

# Accessibility

CIS 7000-001

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# Announcements

Quiz 4 is next Tuesday. It covers everything from content creation up through accessibility (today's lecture).

# Last time

HCI's interdisciplinarity makes available many methodological orientations. Which to apply depends on your goal. To wit:

**Systems:** engineer a thing

**Experiments:** prove a causal thing

**Ethnography:** understand a thing

**Design:** craft a thing

**Computational social science:** analyze a thing

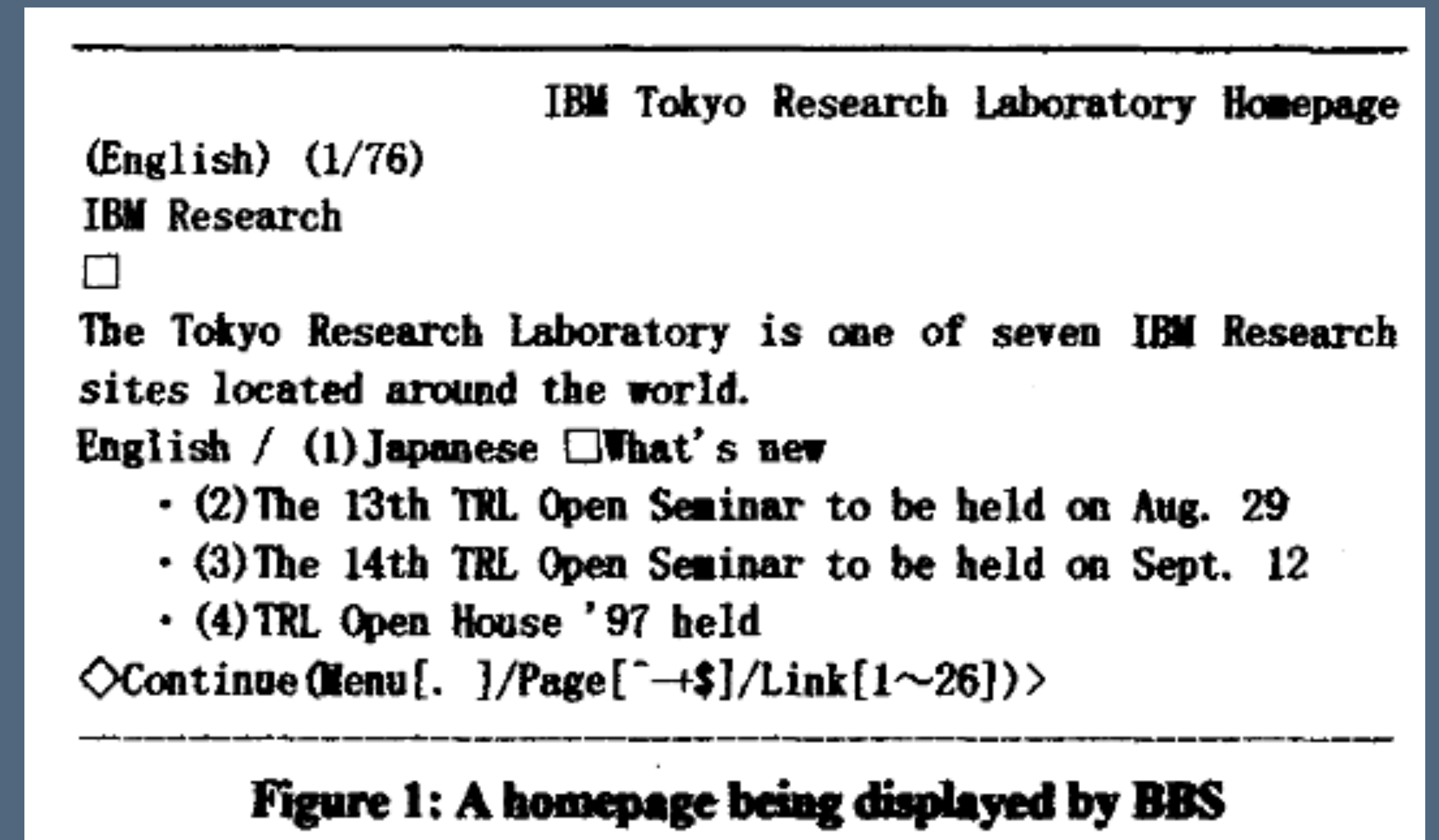
Design your evaluation by starting back at your thesis, mapping that thesis onto a claim, then deriving the evaluation from that claim

# Who gets left out of design?

**Example.** Asakawa and Itoh in 1998 noted challenges of blind web users.

They would use Lynx, where...

- they needed to know the keyboard commands
- hyperlinks were not easily recognizable
- they needed to do a lot of scrolling, as the screen cuts off at 80 columns and 24 lines



# Disability is not uncommon

19% of the US population experiences some form of **disability**

[US Census Bureau 2012, via Jeff Bigham]

Research targets one or more of many groups: [Jenny Lay-Flurrie]

Visual: colorblind, low vision, blind

Hearing: loss, deaf

Cognitive: dyslexia, seizure, learning disabilities, autism

Speech: speech impediment, unable to speak

Mobility: arthritis, quadriplegia

Neural: bipolar, anxiety, PTSD, depression

# Motivating question

Are there general design approaches that could help us make technology that works better for everyone, including those with disabilities who are often forgotten or misrepresented in design?

# Today

Ability-based design

Supporting access beyond the screen and individual

Retrofitting accessibility to existing interfaces

# Ability-based design

# How disability is talked about

**Medical model** of disability: the diagnosis is in the individual's own body.

Implication: something is wrong with their body, and quality of life is reduced

**Social model** of disability: the diagnosis is with behaviors, attitudes, and barriers erected by society, not with the individual.

Physiological differences may produce variation, but it's only disability if society cannot make accommodations

# Universal design

General idea: make a single design accessible to everyone.

Example: curb cuts

Credits for these slides: Lloyd May, Stanford PhD, inclusive media technologies, email with questions about accessibility at [lloyd.may@monash.edu](mailto:lloyd.may@monash.edu)



# Inclusive design practices

Rather than supporting everyone, we focus on individual people who may be underserved, and tailor technology for them.

Pullin and Newell call this “focusing on extra-ordinary users” (2007). They focus on older adults.

Their concerns: universal products are difficult to design. “Accessible” technology is sometimes technically “accessible” but still not very usable.

Instead, **just make good products for different users.**

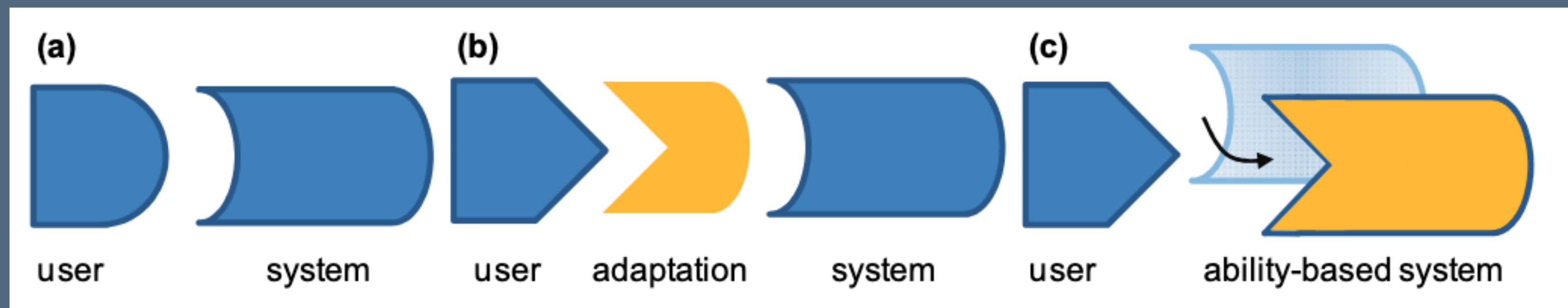
Bonus: sometimes the designs are useful beyond the group of extra-ordinary users you designed for (cassette recorders, Oxo knives).

# Ability-based design

[Wobbrock et al. 2011; Wobbrock et al. 2018]

A challenge to the community: **make affordances broadly accessible, but through the specific abilities** each user has.

Not exactly “universal” — no single solution. Advocates for **adapting designs** to user ability and circumstances.



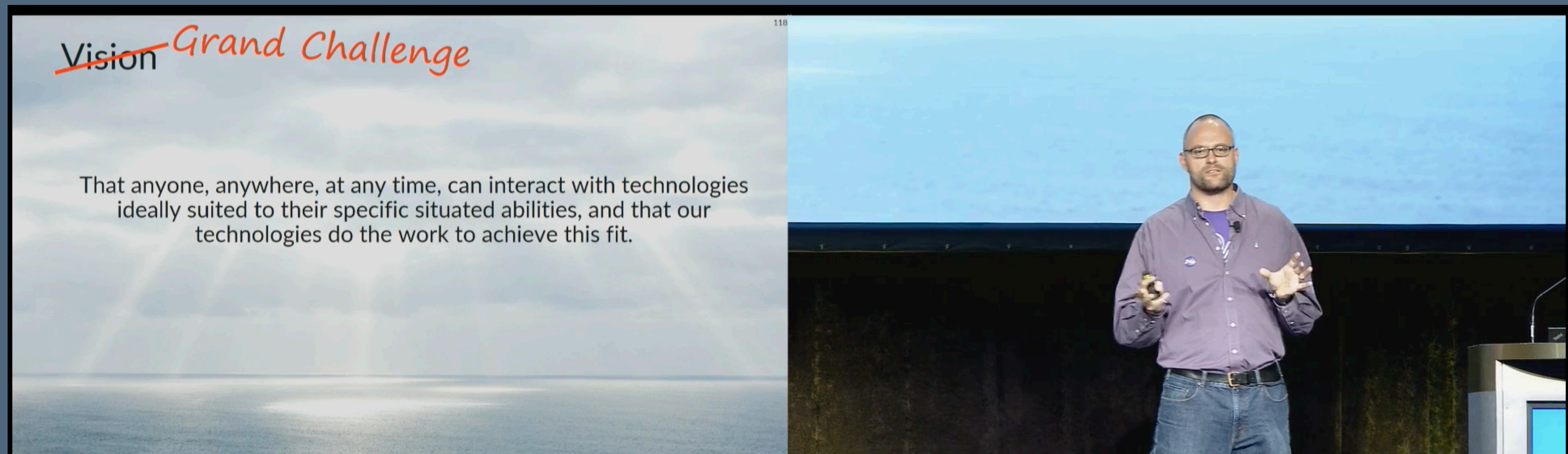
**Figure 2.** (a) A user whose abilities match those presumed by the system. (b) A user whose abilities do not match those presumed by the system. Because the system is inflexible, the user must be adapted to it. (c) An ability-based system is designed to accommodate the user’s abilities. It may adapt or be adapted to them. Our symbols are based on those from prior work (Edwards 1995).

# Ability-based design

[Wobbrock et al. 2011; Wobbrock et al. 2018]

Stop thinking about “dis”-ability, and think about ability-based interaction. “What can we do?”, not “What can’t we do?”

YOU READ THIS



# Where did this come from?

\* Andrew's conjecture

You got a flavor for this in examples shared in the ability-based design reading. Around that time, a lot of work was happening in new sensing techniques and new forms of pervasive technology.

My guess? It was becoming more possible to imagine the possibility of accepting more modalities in more contexts. More opportunities and need to capture varied abilities.

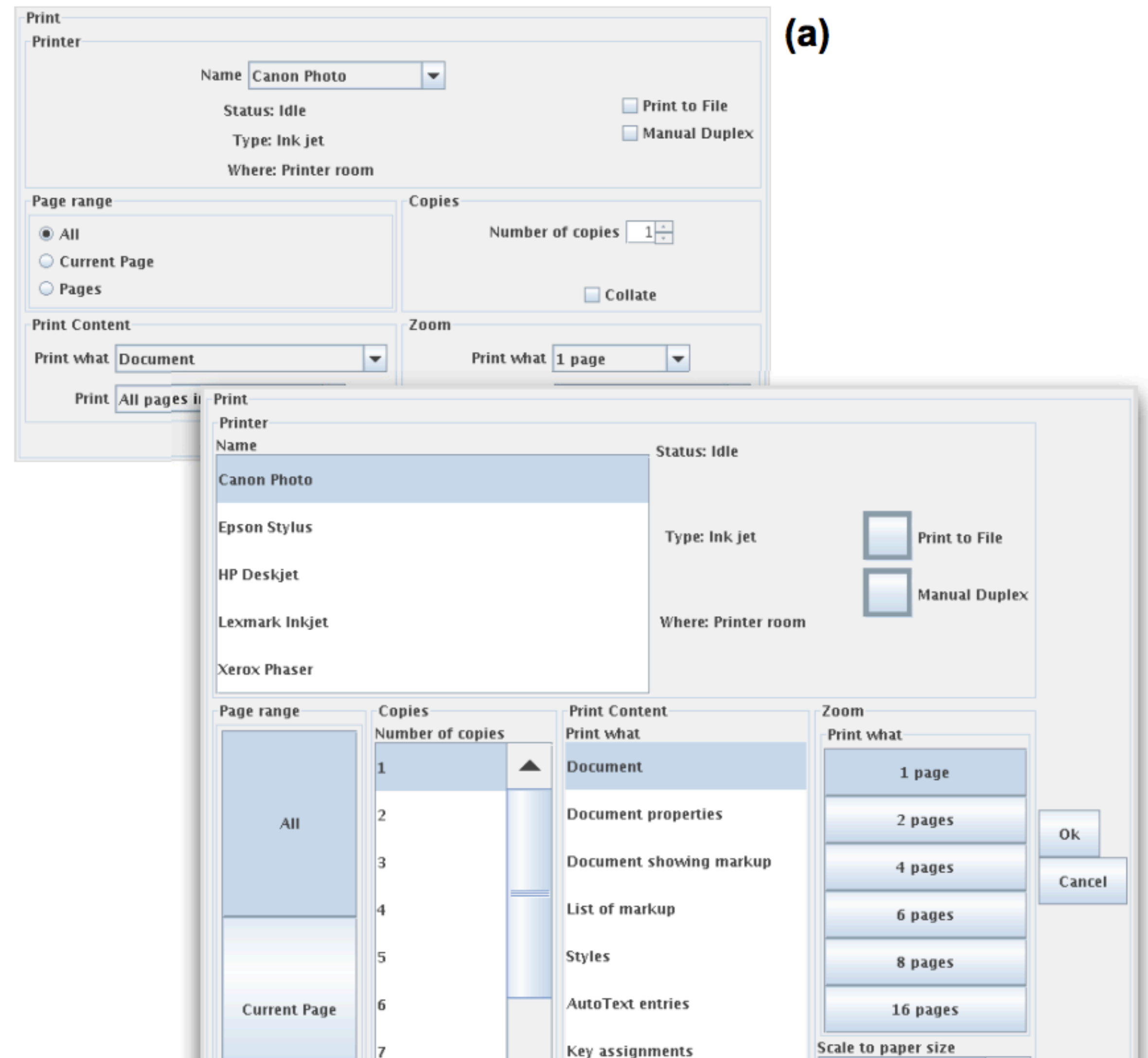
# Example: Rearrange the UI

SUPPLE - [Gajos et al. 2008]

What if you could rearrange an entire user interface based on a user's abilities?

Step one: model the user's motor abilities

Step two: customize the user interface to match those abilities

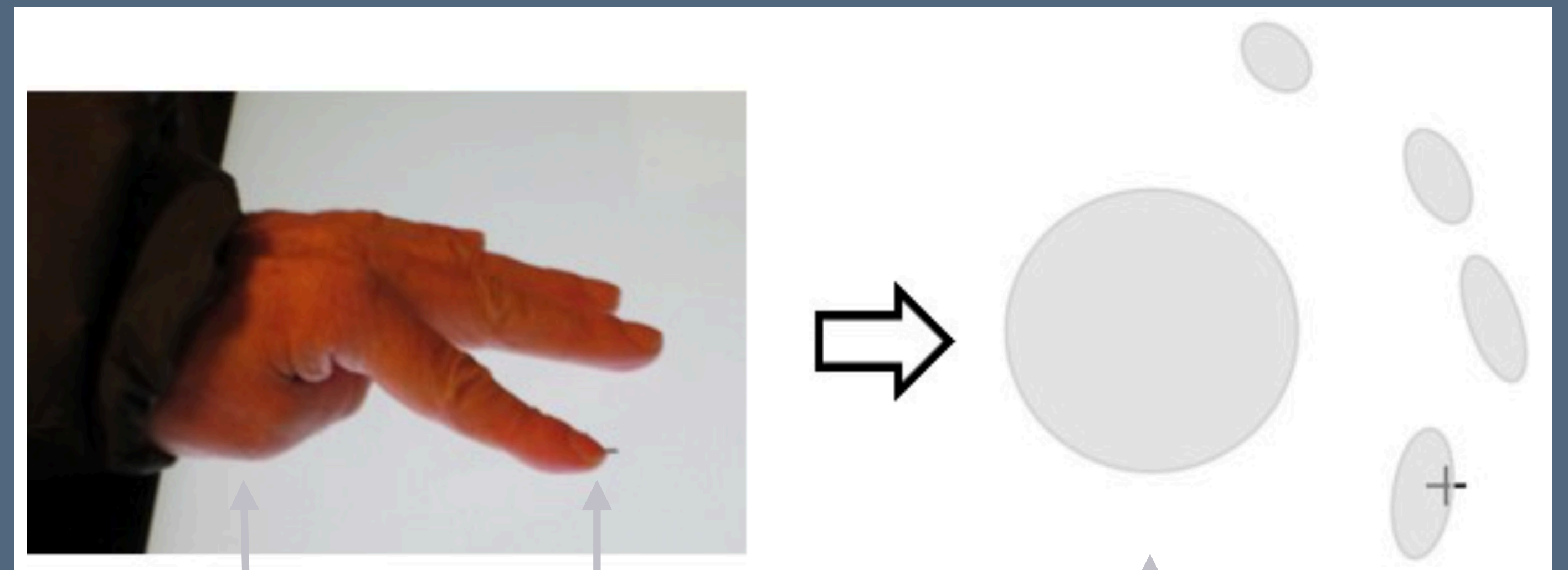


# Example: Tolerant decoding

Smart Touch - [Mott et al.'16]

Motor impairments cause touchscreens to register false touches

So: first capture multiple frames of the user's gesture, and find the most stable part with few new up/down points. Then, template match to previous gestures' selected points.



Intended touch point

Unintended touch points, confusing the recognizer

# Thinking in abilities

[Wobbrock et al. 2011; Wobbrock et al. 2018]

If you can, think about someone you are close to that has/had a disability. Think about an interaction that they don't have access to.

What are the abilities that they have that relate to that interaction?

How could that interaction be redesigned to support them?

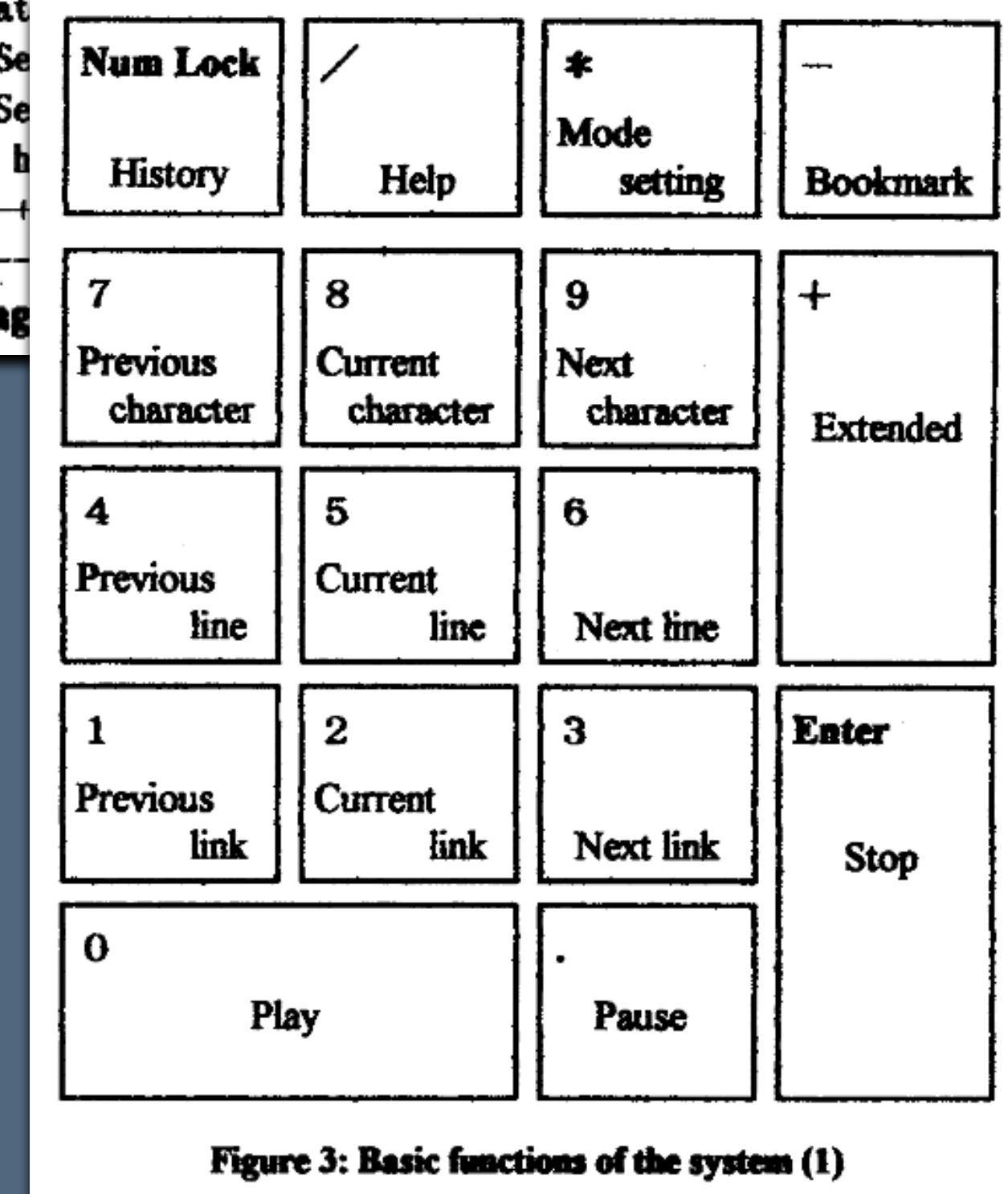
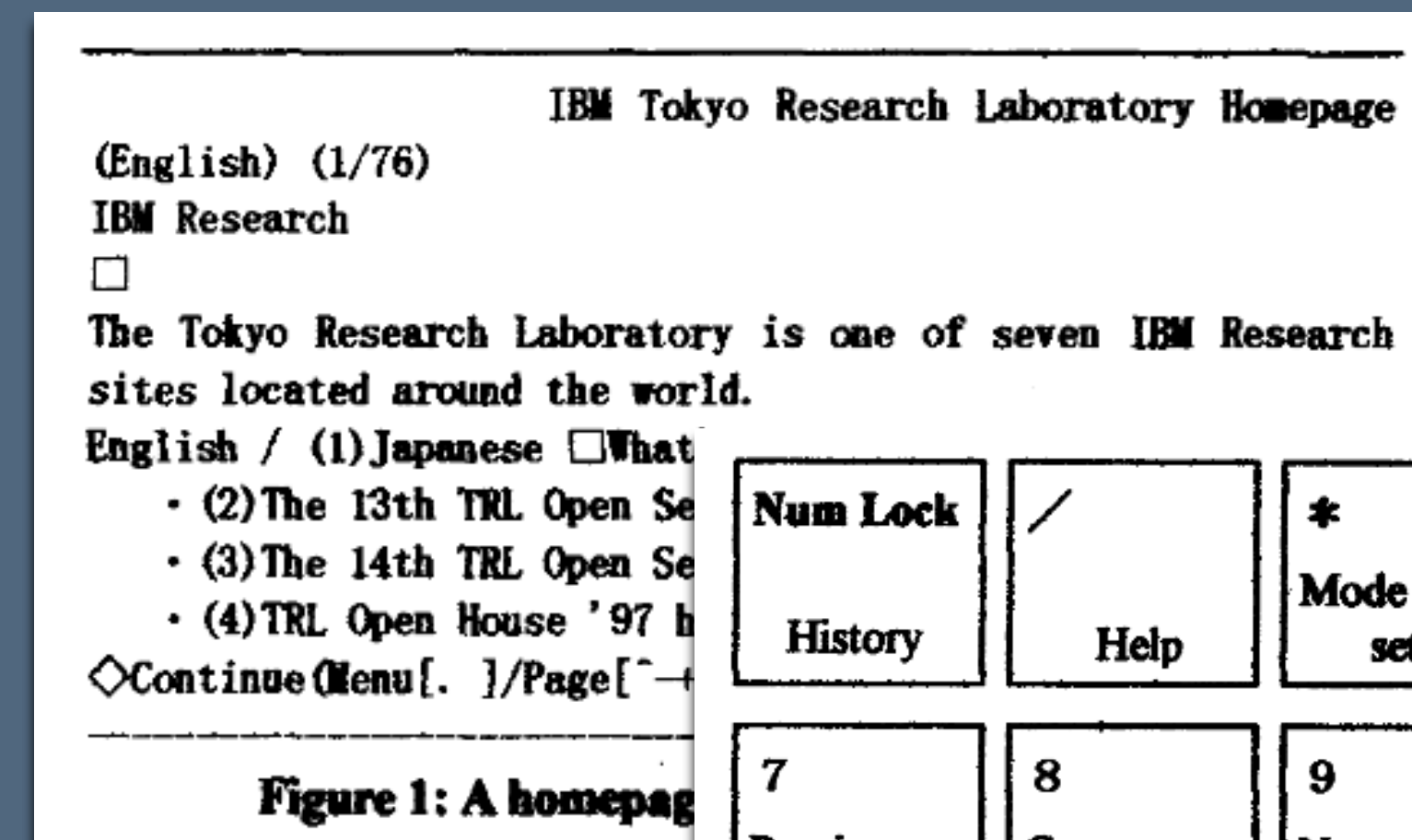
# Examples of ability- based design

# More focused audio output

[Asakawa and Itoh 1998]

Improved web screen reader interface with a few changes:

- provide new key navigation functions
- provide a fast-forward key for screen reading
- read hyperlinks in a different voice.  
read aloud the HTML tags



# Sound awareness via visuals

[Jain et al. 2015]

Gestures and lip movement help interpret speech, but hearing aids and cochlear implants cannot help the listener identify the sound source

Could augmented reality help a person identify a sound's source?



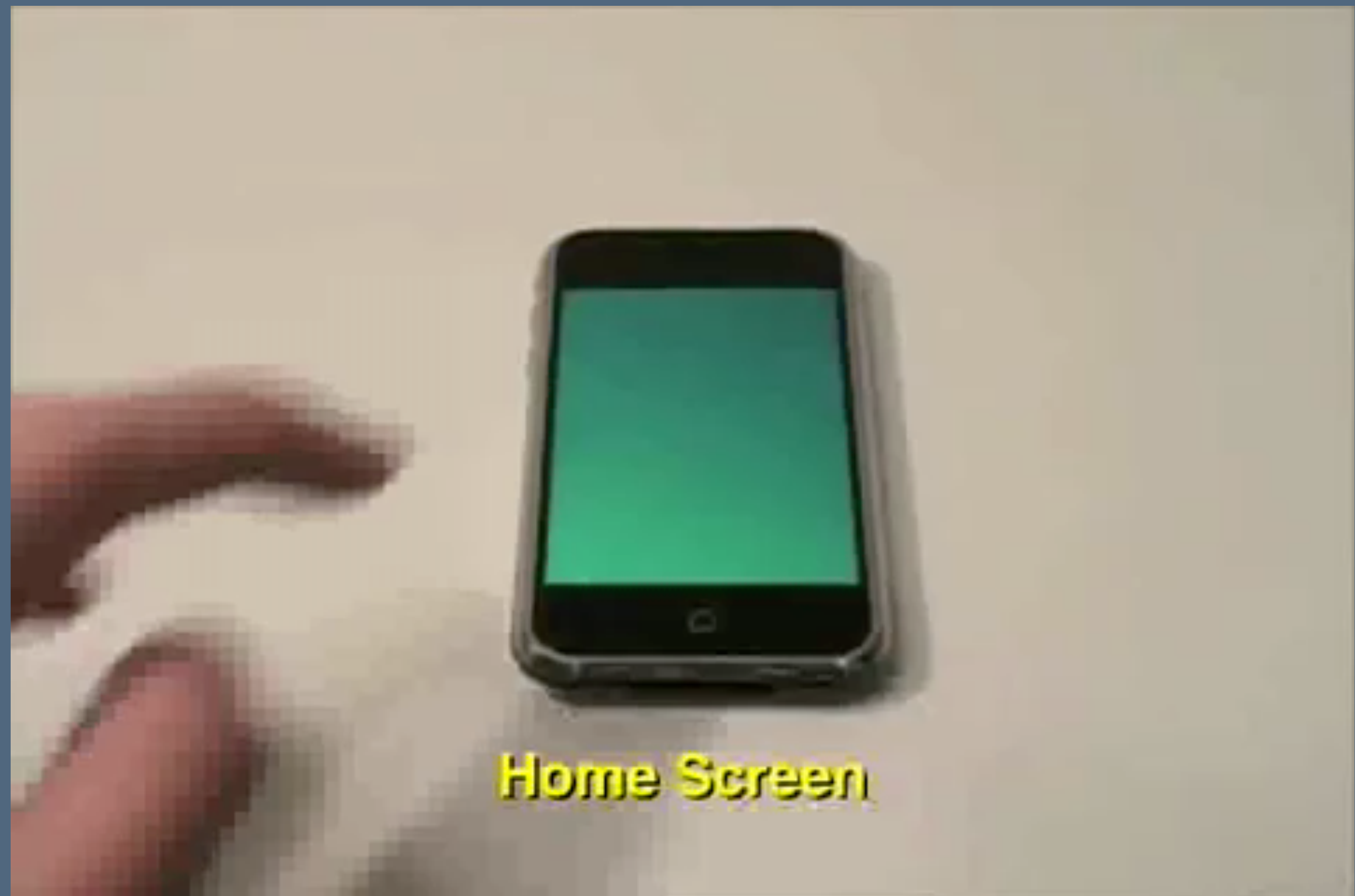
# Using expressivity of touch

[Kane, Bigham and Wobbrock 2008]

How might blind users interact with touchscreen phones?

A “scrubbing”-style interface for voiceover

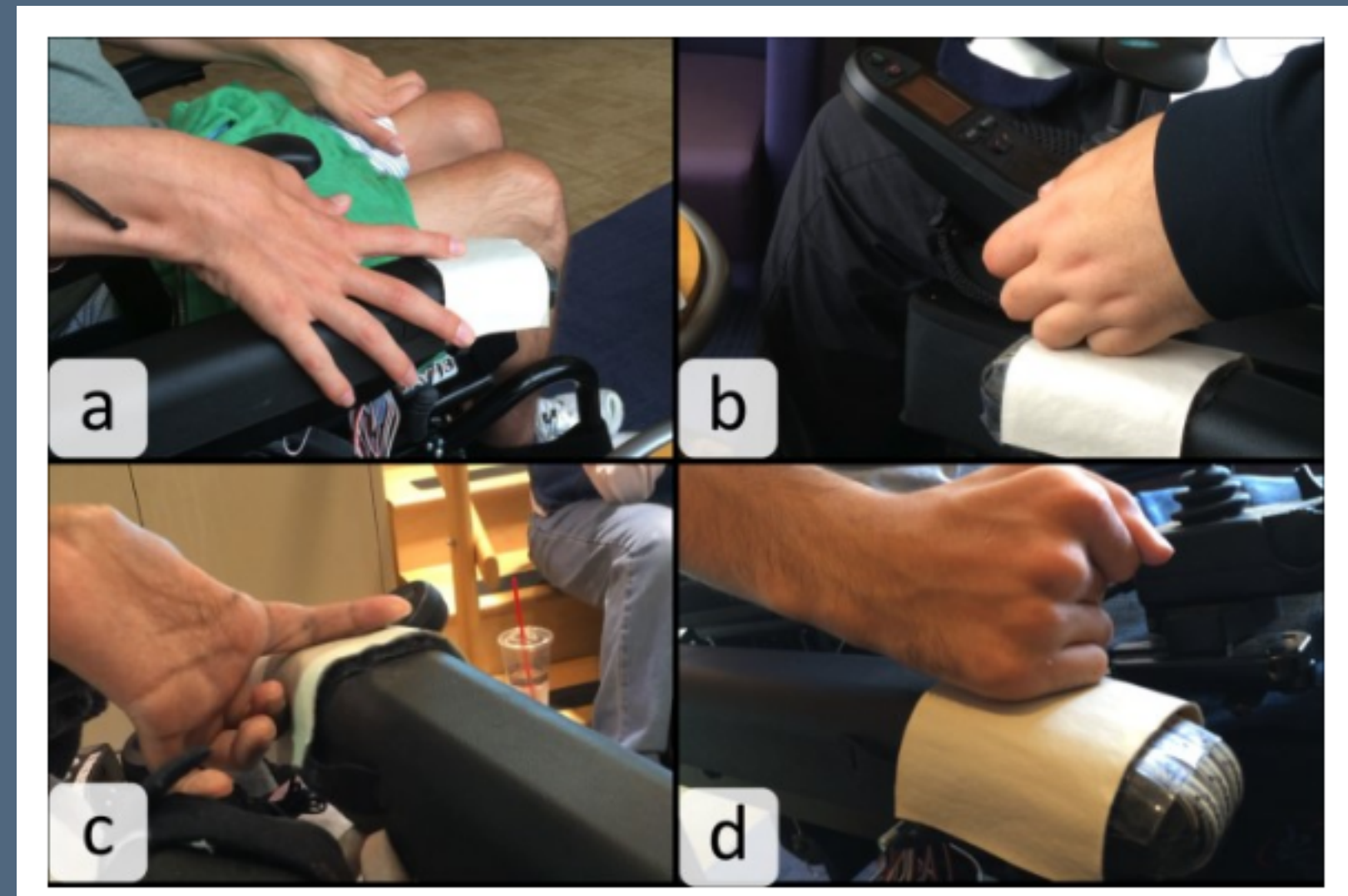
Faster scrubbing invokes more concise summaries



# Expressivity and availability of gesture

[Carrington, Hurst, and Kane 2014]

From “wearables” to “chairables”:  
integrating input and output modalities  
onto power wheelchairs



# Recognizing sign language

[Ma et al. 2018]

Could we unobtrusively translate sign language?

Progress: by using the ubicomp sensor pipeline via wifi reflectance, researchers can now detect over 250 different signs



# Back to ability-based design

[Wobbrock et al. 2011; Wobbrock et al. 2018]

**Core principles:** focus on ability, not disability, respond to poor performance by changing systems, not users.

**Recommended principles:** self-adapt system or allow configuration, tailor support to user's performance and context, provide visibility and control over adaptations.

**Encouraged:** work with common commodity HW/SW

Benefits and gaps in this approach?

**Access beyond the  
screen and individual**

# DIY assistive tech

[Hurst and Tobias 2011; Hurst and Kane 2013;  
Buehler et al. 2015; Mankoff et al. 2019]

Many purchased assistive tools go unused, because they don't quite fit the needs of the individual

Could we empower more end users to tailor their own assistive devices, or those for friends and family?



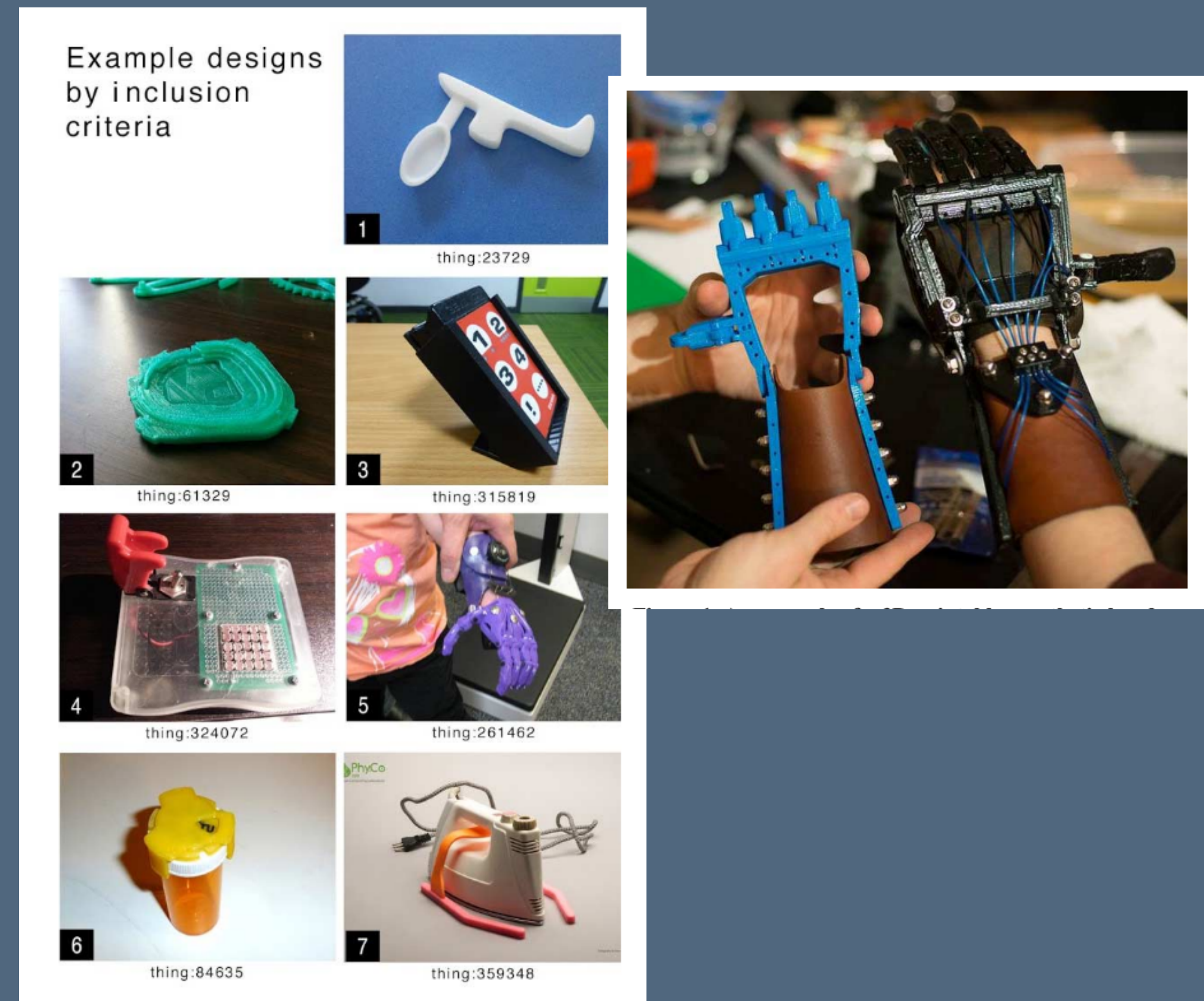
# Making for self and others

[Buehler et al. 2015]

Many custom 3D printable designs were made on the behalf of oneself or for loved ones.

This includes for those with disabilities, older adults, and those managing medications.

Often, designers lack formal training or expertise in assistive technology.



# Help on-demand anywhere

[Bigham et al., UIST '10]

VizWiz - Visual question answering for the blind via Amazon Mechanical Turk

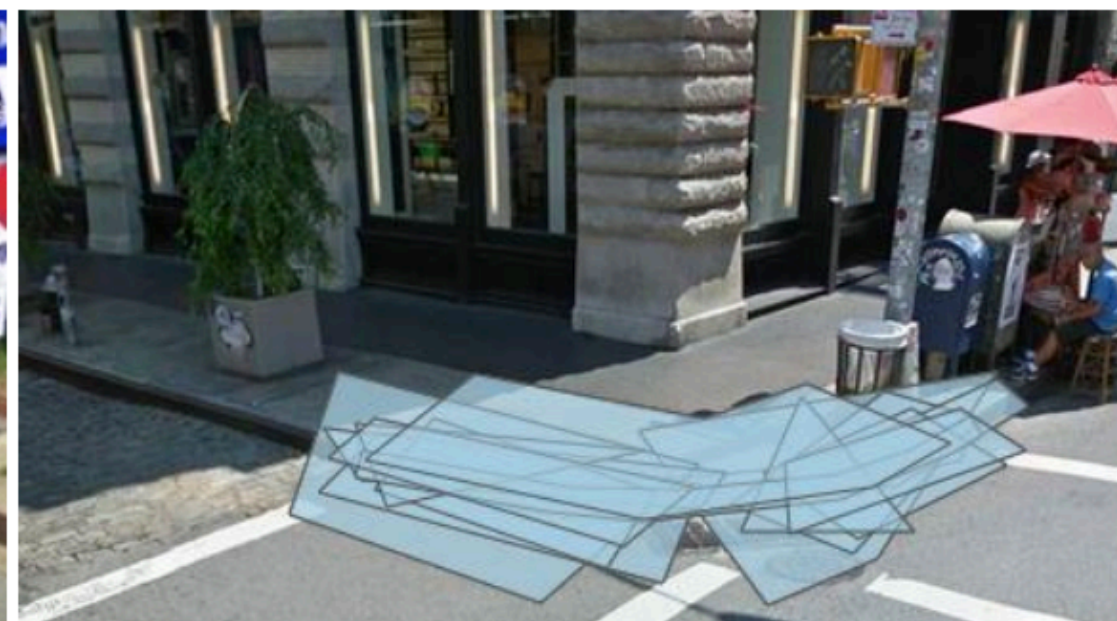
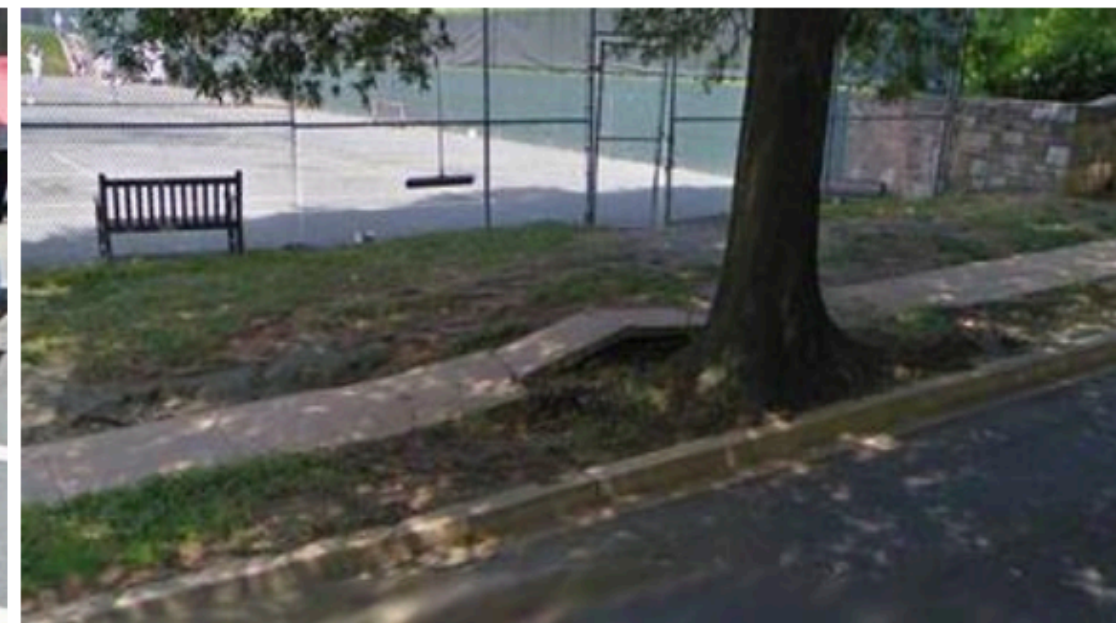
<p>What color is this pillow?</p> 	<p>What denomination is this bill?</p> 	<p>Do you see picnic tables across the parking lot?</p> 	<p>What temperature is my oven set to?</p> 	<p>Can you please tell me what this can is?</p> 	<p>What kind of drink does this can hold?</p> 
<p>(89s) I can't tell. (105s) multiple shades of soft green, blue and gold</p>	<p>(24s) 20 (29s) 20</p>	<p>(13s) no (46s) no</p>	<p>(69s) it looks like 425 degrees but the image is difficult to see. (84s) 400 (122s) 450</p>	<p>(183s) chickpeas. (514s) beans (552s) Goya Beans</p>	<p>(91s) Energy (99s) no can in the picture (247s) energy drink</p>

Enabled responses in 1 to 2 minutes.

# Mapping out physical spaces

[Hara, Le, and Froehlich 2013]

Crowdsourced effort to label Google Street view images for accessibility issues



(a) *Object in Path*

(b) *No Curb Ramp*

(c) *Surface Problem*

(d) *Prematurely Ending Sidewalk*

**Retrofitting accessibility  
onto existing interfaces**

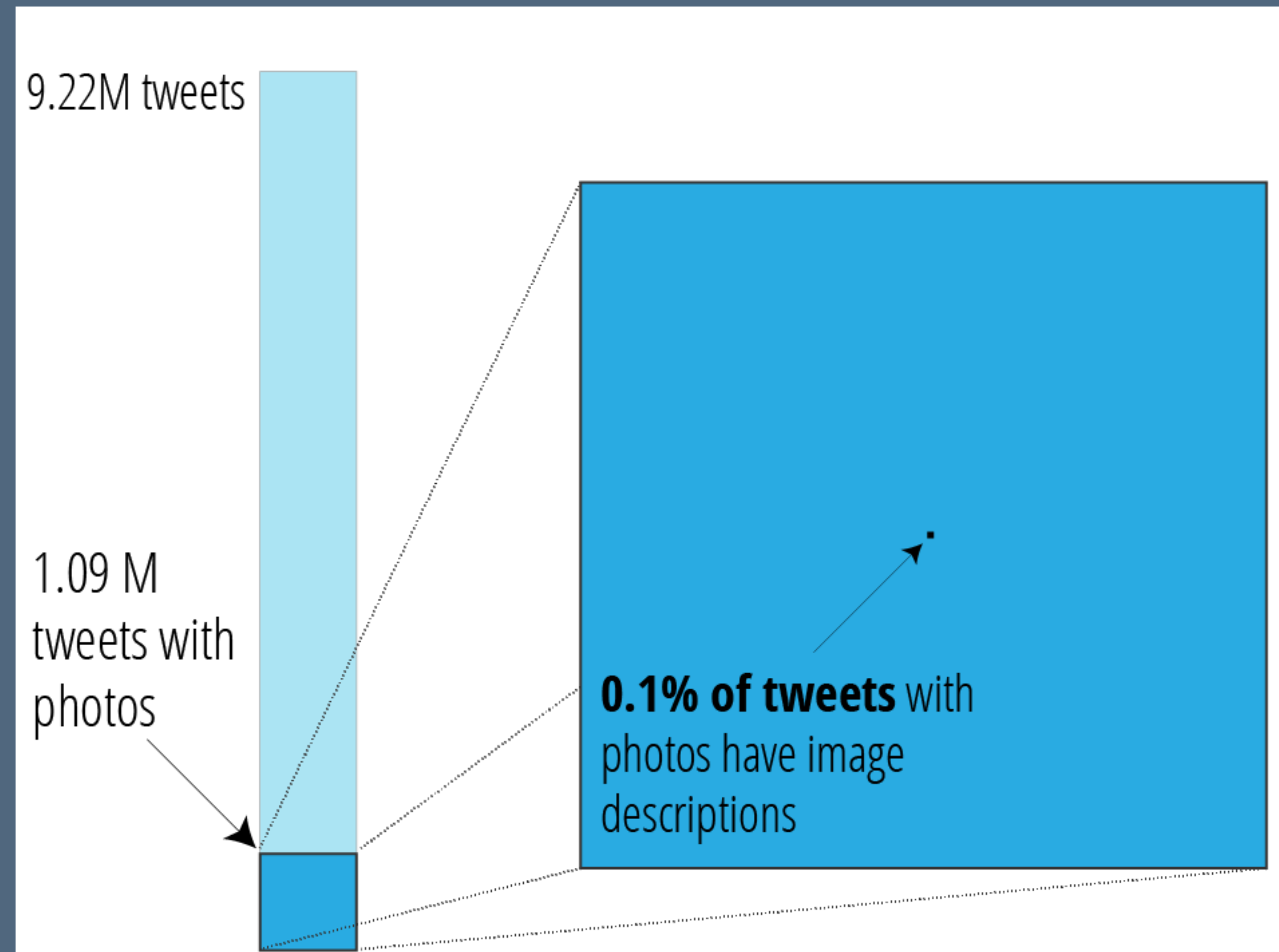
# Failure to follow best practices at scale

[Gleason et al. 2019]

Only 0.1% of images on Twitter media contain user-contributed alt text

Even users who add alt text only add it half the time

On a sample of blind users' simulated feeds, only an estimated 5% of images had alt text.



# Adding accessibility post-programming

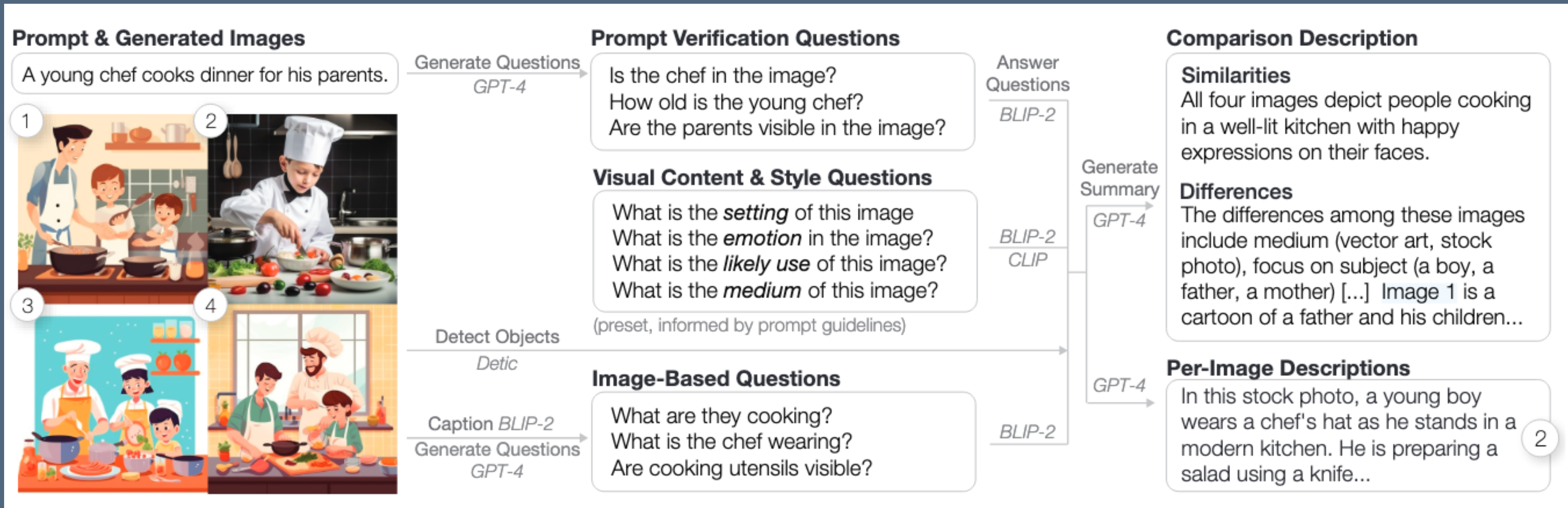
AI-powered screen reader accessibility [Zhang et al. 2021]

iOS Screen Recognition



# Making New AI features accessible

[Huh et al. 2023]



**Some additional thoughts**

# Many other areas, including:

**Aging:** e.g., can we support those with dementia to share their art with family? [Lazar, Edasis, and Piper 2017]

**Neurodiversity:** e.g., how might we craft interactive visual supports for communication between caregivers and children with autism? [Hayes et al. 2010]

**Mental health**

**Chronic pain**



# Accessibility and disability

[Hofmann et al. 2020; Mankoff, Hayes, and Kasnitz 2010]

**Accessibility:** focus on creating technology related to impairment

Contributes an engineering lens

**Disability studies:** focus on understanding disability and advocating against ableism

Contributes a critical lens

These two lenses can be in tension: engineering often scopes down, but in the process, decontextualizes disability

How ought we to thread this needle?

# Summary

**Ability-based design** refocuses our attention from what a person cannot do to what they can do, and anchors the design process in their abilities

Accessibility sometimes requires going beyond supporting individual action to **community action**, and beyond screen interactions **adapting the physical world**.

Sensing and AI techniques can help us to **retrofit existing interfaces** to provide features that provide clear accessibility wins.

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