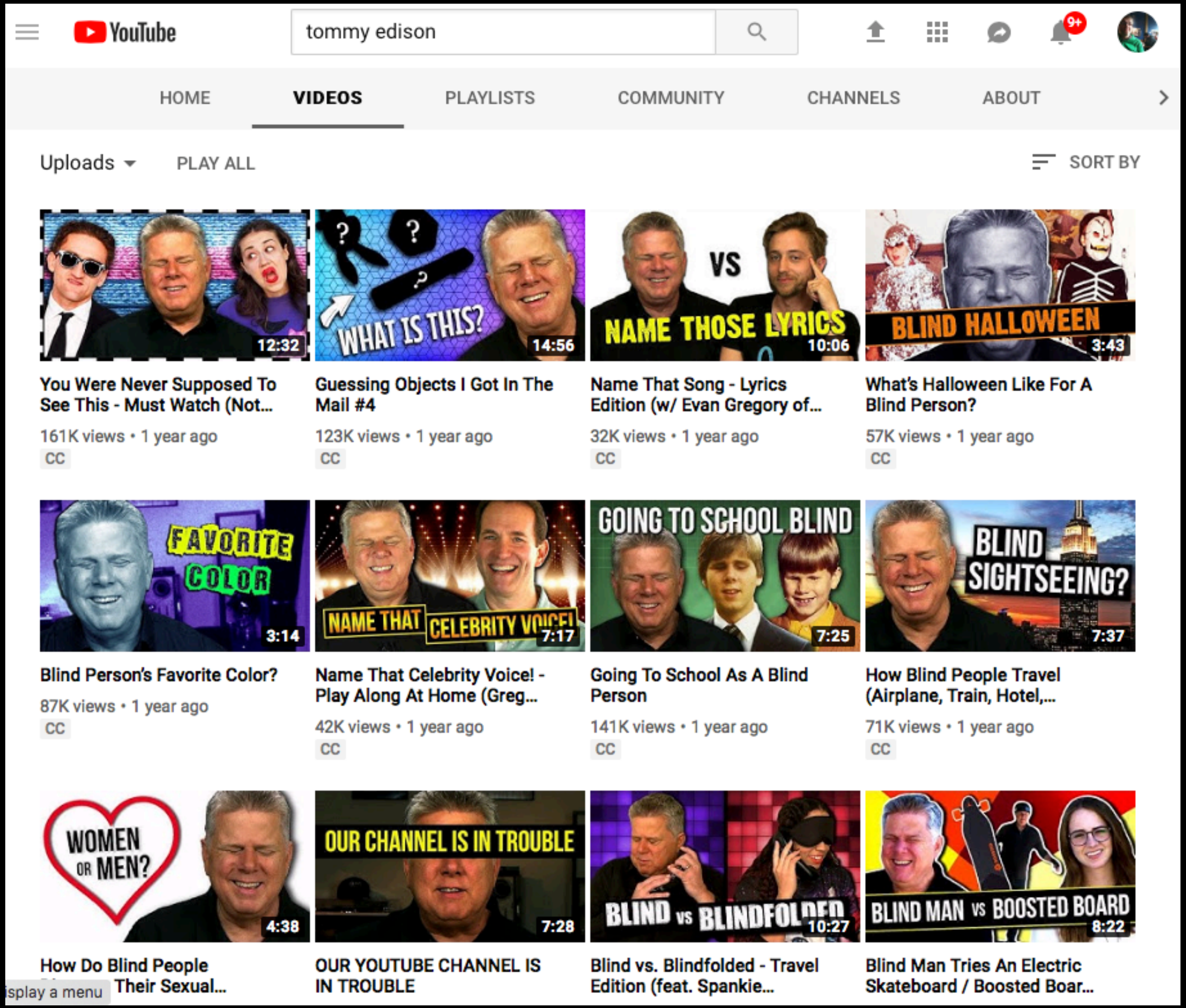
Using mobile screen readers

- How to deal with audio in public?

Mobile screen reader poses

YouTube demos

- Many, many demos of assistive technology use
- Emerging YT policies like Tommy Edison



SHIT SIGHTED PEOPLE SAY

TO BLIND PEOPLE

Distinctions between groups

- Born blind vs. became blind
- “Total blindness” vs., for example, light perception
- In my experience, these distinctions usually don’t matter as much as we would think
  - Do all sighted people care what color their shirt is?
  - Are all sighted people good at reading maps?
- Other differentiating factors: What AT do they use? What is the task and what are the functional challenges?
- But, some surprises: For example, did the person learn to write?

Low vision

Big ideas: low vision

- People with low vision use a very different set of technologies than others
- Where we can, take advantage of user's visual abilities
- Solutions will often involve customizable user interfaces

What is low vision anyway?

- An estimated 253 million people live with vision impairment: 36 million (14%) are blind and 217 million (85%) have moderate to severe vision impairment
- 81% of people who are blind or have moderate or severe vision impairment are aged 50 years and above

Data from [World Health Organization]

Legally blind?

- Defined in USA as:
  - Visual acuity of 20/200 or less (in “best” eye) with correction
  - Or a visual field of 20 degrees or less (vs. ~190 degrees for typical vision)

Brainstorming problems

- What are some tasks that you did today that might be negatively affected by low vision?

Problems

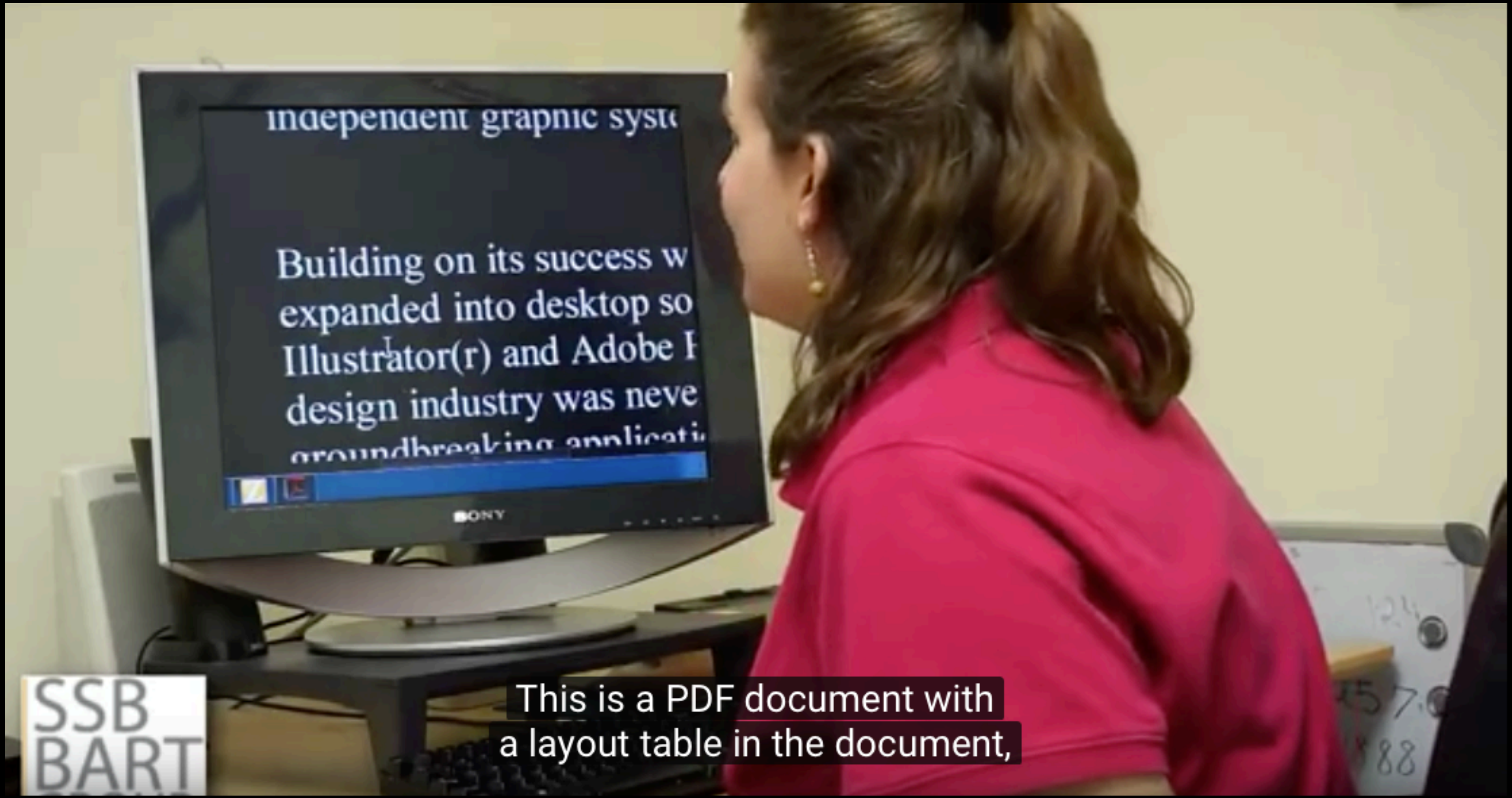
Common challenges

- Seeing fine details
- Differentiating colors or patterns
- Visual comparisons (when zoomed in)
- Peripheral vision and group awareness
- Increased sensitivity to environmental effects: glare, brightness, darkness

Using technology

- Often prefer vision over screen reader (why?)
- Typically use **magnification**
  - … and sometimes high-contrast mode
  - Even when screen readers could be more efficient
- May involve use of a magnifying lens, or placing face close to the screen
- Need support both for computer screens and other documents (paper documents, projection screens, etc.)

Magnification example



What is it like using a magnifier?

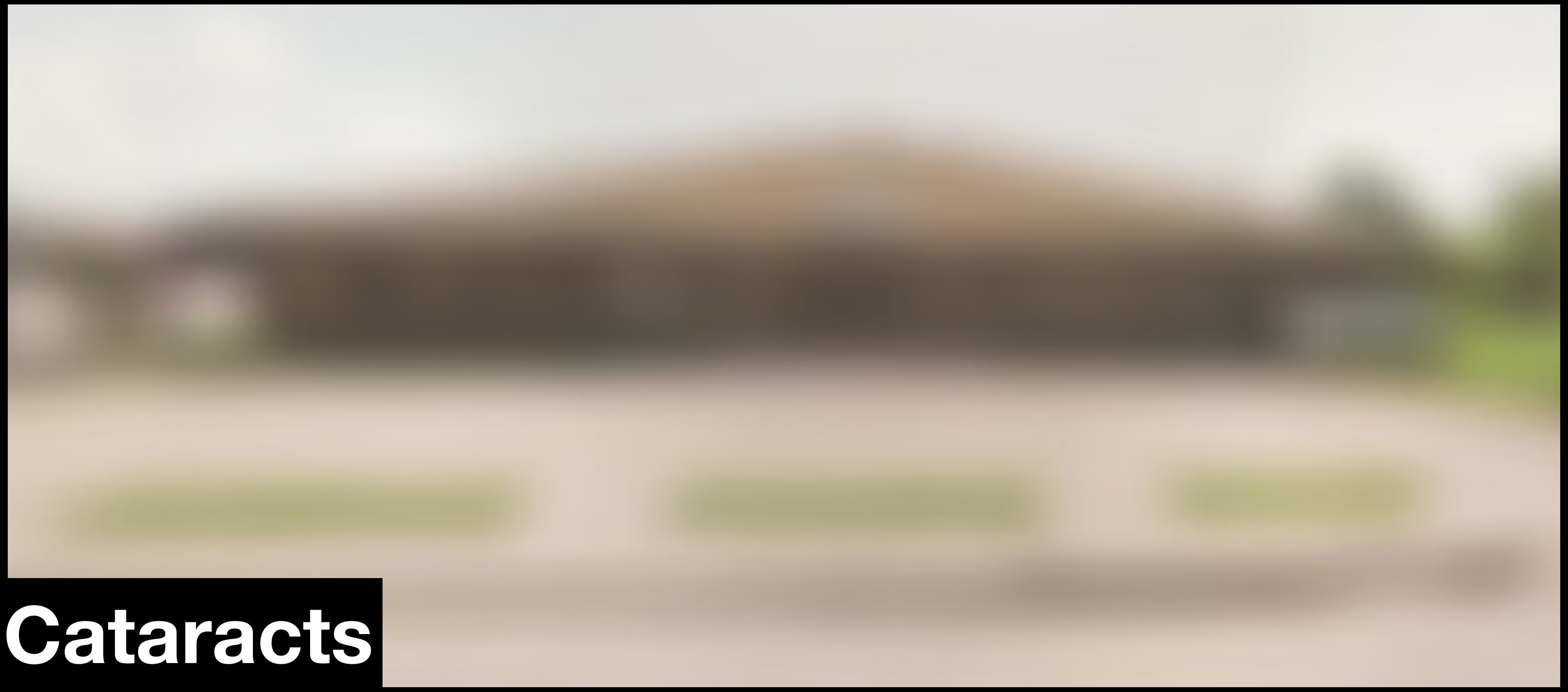
- Subtle visual details can be blown out
- Very little information on the screen at one time
- Requires lots of scrolling

Magnification or screen reader?

- Learning to use a screen reader is difficult
- People will often hold onto their visual reading ability, even when performance is worse
- Magnification is often personalized: magnification level, colors

Presentations of low vision


Normal vision


Cataracts


Retinopathy


Glaucoma

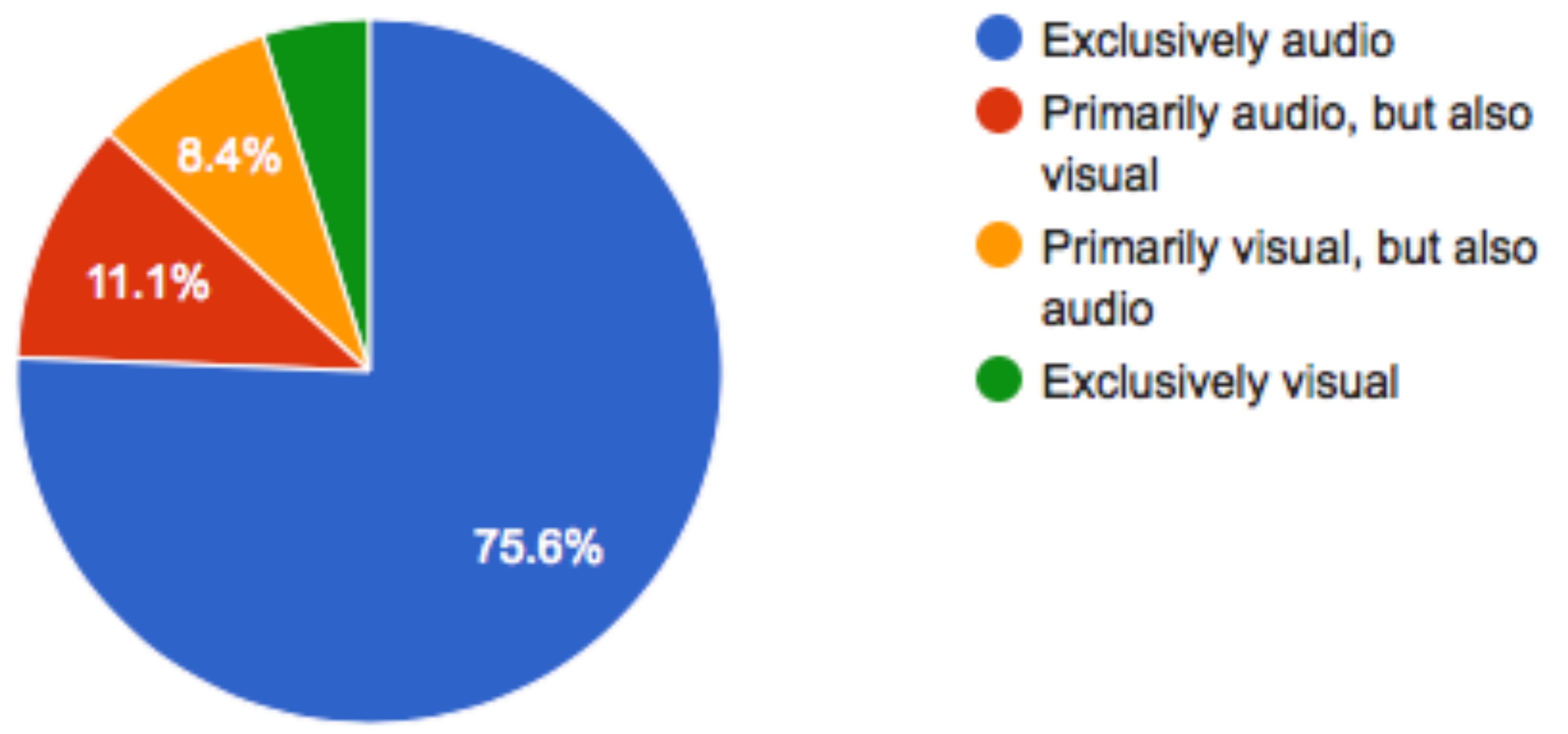
Other ways low vision users are different

- Many potential manifestations: blurry vision, limited field of view, etc.
- Can be progressive (e.g. Usher Syndrome)
- Comorbid conditions: deafness (deafblind), cognitive, motor, aging
- May not have blindness training skills (Braille, white cane, screen readers)

Functional effects

- Limited field of view
- Occluded areas
- Blurriness
- Lack of contrast
- Limited near or far vision

Screen Reader Usage



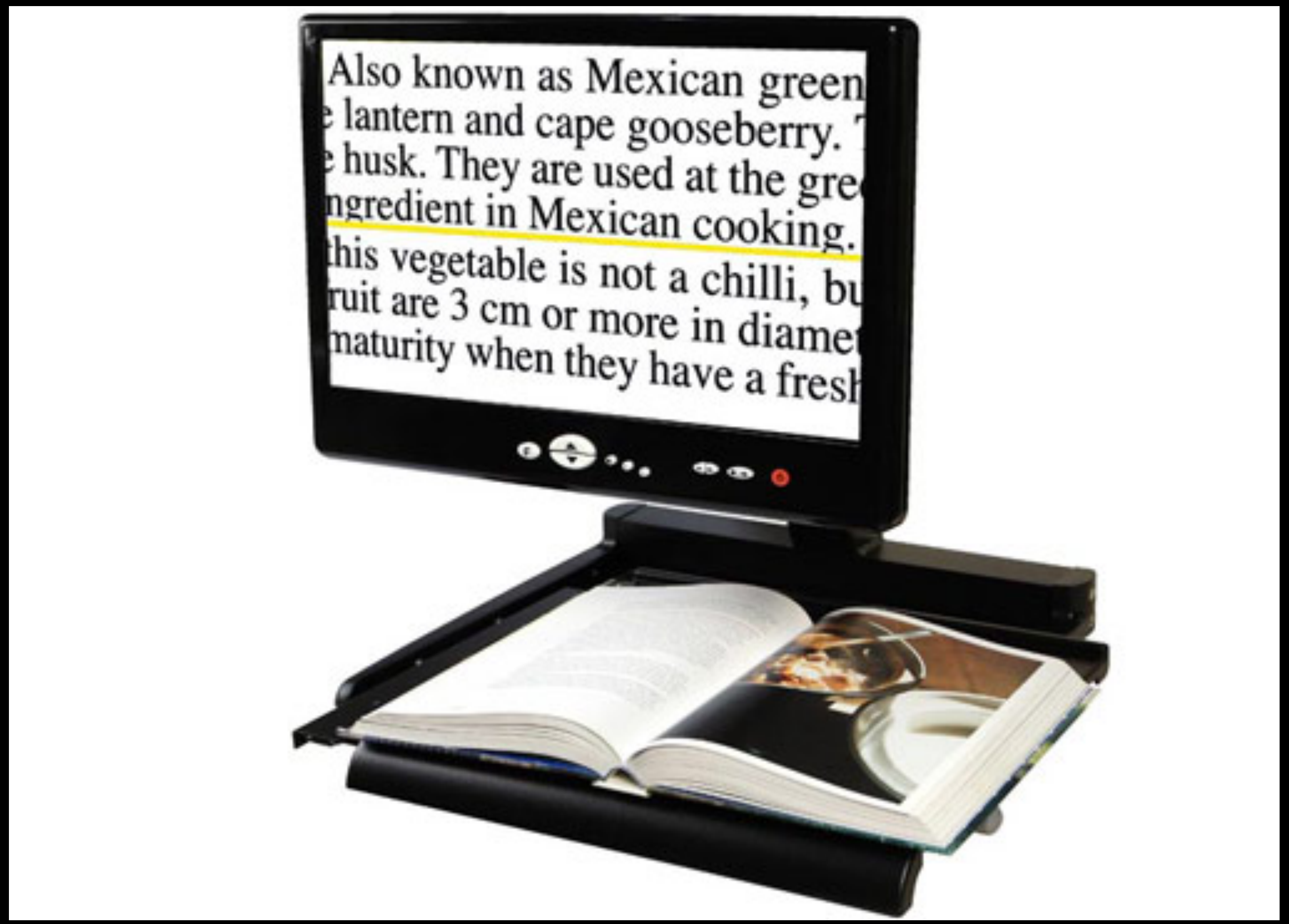
Which of the following most accurately describes your screen reader usage?

Response	# of Respondents	% of Respondents
I exclusively rely on screen reader audio	1,311	75.6%
I primarily rely on screen reader audio, but also use visual content	193	11.1%
I primarily rely on visual content, but also use screen reader audio	145	8.4%
I exclusively rely on visual content	85	4.9%

(Some) technologies used

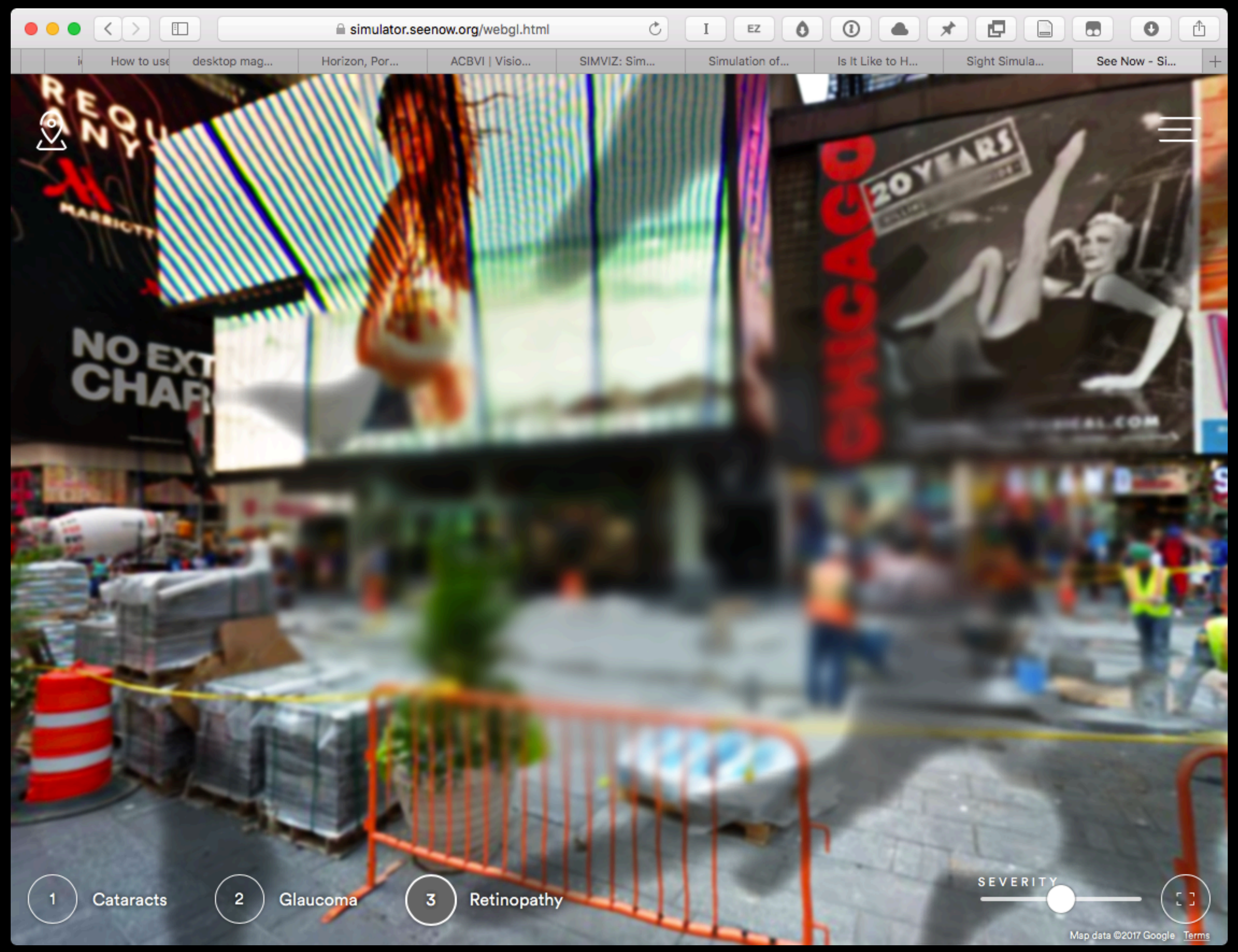
Low tech:
magnifiers,
scope

High tech:
desktop
magnifier, phone



Simulating low vision

- On the desktop: SeeNow
- Google Cardboard: SimViz
- … but individual experiences may be very different



Limitations of simulation

- ‘New research findings from the University of Colorado indicate that blindness simulations – intended to be bridge-builders resulting in greater compassion and understanding – can sometimes harm rather than help. According to the authors, simulation activities, and blindness simulations in particular, "highlight the initial challenges of becoming disabled" and thus "decrease the perceived adaptability of being disabled and reduce the judged capabilities of disabled people."’

How to handle low vision on the web

- Offer font size buttons
- Offer a high-contrast or large print stylesheet
- Users may adopt their own custom stylesheet

Research challenges

- Low vision AT often underexplored in research (why?)
- Partial vision can even be a deterrent to participating in research
- **Big challenges:** Better magnification, better UI support for magnification, help with finding stuff

Other visual challenges

User groups to consider

- Older adults
- Color blindness
- Deafblindness

Older users on the web (65+)

- As of 2012, about 19 million older Americans on the web

- Aging can affect vision, motor control, memory, and more

% users who encountered problems	21-55	65+
Vision	5%	18%
Dexterity	5%	27%
Memory	37%	51%

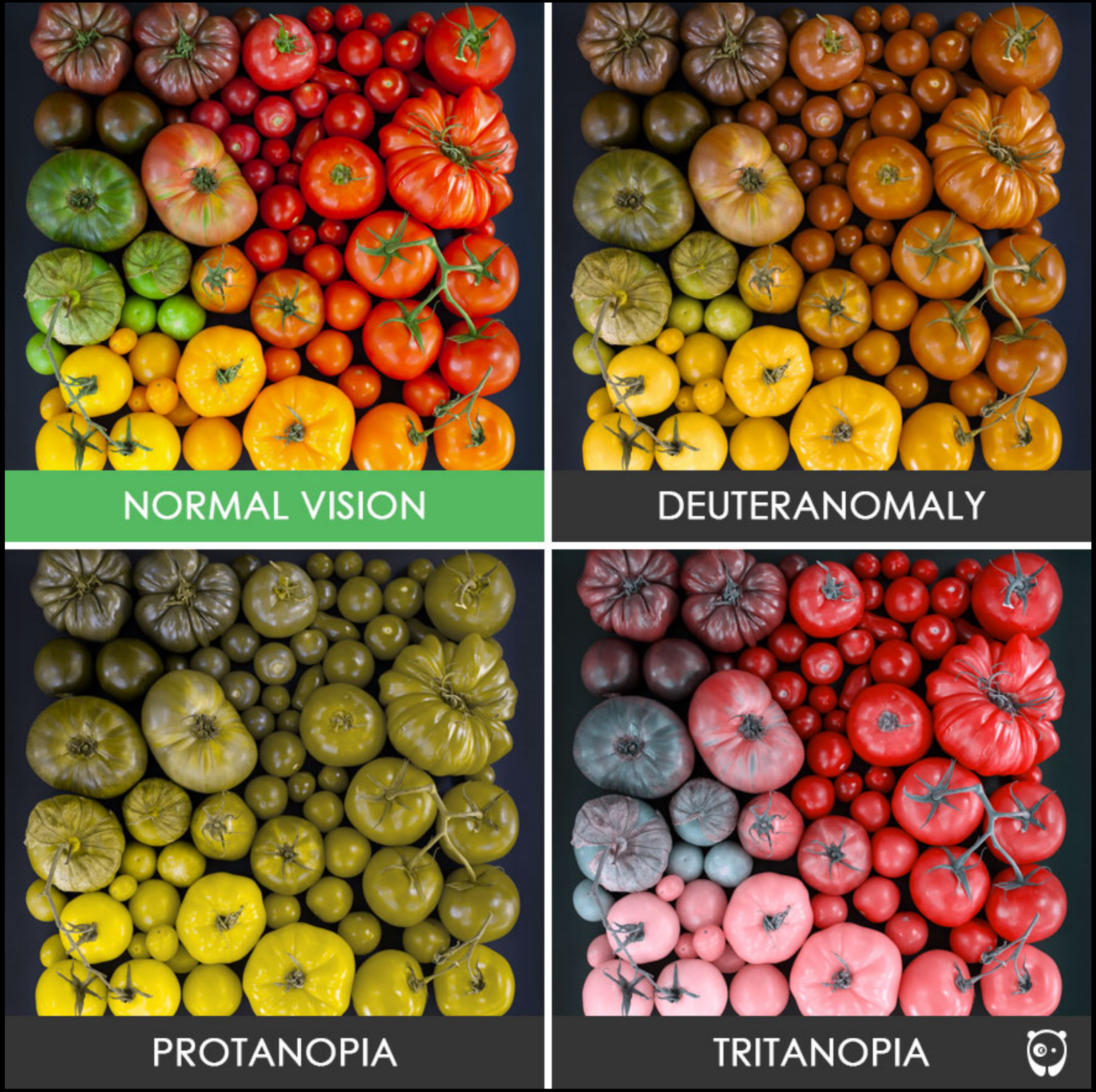
Visual design for older adults

- Design with high visual contrast
- Allow users to change text size without breaking anything
- AARP recommends providing on-screen controls for changing text size (why?)

Color blindness

- Affects about 10% of men; fewer women
- **Difficulty distinguishing colors** is the primary functional challenge
- Several “types” of color blindness, but individual differences remain


NORMAL VISION
DEUTERANOMALY
PROTANOPIA
TRITANOPIA


NORMAL VISION
DEUTERANOMALY
PROTANOPIA
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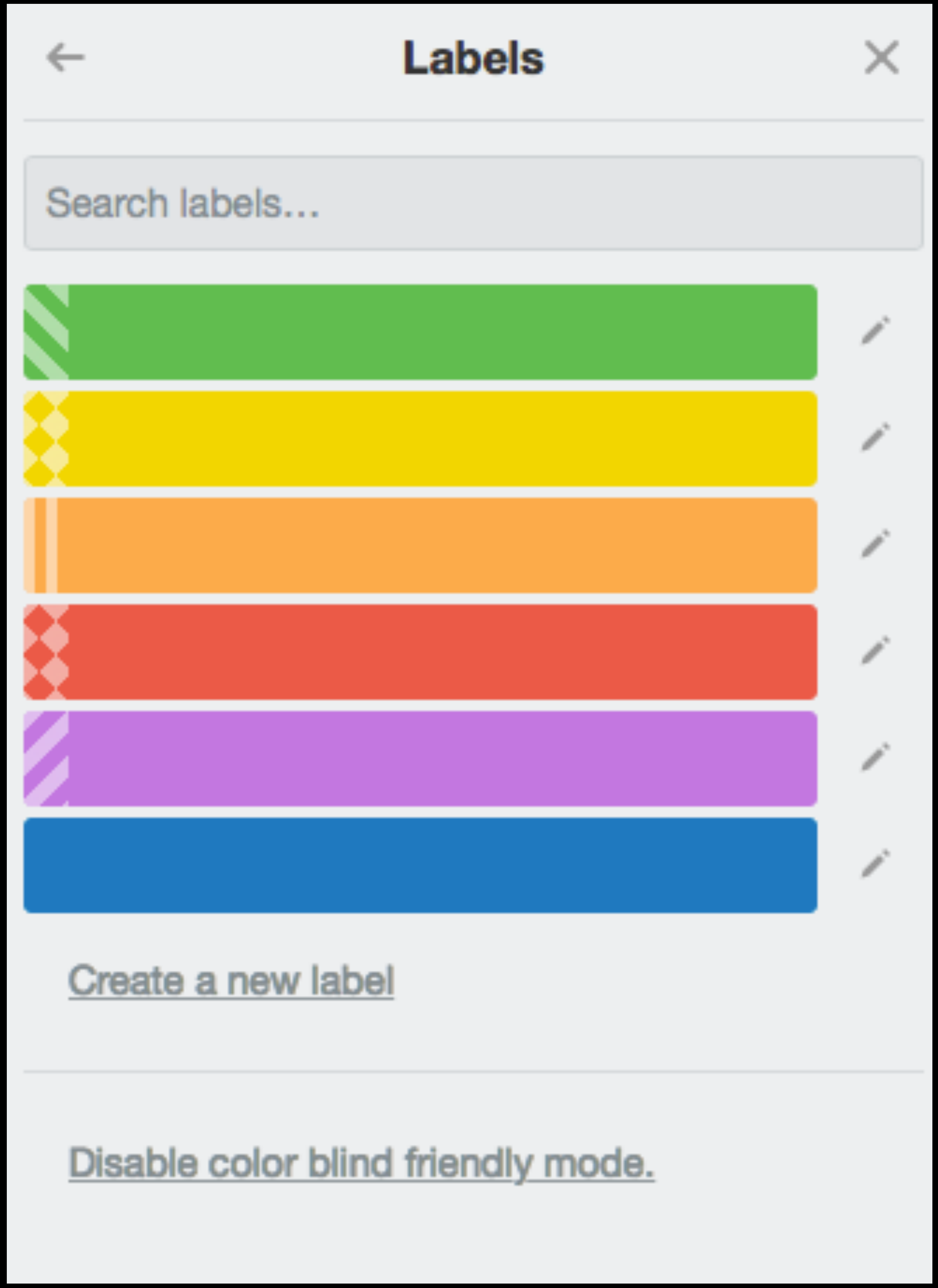
Designing for color blindness

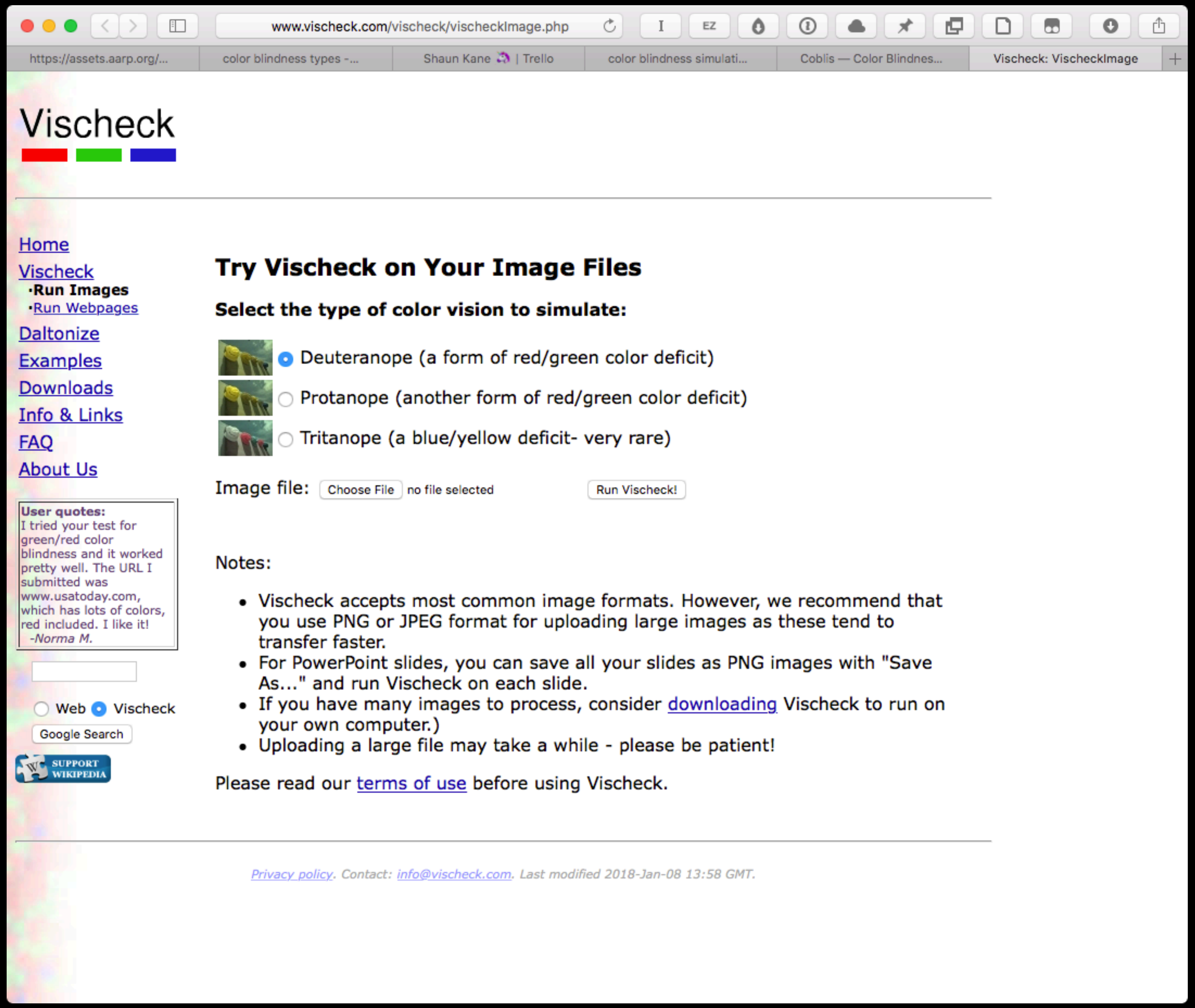
- Don’t use color alone to distinguish items
- Instead, combine with shape, texture, or some other factor
- Avoid a special color blind friendly mode; make it work out of the box



Universal design for color deficiency

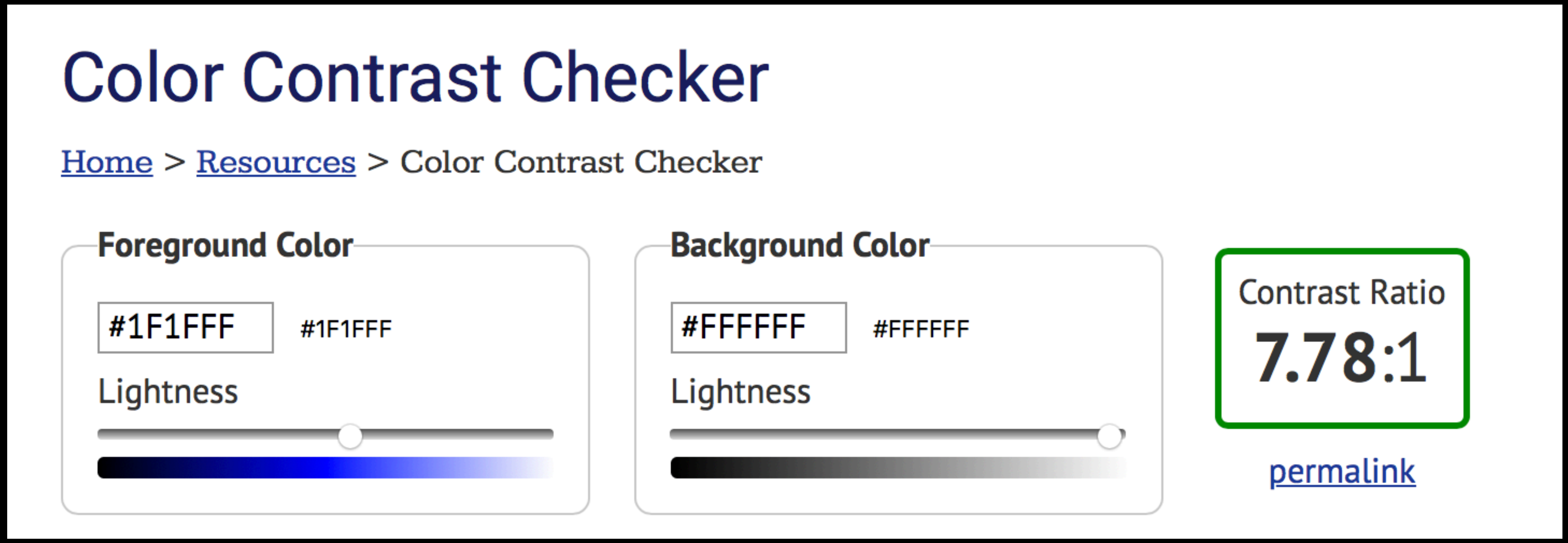
Simulating color blindness

- Web tools (e.g. vischeck.com)
- Accessibility testing tools built into Photoshop, Sketch
- Greyscale mode on Mac, iOS
- SimViz on Google Cardboard
- Or print it out



Using contrast

- WCAG requires 4.5:1 contrast ratio for text and background
- Some tools exist, e.g. [WebAIM contrast checker]



Wednesday

Today

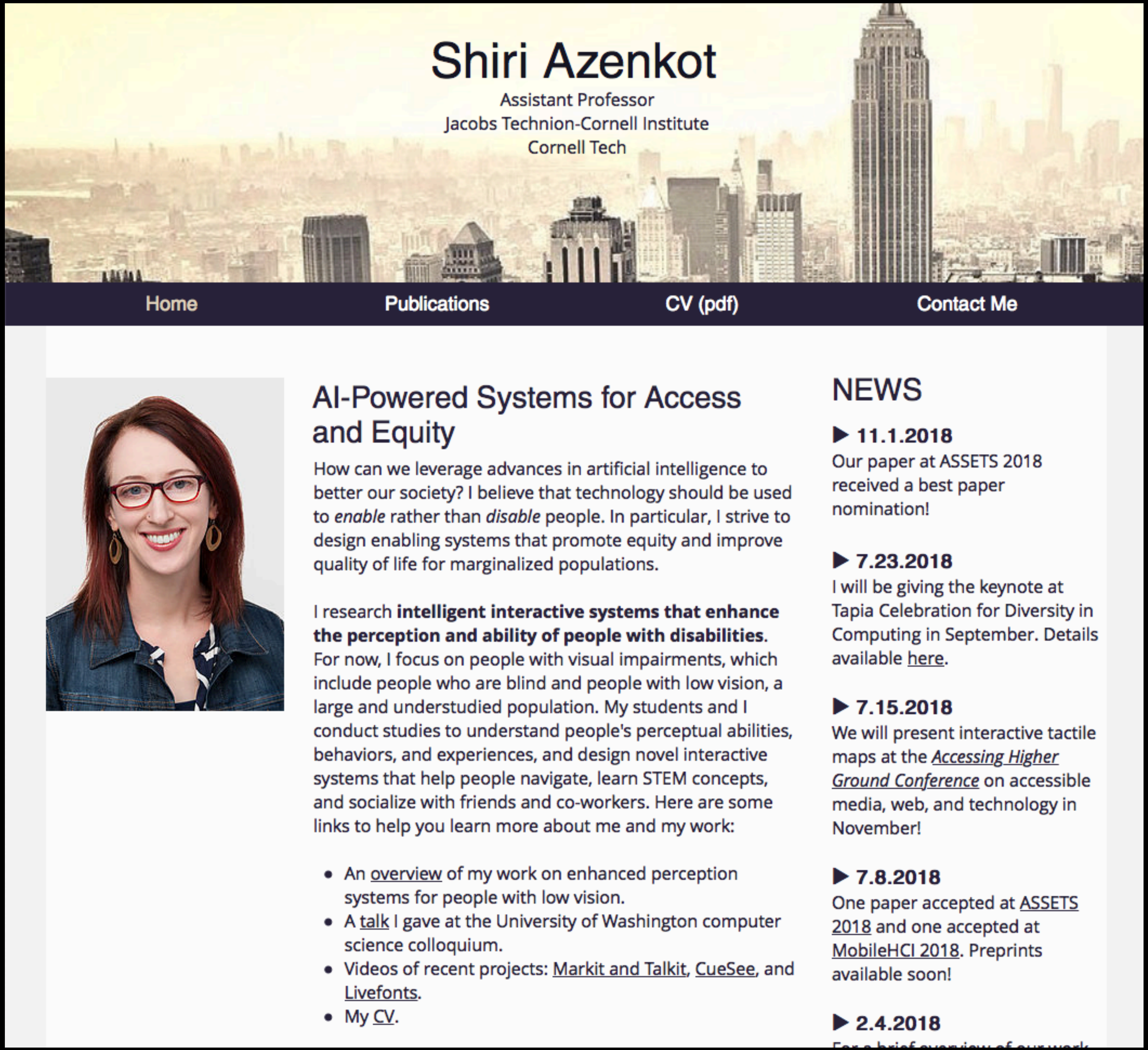
- Some interesting research
- Deafblindness technology
- Project time

Low vision tech

- ForeSee
- CueSee

Shiri Azenkot

- Faculty @ Cornell Tech
- Working on AR/VR tools for low vision



ForeSee

- Using AR to act like a magnifier for the real world environment
- Paper
- Demo video


Oculus

CueSee

- Extend concept of ForeSee to help with a new task: locating objects
- Explores methods for
- Paper
- Demo video

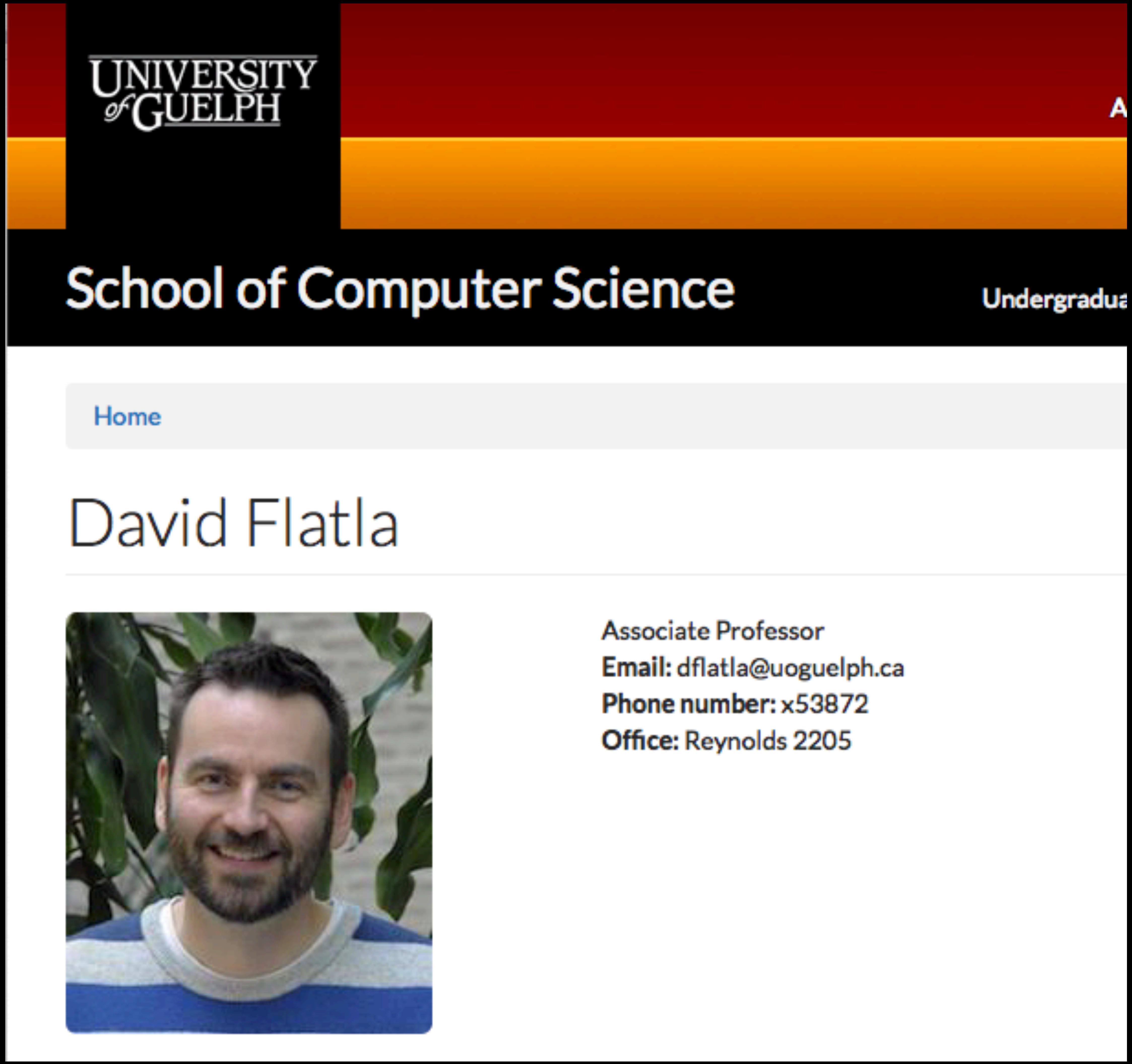

NUTRI GRAIN
NUTRI GRAIN

Color blindness research

- Modeling color vision deficiencies
- AR for color vision

David Flatla

- University of Guelph 🇨🇦
- Is color blind & researches color blindness



“So That’s What You See!” Building Understanding with Personalized Simulations of Colour Vision Deficiency

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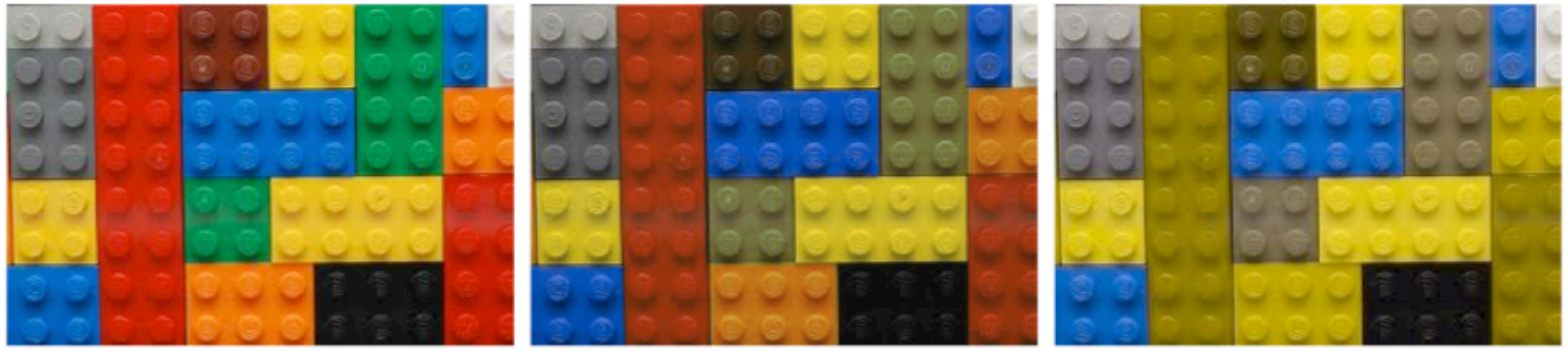


Figure 1. Difference between generic simulation of CVD and personalized simulation. Left: original image; middle: personalized simulation for one of our study participants; right: generic dichromatic deuteranopic simulation (www.vischeck.com).

ABSTRACT

Colour vision deficiencies (CVD) affect the everyday lives of a large number of people, but it is difficult for others – even friends and family members – to understand the experience of having CVD. Simulation tools can help provide this experience; however, current simulations are based on general models that have several limitations, and therefore cannot accurately reflect the perceptual capabilities of most individuals with reduced colour vision. To address this problem, we have developed a new simulation approach that is based on a specific empirical model of the actual colour perception abilities of a person with CVD. The resulting simulation is therefore a more exact representation of what a particular person with CVD actually sees. We tested the new approach in two ways. First, we compared its accuracy with that of the existing models, and found that the personalized simulations were significantly more accurate than the old method. Second, we asked pairs of participants (one with CVD, and one close friend or family member without CVD) to discuss images of everyday scenes that had been simulated with the CVD person’s particular model. We found that the personalized simulations

percent of men have reduced sensitivity to the red-green colour axis), or can be acquired through factors such as age (e.g., cataracts or yellowing of the lens), exposure to chemicals (e.g., solvents such as styrene), or brain injury (e.g., stroke or trauma).

Colour vision deficiencies cause many different problems, ranging from minor annoyances (e.g., being unable to differentiate between visited and unvisited website links) to difficulties that compromise safety (e.g., when alert messages do not stand out from the background). Although CVD has many implications for professional activities, our focus in this paper is on the profound effects that it has on everyday life. Some of these effects are well known, such as the stereotype of a man with red-green CVD who can’t match the colour of his socks, but there are many other commonplace activities where reduced colour perception dramatically changes experience and ability. For example, a person with CVD may have difficulty buying or picking fruit (since we use colour to judge ripeness), cooking meat (since the difference between ‘rare’ and ‘well done’ is primarily a colour difference), communicating with others about things in the world (“Quick – hand me the green one!”), and sharing the aesthetic

Impacts of color blindness

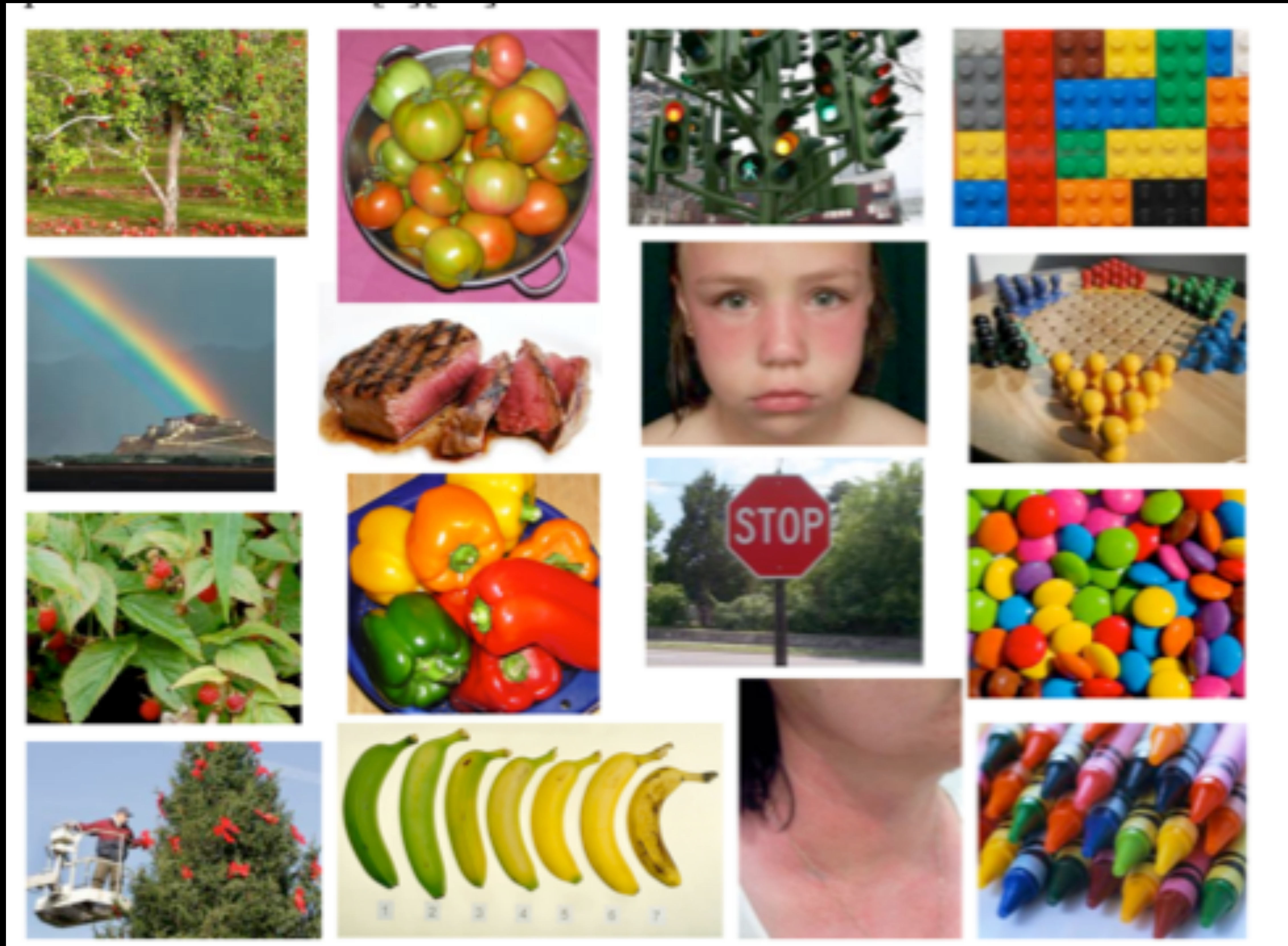
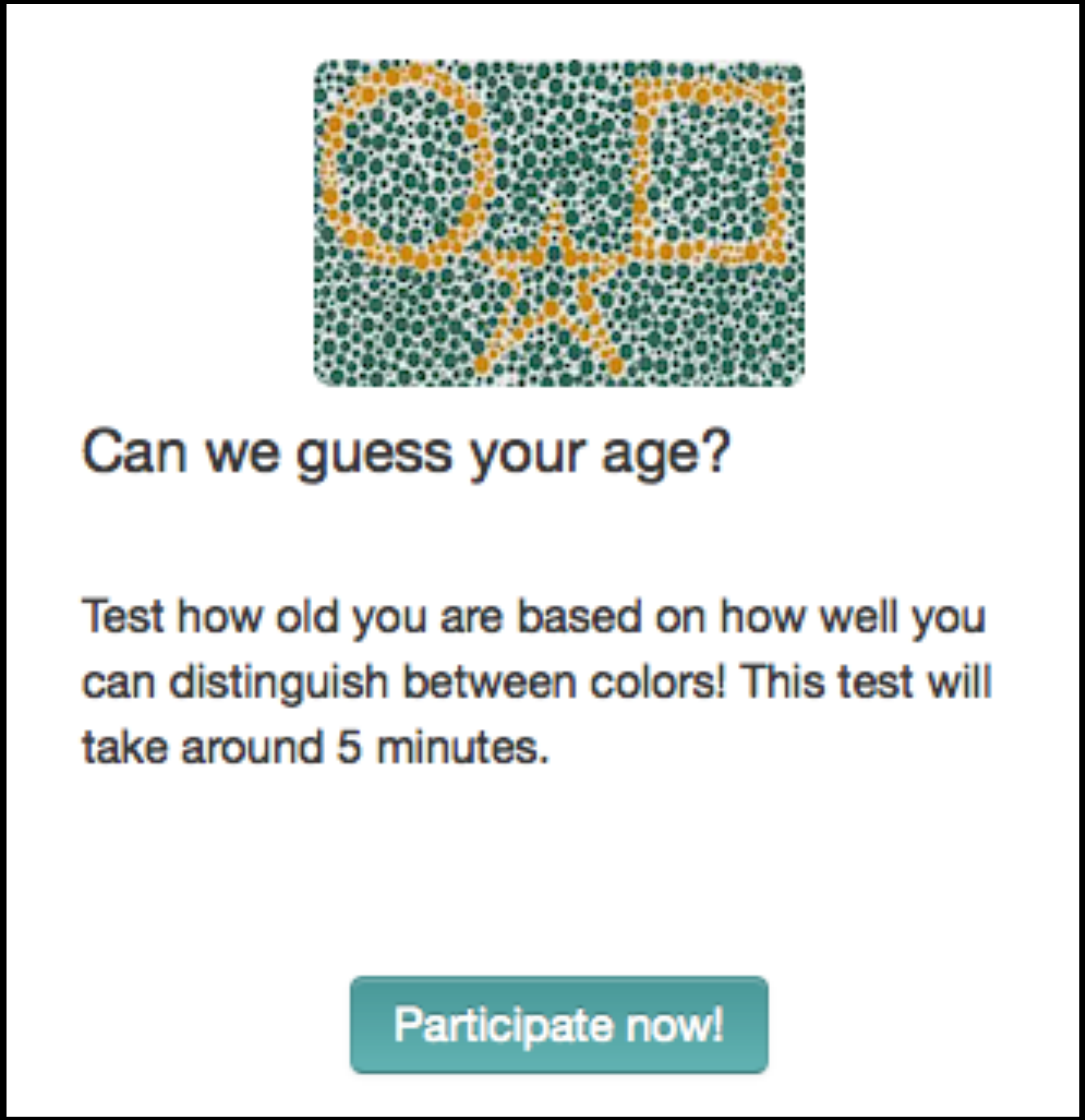
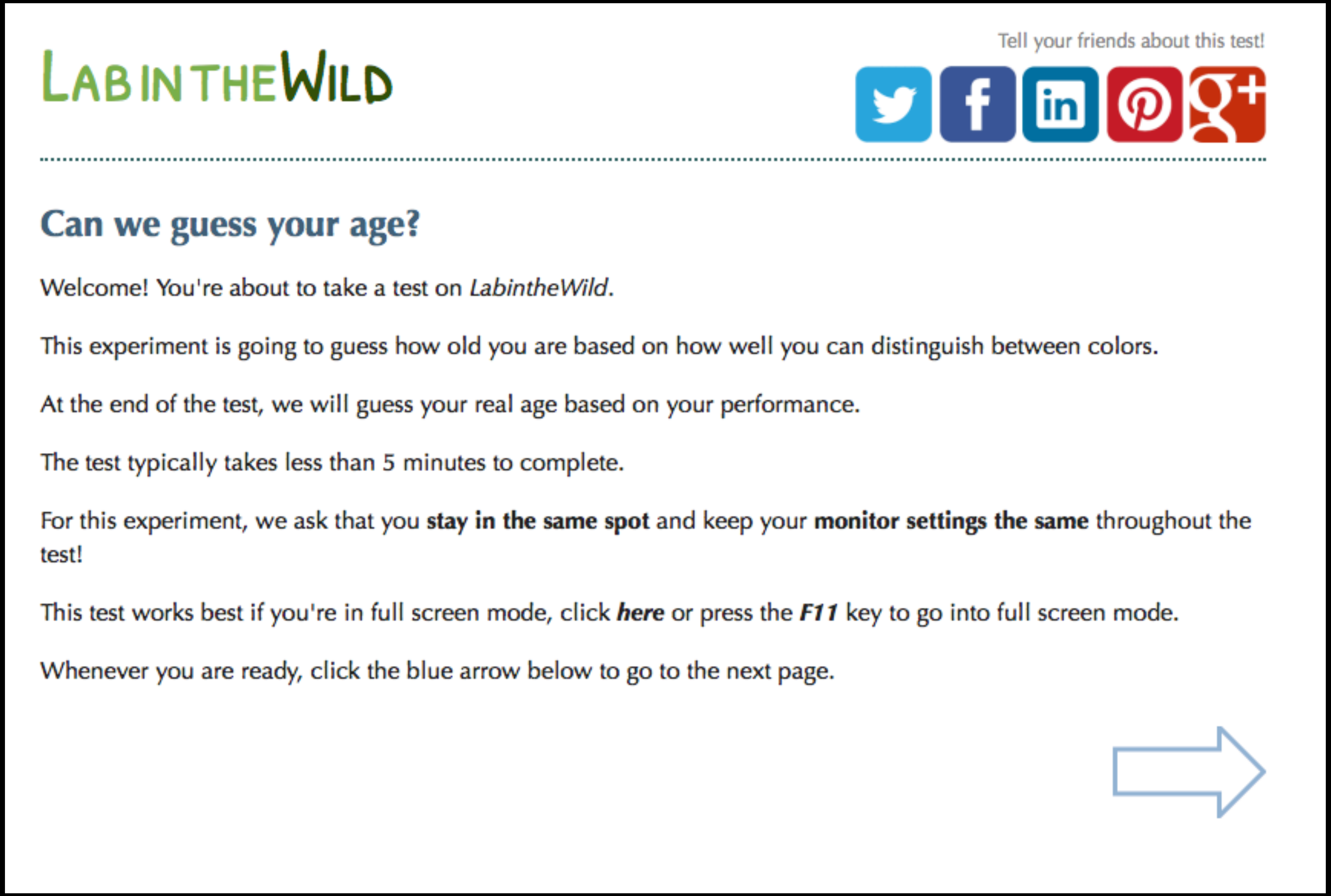


Figure 8. Images used in the exploration phase of the study.

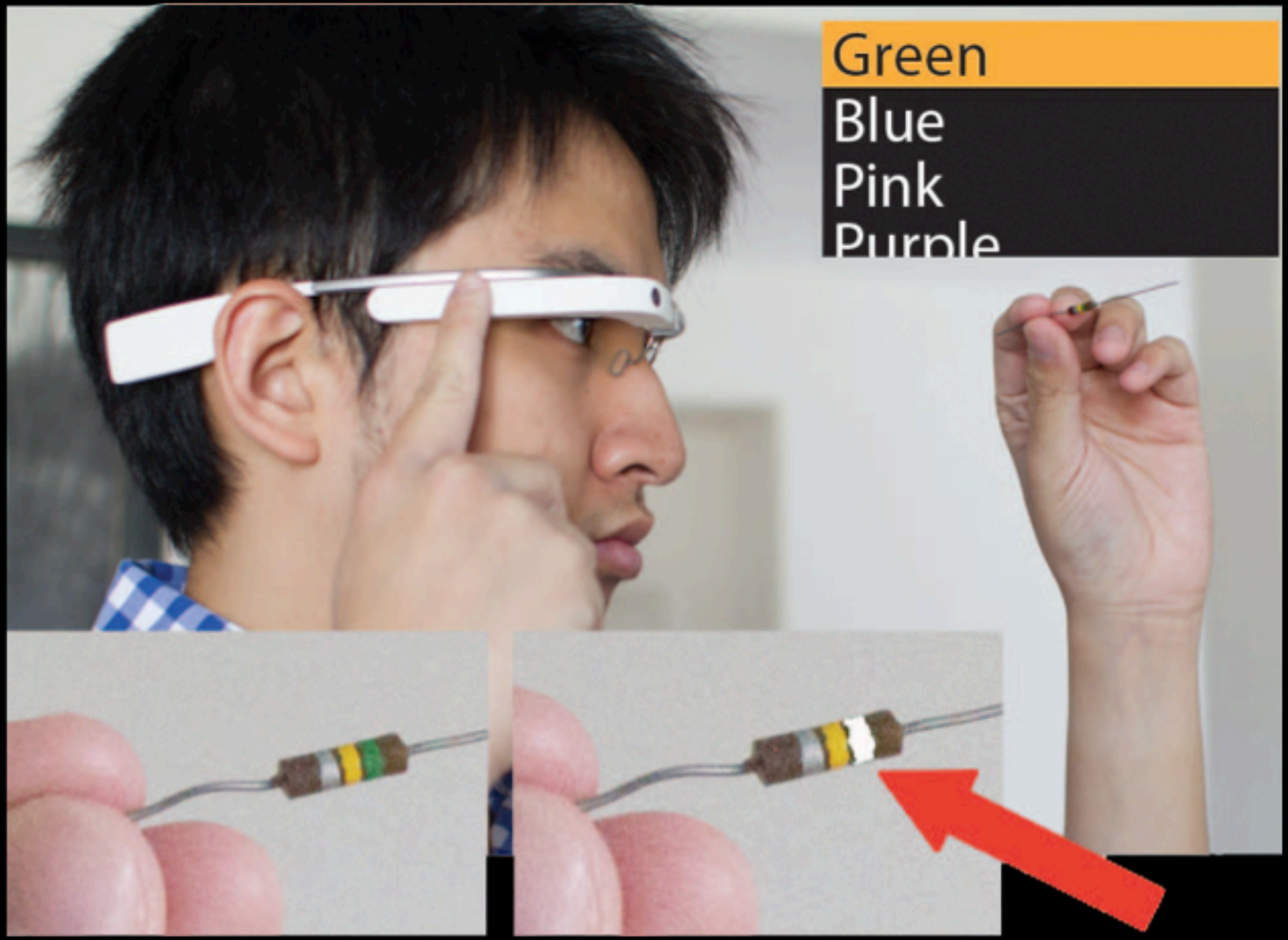
Collecting data about color vision





Chroma: AR for color blindness

- Overlays information about color in the environment
- Multiple modes depending on the task



1. Highlighting mode
2. Contrast mode
3. Daltonization
4. Daltonization with outlining

Some interesting blind AT systems

- Sensory substitution
- Braille input

The vOICe

- Vision to sound with AR glasses
- Sound maps to visual characteristics

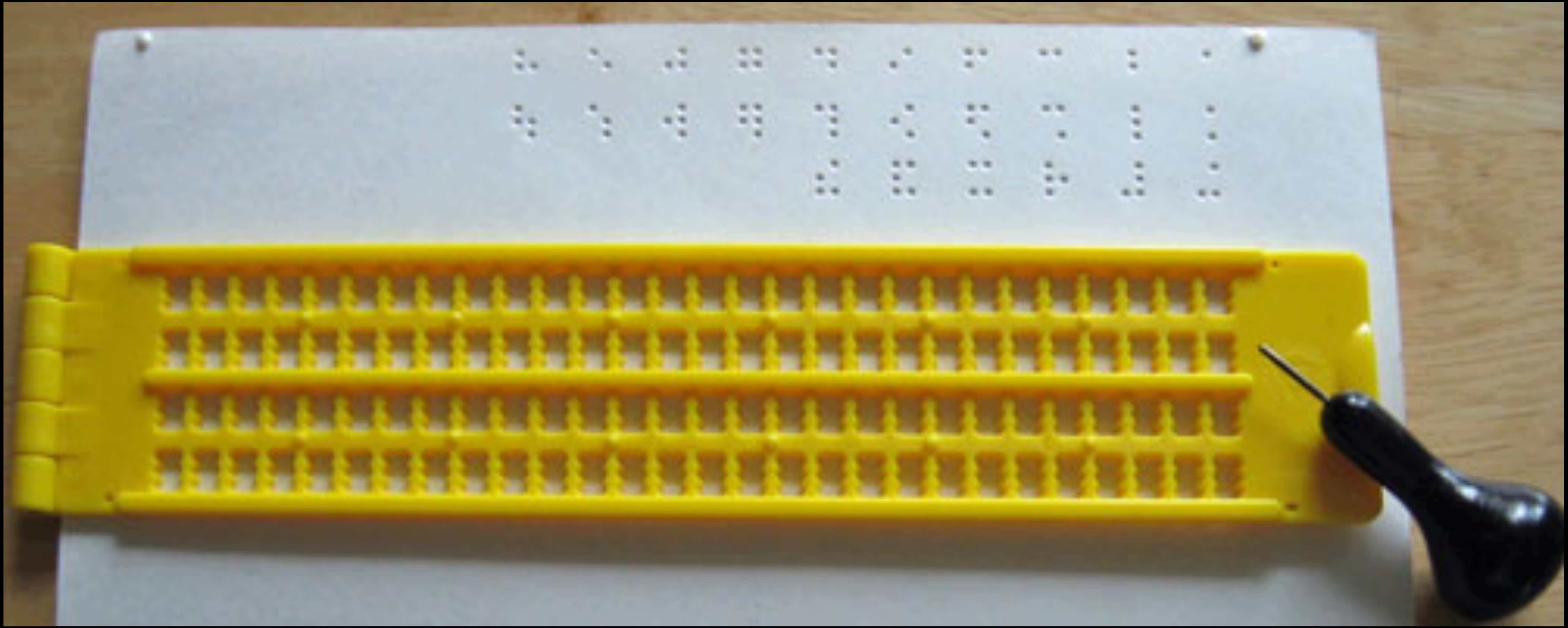
Brainport

- Camera connects to electrodes placed in a grid on the tongue
- 20x20 grid

Braille input?

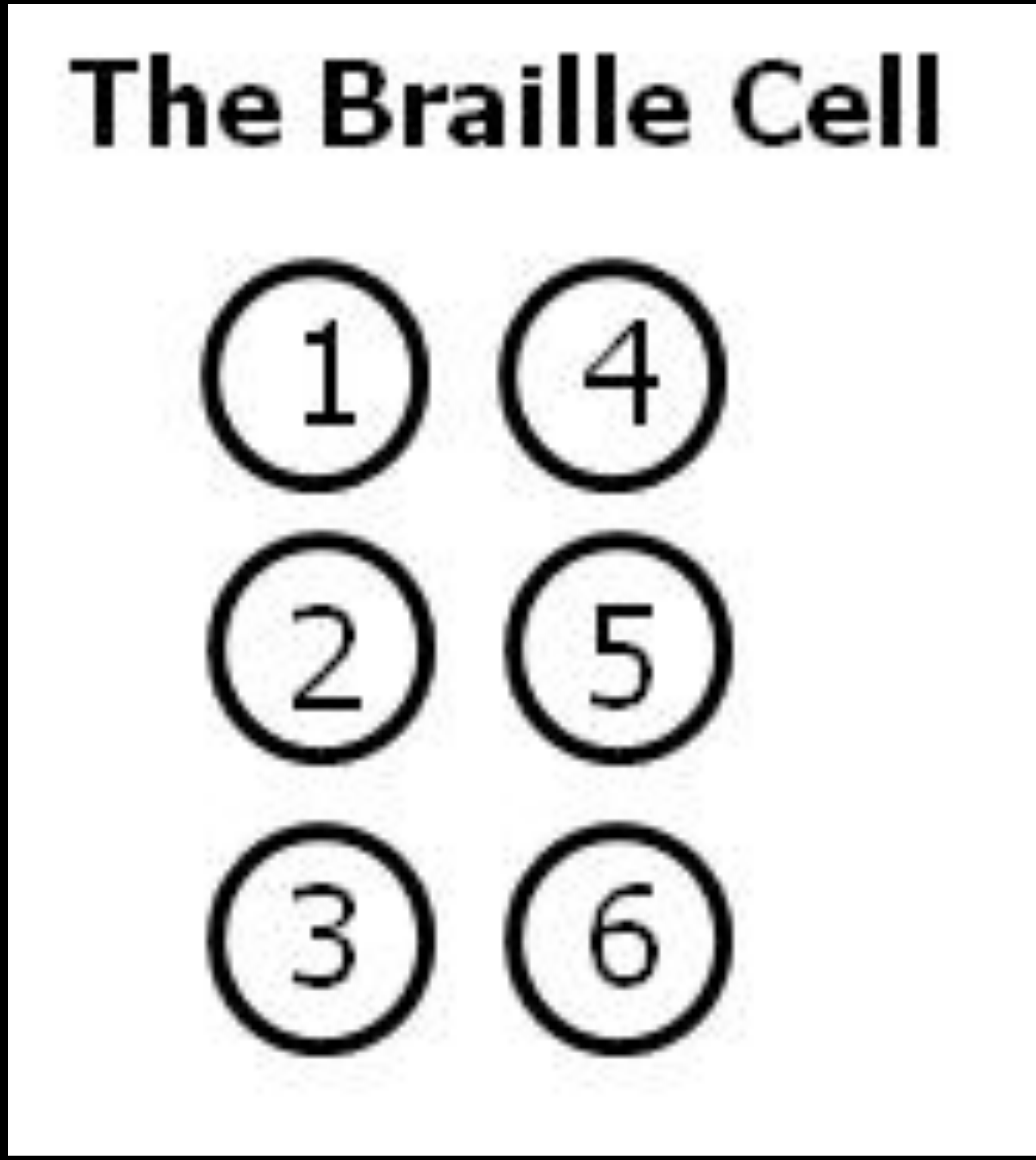
- On paper
- On the computer

Slate and stylus



Blind sketching

Braille computer input



Deafblindness

Deafblindness

- Combine some vision loss with some hearing loss
- Between 70,000 and 100,00 in the US
- About 50% have a condition called Usher Syndrome
  - Born deaf, lose vision over time
    (especially peripheral vision)
- May grow up speaking sign languages like ASL; may learn tactile sign language and Braille
- Typically use Braille for computer access

Communicating while deaf-blind

- What do you do??
- Let’s brainstorm some solutions

Deafblind communication methods

Protactile signing

- Adaptation of ASL onto the body

TeleTouch (1950s)

- Physical typewriter mechanically connected to a Braille cell

DeafBlind Communicator (2009)

- One device for the sighted partner to type on, connected to a portable Braille terminal
- Interesting in part because it’s a 2 device solution

The Deafblind Communicator

Up next

- Continue on Project 1
- Next week: Speech UIs

Situational vision impairments

- What are some situations that could affect visual acuity for everyone?

Some impairing situations

- Bright lights (e.g. sun)
- Dark rooms
- Interacting at a distance
- Reduced visual attention may have similar effects (e.g. using tech while driving)

Takeaways

- Many different forms of vision impairment
- So, take a functional approach
- Give users control over presentation
- Use color and contrast wisely
- Consider opportunities to make the outside world more accessible too

Further reading

- W3C guidelines for low vision