Human-Computer Interaction

Accessibility

Professor Bilge Mutlu

Announcements

- Today is our penultimate class
- Please complete the course evaluation (through AEFIS) by **May 1**
  - Response rate is currently at **39%**; last semester was **80%**
  - We will end class *10 min early* to give you time for the evaluations
- Final report deadline is extended to **May 6** (next Wednesday)
- Questions?

Today's Agenda

- Overview: *Accessibility*, *Accessible Design*, *Assistive Technology* (30 min)
- Discussion: *Breakout Groups (10 min)*, *General Discussion (10 min)*
- Q&A: *Last Week*, *Deliverables*, *Final* (10 min)
- Course evaluations (10 min)

Wednesday's Agenda

- Overview: *Reporting Statistics, Writing* (30 min)
- Hands-on Activity (20 min)
- Stats session (20 min)
  - If you want me to use your data, please send it to me beforehand
  - Be sure to properly format your data matrix 👉

Participant ID	Group	Task	Time
Participant 01	Standard	Complex	285
Participant 01	Prediction	Complex	160
Participant 01	Speech-based dictation	Complex	201
Participant 02	Standard	Simple	272
Participant 02	Prediction	Simple	191
Participant 02	Speech-based dictation	Simple	161
Participant 03	Standard	Complex	189
Participant 03	Prediction	Complex	250
Participant 03	Speech-based dictation	Complex	178
Participant 04	Standard	Simple	247
Participant 04	Prediction	Simple	288
Participant 04	Speech-based dictation	Simple	180
Participant 05	Standard	Complex	233
Participant 05	Prediction	Complex	285
Participant 05	Speech-based dictation	Complex	225
Participant 06	Standard	Simple	200
Participant 06	Prediction	Simple	202
Participant 06	Speech-based dictation	Simple	162

What are key challenges regarding accessibility?[1]

Risks	**Description**
Inaccessible devices/services	Devices or services that cannot be used by people with special needs, even if they have adequately adapted equipment
Loss or privacy	When personal information stored and/ore transmitted without the authorization of the user
Loss of autonomy	When decisions about the user are taken by other than the user or the person(s) authorized by the user
Economic factors	Devices and services out of the financial capability of the users because excessive technology is used
Invasive and/or socially unacceptable location systems	Systems for personal location that invade personal freedom and/or devices for location that are socially unacceptable

[1] Abascal & Nicolle, 2005, Moving towards inclusive design guidelines

What is accessibility?

Definition of Usability: The effectiveness, efficiency, and satisfaction with which a specified set of users can achieve a specified set of tasks in a particular environment. — ISO 9241-11

Definition of Accessibility: The usability of a product, service, environment, or facility by people with the widest range of capabilities. — ISO 9241-20

How is accessibility related to disability?

Accessibility is the extent to which an interactive product is accessible by as many people as possible.

The primary focus of accessible design is making systems accessible to individuals with *disabilities*.

What is disability?[2]

Definition: A *disability* is any condition of the body or mind (impairment) that makes it more difficult for the person with the condition to do certain activities (activity limitation) and interact with the world around them (participation restrictions).

Disability can change over time with age or recovery, and the severity of the impact of disability can change over time. Fewer than 20% are born with a disability, although 80% of people will have a disability once they reach 85.

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[2] Source: CDC

Three Dimensions of Disability[3]

1. **Impairment** in a person's body structure or function, or mental functioning (e.g., loss of a limb, loss of vision, or memory loss)
2. **Limitation in activities** (e.g., difficulty seeing, hearing, walking, or problem solving)
3. **Restrictions in participation** in activities of daily living (e.g., working, engaging in social and recreational activities, and obtaining health care)

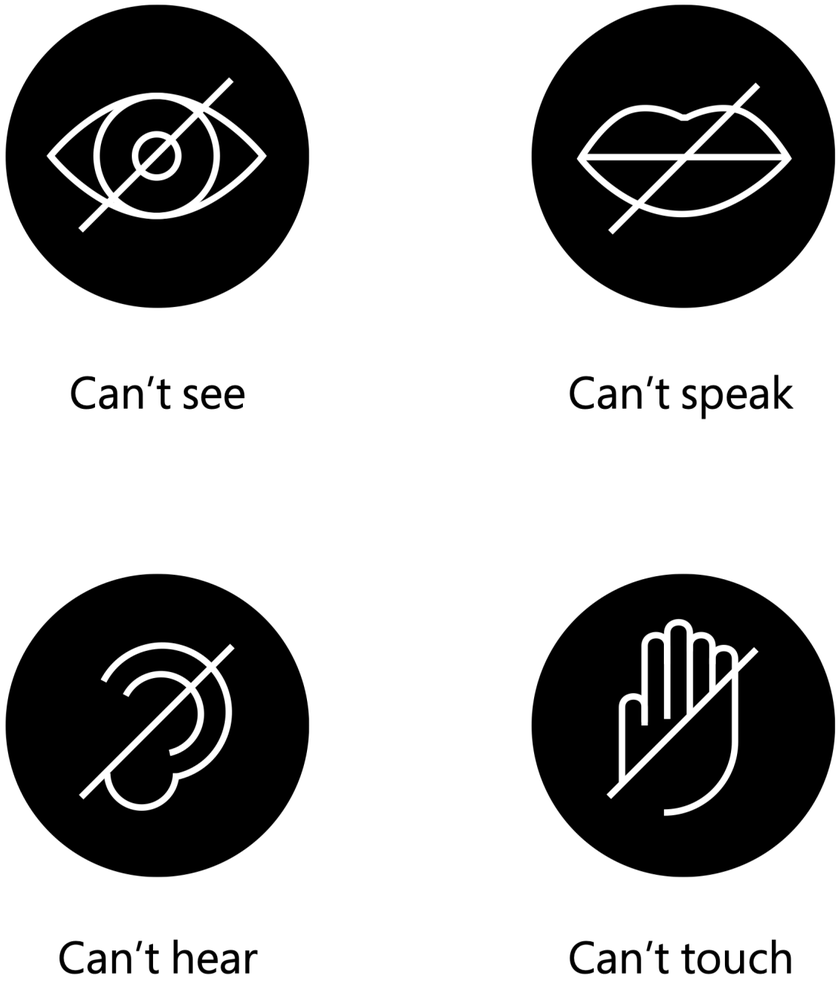
[3] Source: World Health Organization

Types of Impairment: Anatomical[4]

Sensory Impairment: Involves impairment in one or more senses, such as loss of vision or hearing.

Physical Impairment: Involves loss of function to one or more parts of the body, e.g., congenitally or after stroke or spinal-cord injury.

Cognitive Impairment: Includes cognitive deficits, such as learning impairment or loss of memory/ cognitive function due to aging or conditions such as Alzheimer's disease.



[4] Image source: Microsoft Inclusive Design Toolkit

What are some common impairments?

Visual Disabilities: Vision impairments, including long-sightedness, blindness, and color blindness.

Motor/Mobility: Muscular or skeletal impairments in the hands, arms, or the whole body that affect user and mobility, e.g., users are in a wheelchair or bedridden, and thus the context of use.

Auditory: Hearing deficits differing in severity, e.g., deafness.

Seizures: Neurological impairments, e.g., photosensitive epilepsy, that result in sensitivity to light, motion, and flickering and trigger seizures.

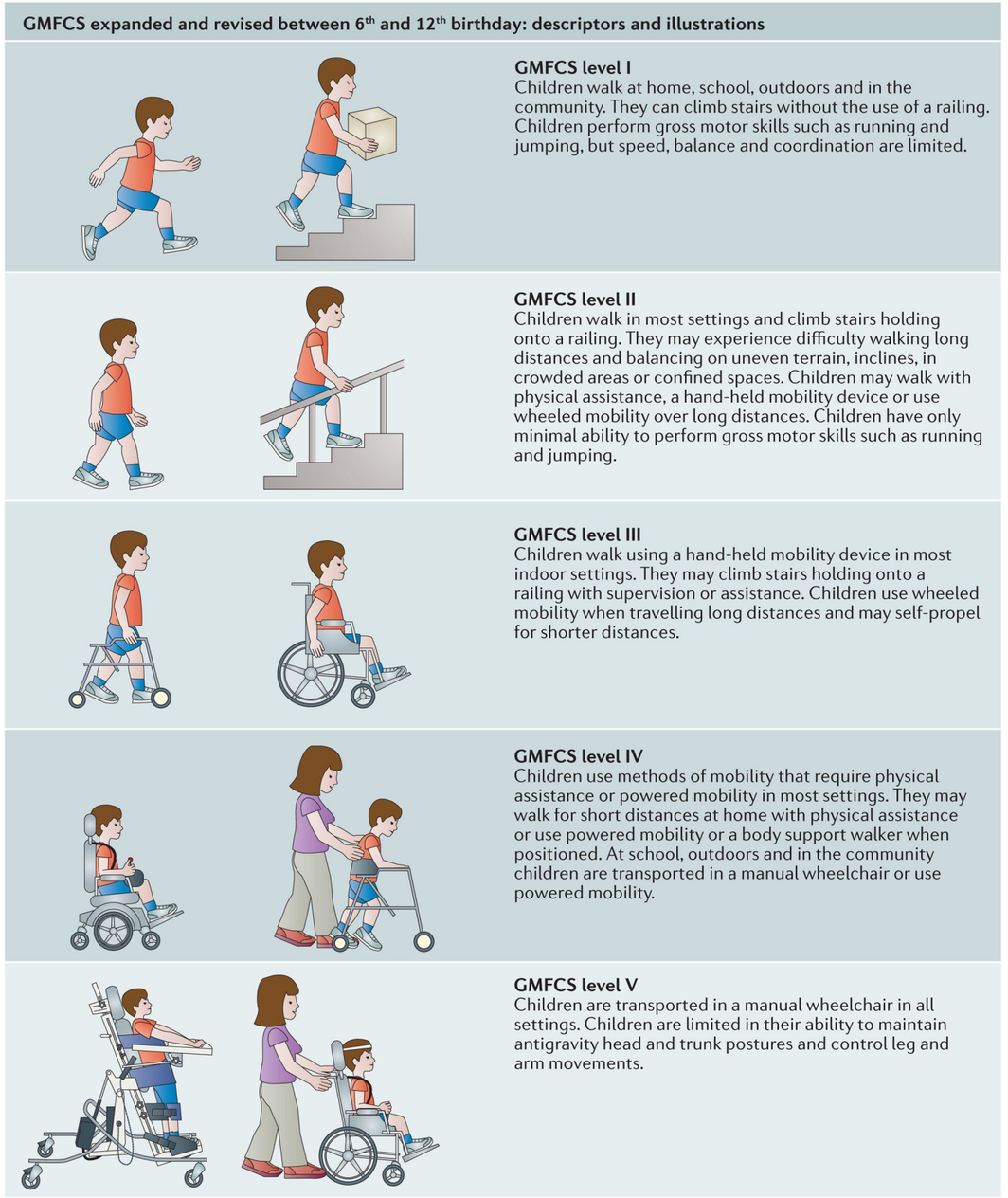
Cognitive/Learning: Congenital, developmental, and traumatic (e.g., TBI) conditions that result in cognitive or learning challenges.

How do impairments vary?[5]

Impairments can vary in severity or structure depending on the source and nature of the impairment.

Severity: Children with cerebral palsy can have basic mobility or completely depend on a caretaker.

Structure: Vision impairments can include color blindness, peripheral-only vision, no light perception.



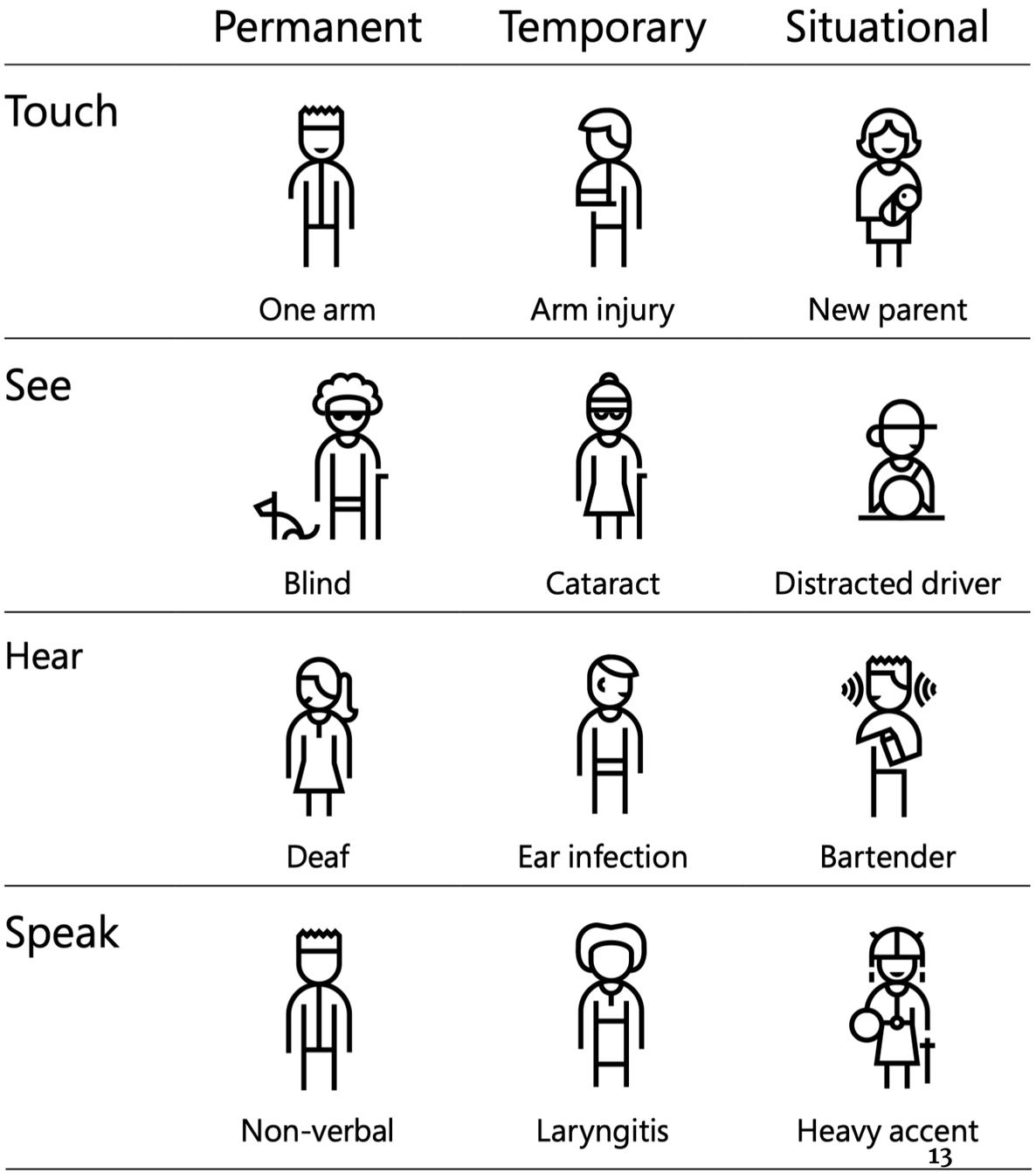
[5] Image source; Gross Motor Function Classification System (GMFCS)

Are impairments permanent?[6]

Permanent Impairment: Congenital or long-term conditions, such as color blindness, missing body parts, etc.

Temporary Impairment: Impairments that improve over time, such as recovery after illness or accidents, e.g., a broken arm.

Situational Impairment: Impairments introduced by context, such as environments with low light or noise.



[6] Image source: Microsoft Inclusive Design Toolkit

How do we improve accessibility?

Two ways to address accessibility problems:

1. Accessible design
2. Assistive technologies

How can we do accessible design?[7]

Disability as **context dependent**: Disability is not just a health problem. It is a complex phenomenon, reflecting the interaction between features of a person's body and features of the society in which he or she lives.

Context-dependent disability results from a mismatch between abilities and the environment:

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Ability + Context = Disability
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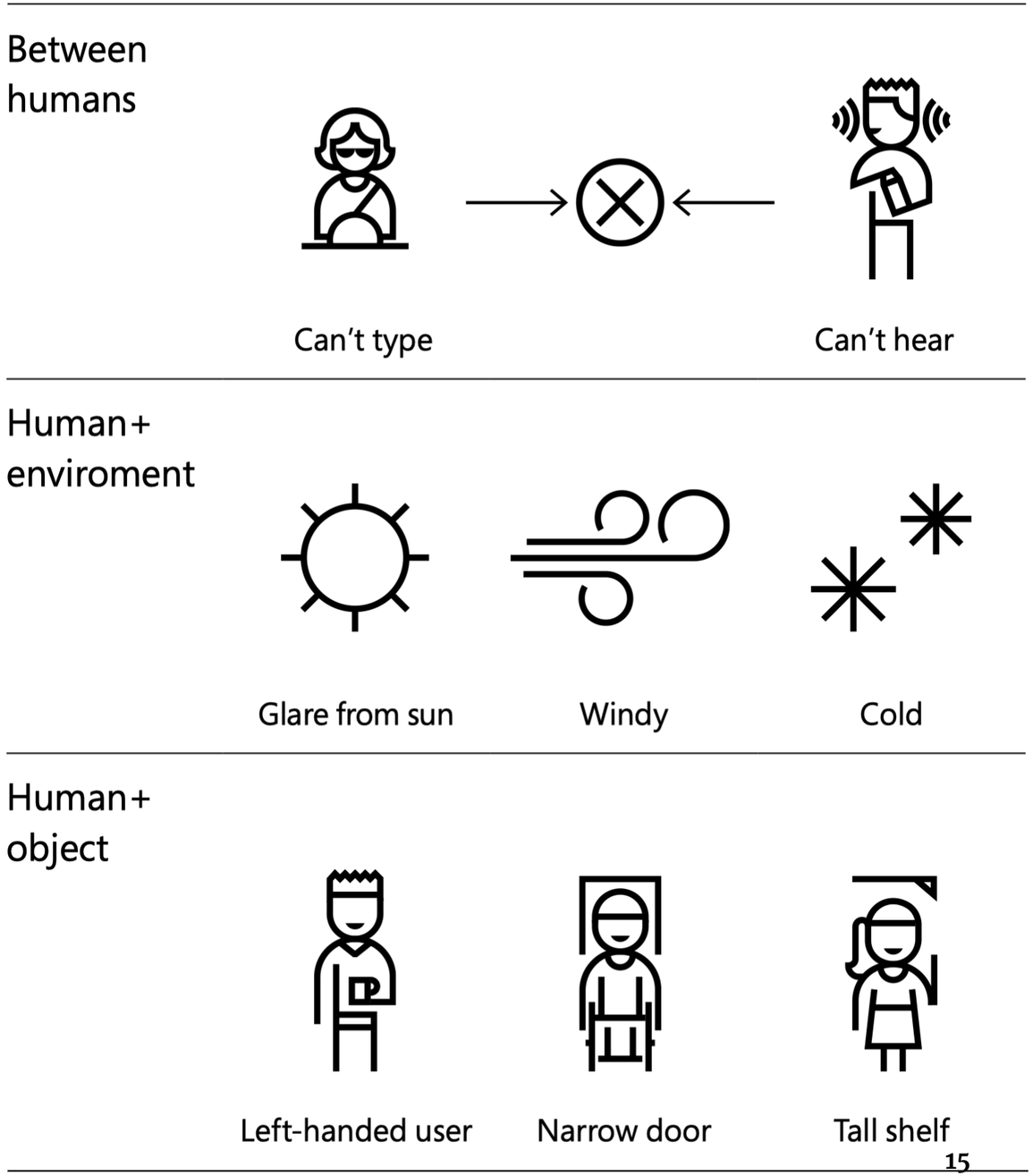


[7] Image source: Microsoft Inclusive Design Toolkit

What is universal (or inclusive) design?[8] [9]

Definition: The design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design.

The main premise: Design solutions that benefit some individuals may benefit the whole society. E.g., in the US, only 26K people are suffer loss of upper extremities. Designs that would benefit these 26K would also benefit another 21M people with temporary or situational disabilities.

[8] Ron Mace, 1996

[9] Image source: Microsoft Inclusive Design Toolkit

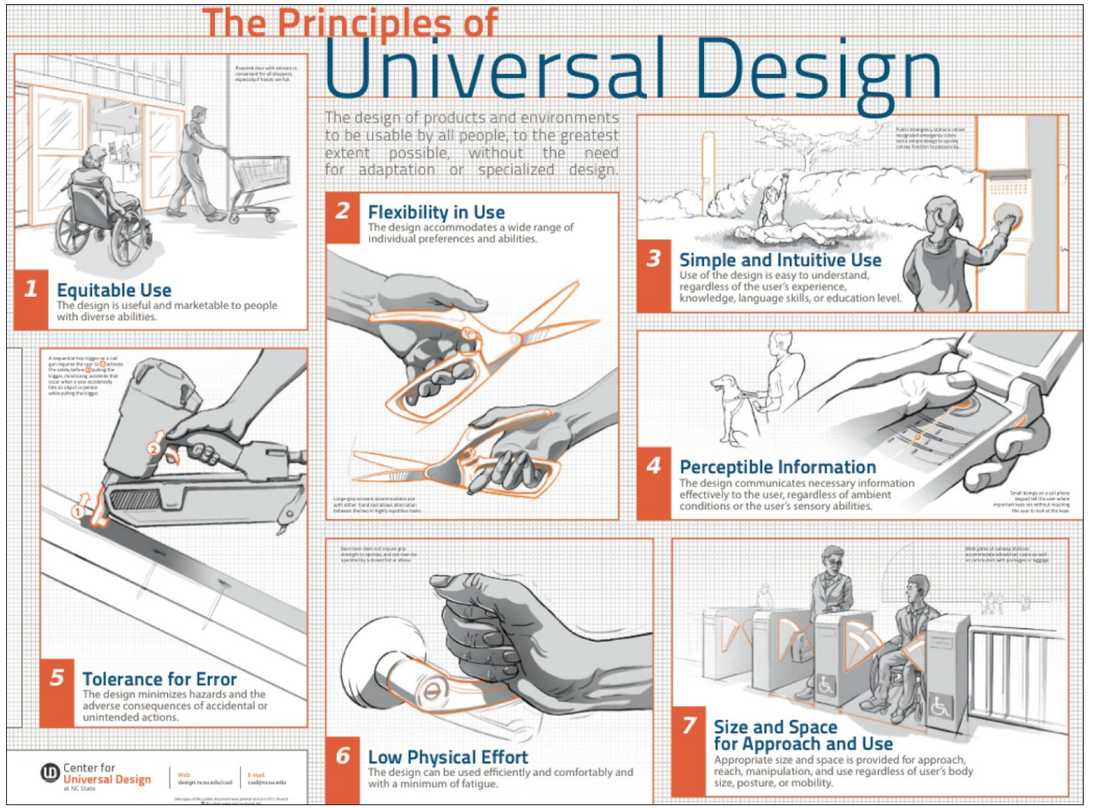
What's an example?[10]

Closed Captioning: Although closed captioning was originally developed for individuals with hearing impairments, they now also benefit reading in noisy environments and learning to read.

[10] Image source: Microsoft Inclusive Design Toolkit

How do you do universal design?[11]

1. Equitable use
2. Flexibility in use
3. Simple and intuitive use
4. Perceptible information
5. Tolerance for error
6. Low physical effort
7. Size and space for approach and use

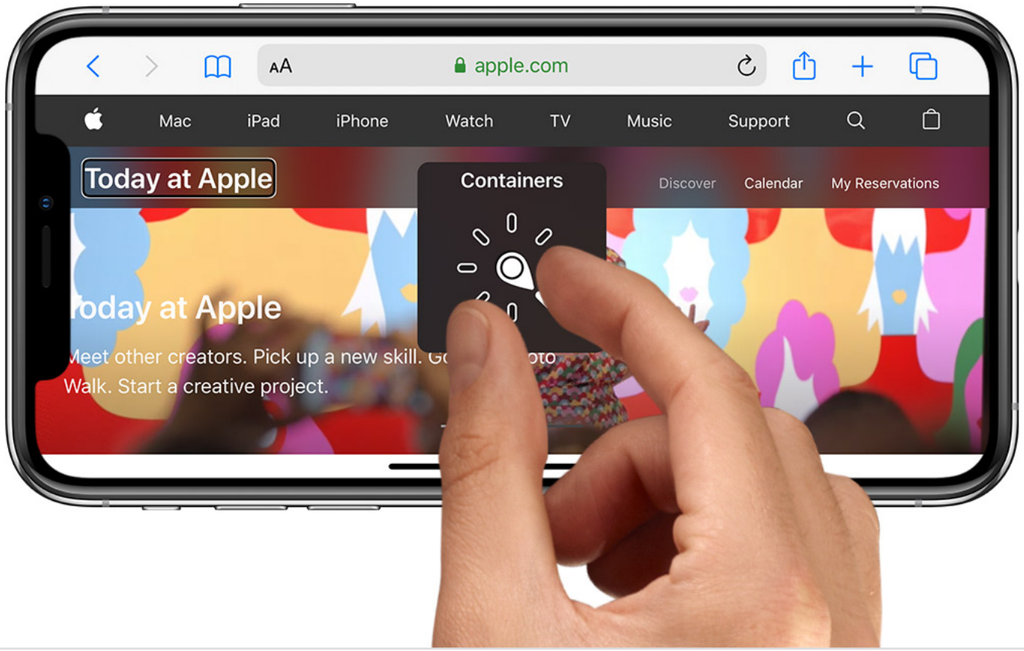


[11] Image source: Interaction Design Foundation

What are assistive technologies?

Definition: Specialized tools that close accessibility gaps.

Screen Readers: Software used by individuals with vision impairments to read screen content. E.g., VoiceOver in iOS.[12]



Screen Magnification: Enlarges text or graphics on screens to improve visibility of content for individuals with limited vision.

[12] Images: Left, Right

Text Readers: Tools that read out loud text on screens to support vision and learning disabilities.[13]

Braille for the Web: A mechanical device that translates textual content on the screen into Braille.

[13] Images: Left, Right

Alternative Input Devices: Tools that help users with motor impairments who cannot use a mouse or keyboard with pointing. E.g., motion/eye tracking.[14]

Alternative & Augmentative Communication: Tools that help individuals who are unable to use verbal speech to communicate.

[14] Images: Left, Right

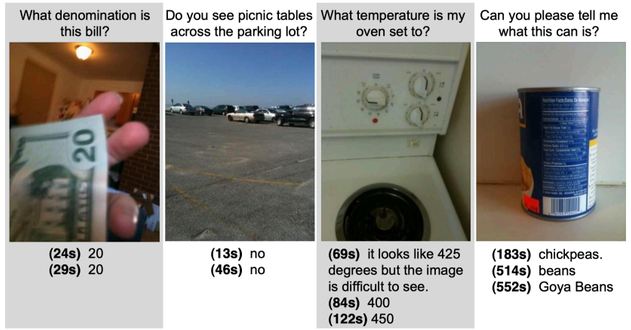
What is the research space like?

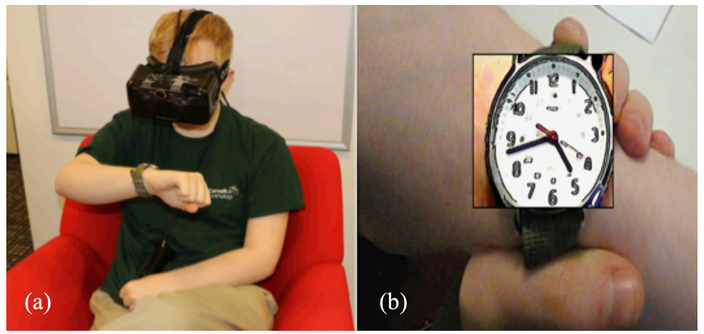
Research on accessibility in HCI primarily involves design-based research on assistive technologies.

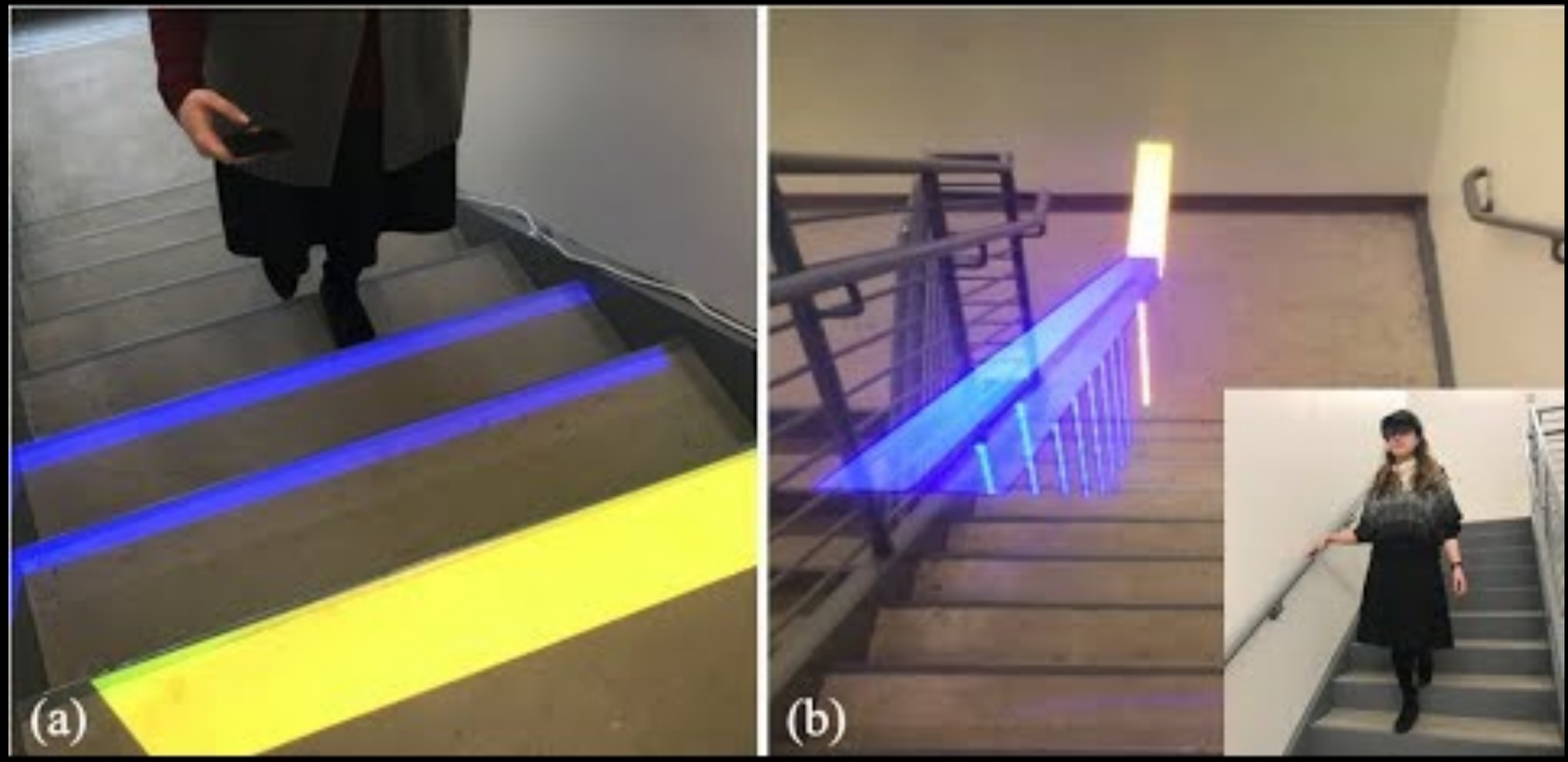
Top: VizWiz (Bigham et al., 2010)

Center: ForeSee (Zhao et al., 2015)

Bottom: N/A (Funk et al., 2015)






(a)
(b)

Discussion Questions

- What are some other examples of universal design?
- What other disabilities have you encountered that might limit technology use?
- What assistive technologies have you used or encountered?
- What are grand challenges in designing assistive technologies?
- What external resources have you found?