

From Exclusion to Inclusion

Ethical Responsibilities towards Disabled People in the
Development of Digital Technology

**Design IT.
Create Knowledge.**

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Motivation



- Globally, every sixth to seventh person is disabled [Sh17; Wo23]
- Disabled People are systematically excluded from participation, disadvantaged, or patronised [AC25; Va23; Wo23]
- We will consider **four dimensions** for the proper inclusion of disabled people:
 - 1) Bias
 - 2) Design
 - 3) Accessibility
 - 4) Participation



Who of you was taught about making technology inclusive in a compulsory course during your studies?

Disclaimer: this talk will be ~45 min, to cover a broad variety of issues and methods

Agenda



Motivation

Basics

- Terminology

- Diversity of Disabilities

Dimensions

- Bias

- Design

- Accessibility

- Participation

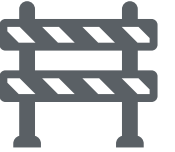
- Relationships between the Dimensions

Discussion

Terminology: Impairment vs. Disability [Sh17]



- **Impairment:** a physical, sensory, intellectual or mental difference or limitation. Impairments can involve pain.
- **Disability:** society fails to accommodate a person's impairments, e.g., through inaccessible environments, discriminatory attitudes, inflexible institutions, or exclusionary practices.



Terminology: Medical vs. Social



- **Social Model:** People are disabled primarily by social, environmental, and attitude barriers, rather than by their impairments themselves. [Sh17]
- **Medical Model:** Disability is a problem located within an individual, caused by disease, injury, or impairment. [CMT24]
- **People First Language:** E.g. “people with disabilities”, “person in a wheelchair”, “person with autism”. Avoids defining individuals solely by a medical condition. [Sh17]
- **Identity First Language:** E.g. “disabled people”, “wheelchair user”, “autistic person”. It stresses a collective identity. [Sh17]



- conditions may:
 - be obvious from birth (e.g., Down syndrome)
 - become apparent with atypical development (e.g., autism spectrum disorder)
 - stem from traumatic injuries (e.g., spinal cord injury)
 - be episodic or degenerative (e.g., depression, multiple sclerosis)
 - be associated with ageing (e.g., dementia)
 - be visible (e.g., dwarfism)
 - be invisible/hidden (e.g., epilepsy)

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What is Bias?

Bias: “the action of supporting or opposing a particular person [...] in an unfair way, because of allowing personal opinions to influence your judgment” [Ca26]

Note: Bias can be **unconscious**

Automation bias: “tendency of human beings to defer to decisions made by algorithmic and technological systems” [AC25, p. 34]

Example for bias: Robodebt [GS22]



Robodebt: System of Online Compliance Intervention

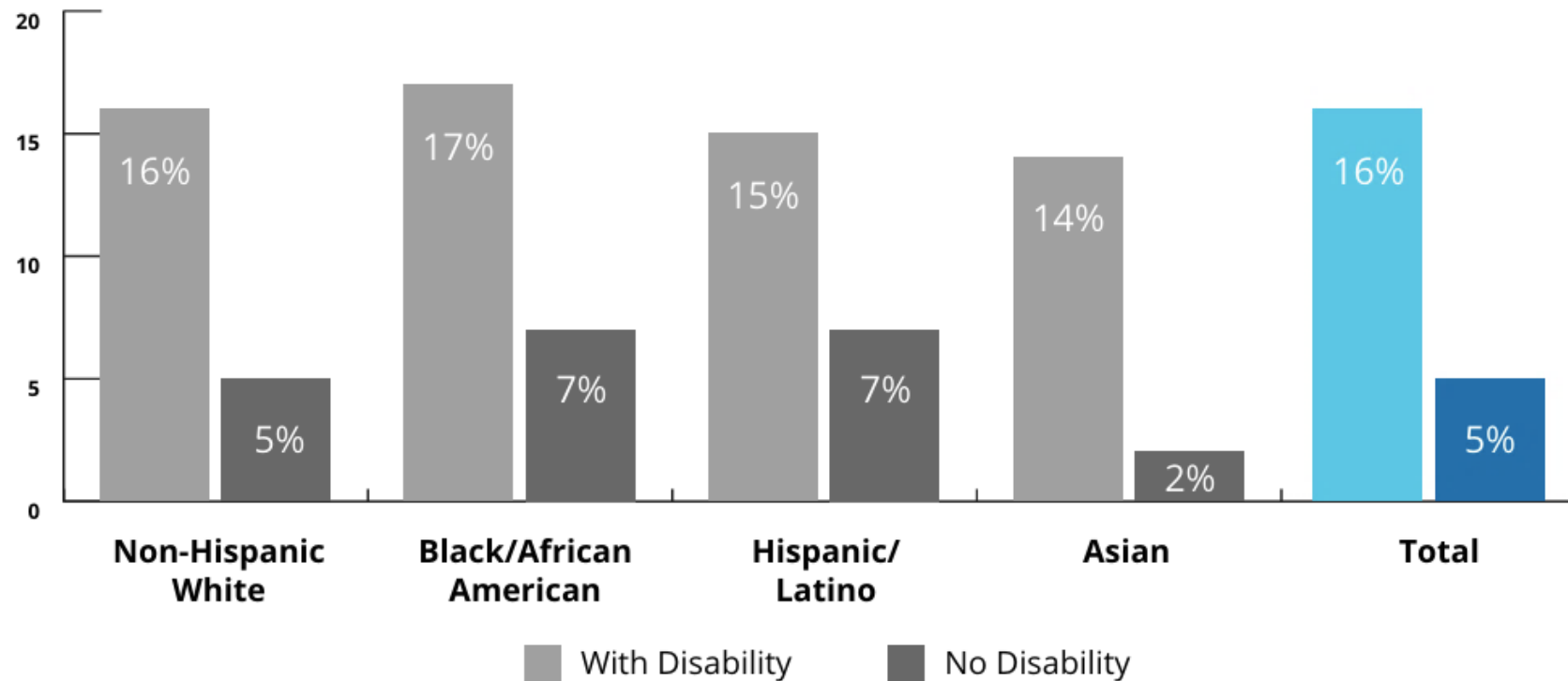


- **automated debt recovery system** from the Australian Government for welfare recipients (2015-2020)
- More than 400,000 people were wrongly accused of owing debts [CF25]
- Disabled people were disproportionately affected and often received false or impossible-to-pay debt notices. [GS22]
- In 2020, Australia's Federal Court ruled this system illegal: the automated debt calculation was "*fundamentally flawed.*" [CF25]

2026											
J	F	M	A	J	J	A	S	O	N	D	
earns \$100 / fortnight						earns \$2000 / fortnight					
receives \$808.70 welfare / fortnight						receives no welfare					
earned \$17,300											
earned \$665.38 / fortnight on average						earned \$665.38 / fortnight on average					
"falsely" received welfare → receives debt notice (\$10,513.1)											

[Au26]

Figure 13: Adults Who Did Not Get Medical Care because of Cost in the Last 12 months, by Disability Status and Race



Source: National Health Interview Survey, 2015

A Vicious Cycle



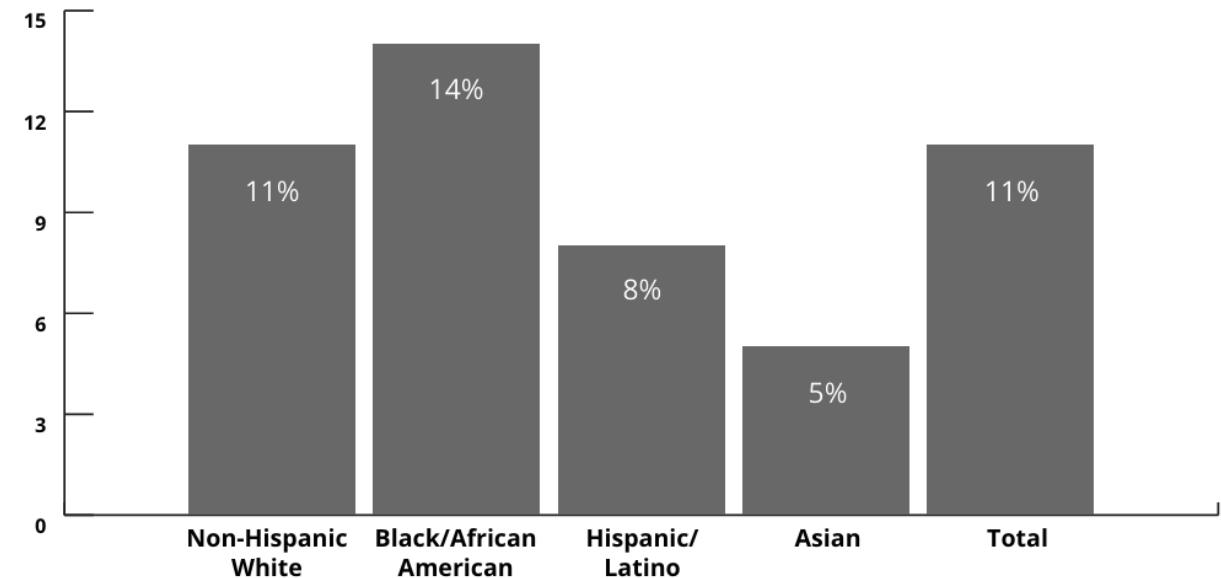
- **Biases multiply:**

- People who belong to multiple marginalised groups are at greater risk of experiencing discrimination in healthcare [AC25]

- **Biases create biases:**

- “certain racially marginalized groups are disproportionately likely to be disabled” [AC25, p.47]
- poverty causes disability [Go19]
- disability causes poverty [Go19]

Figure 2: Prevalence of Disability by Race



Source: American Community Survey, 2015

[Go19, p. 9]

Minimising Bias in Research [Ja23]

- ensure **transparency** throughout the entire research process
- implement peer review with **independent** reviewers
- **replicate** the findings
- use **objective** measures
- disclose all funding sources and potential **conflicts of interest**
- employ **blinded assessments** where appropriate
- **encourage diversity** in research teams and samples



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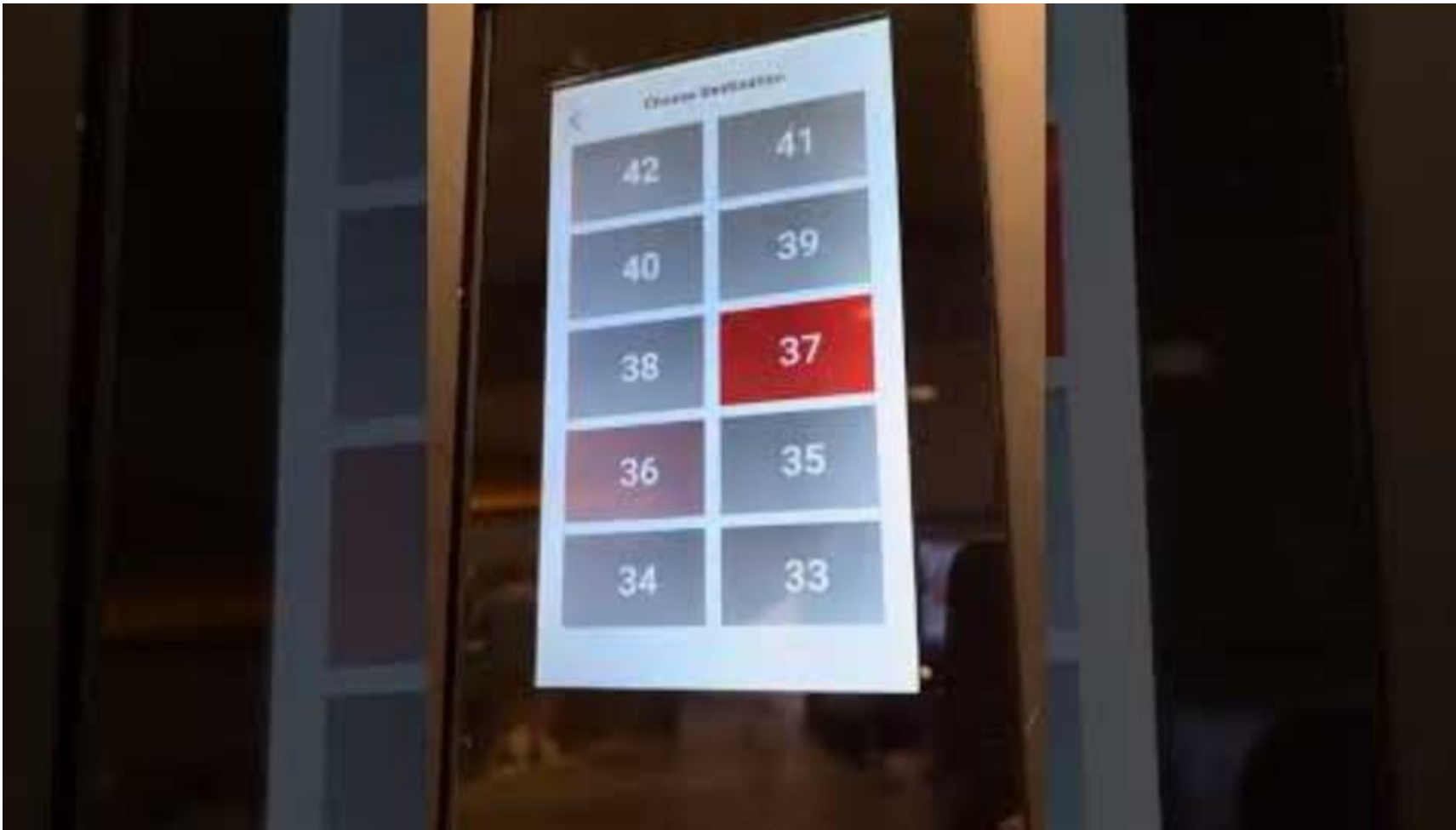
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Discussion

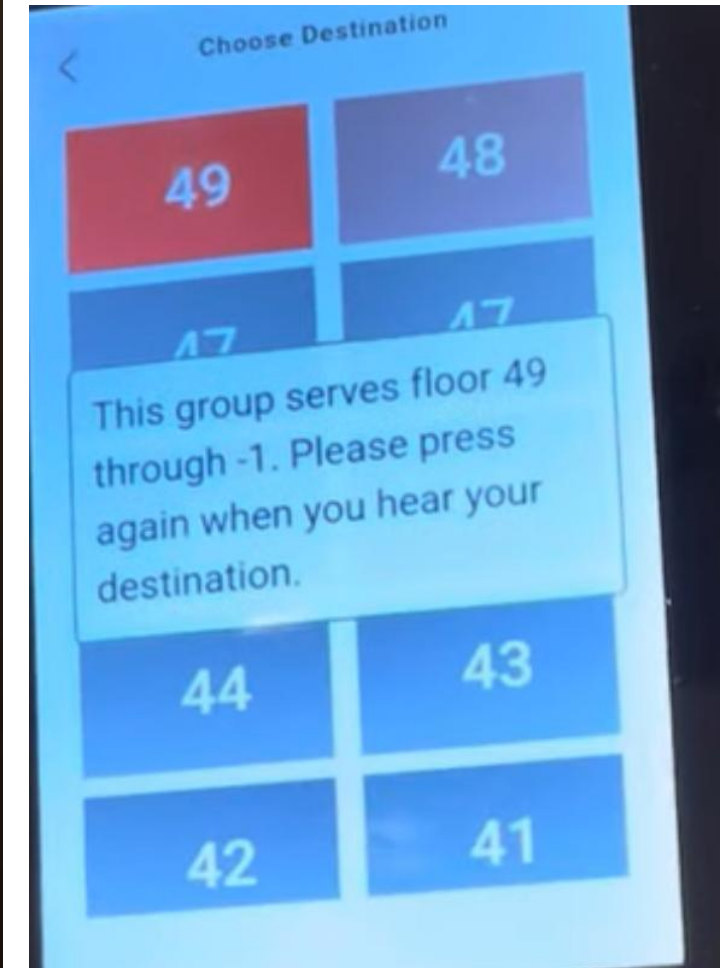
Inaccessible Design

- can lead to systemic discrimination against disabled people
- Example: public touch-screen-only interfaces
 - assume good vision
 - fine motor control
 - must be in reach
 - possibly require the simultaneous use of two hands





Example: Elevator 1

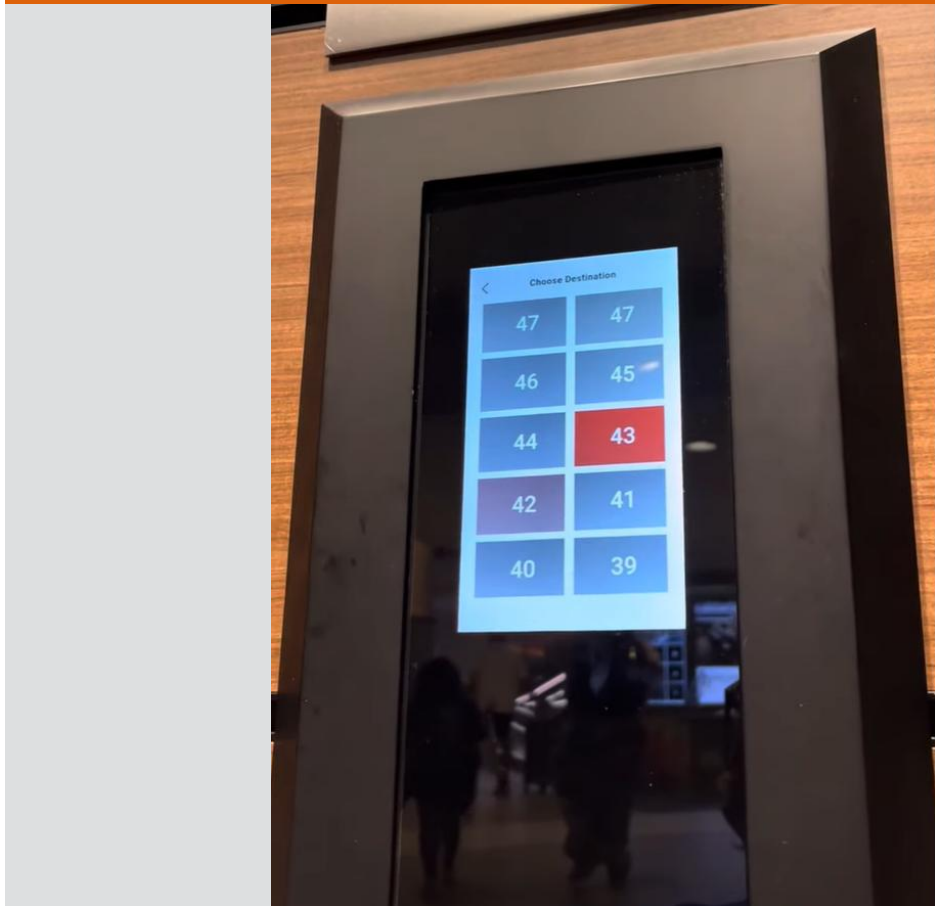




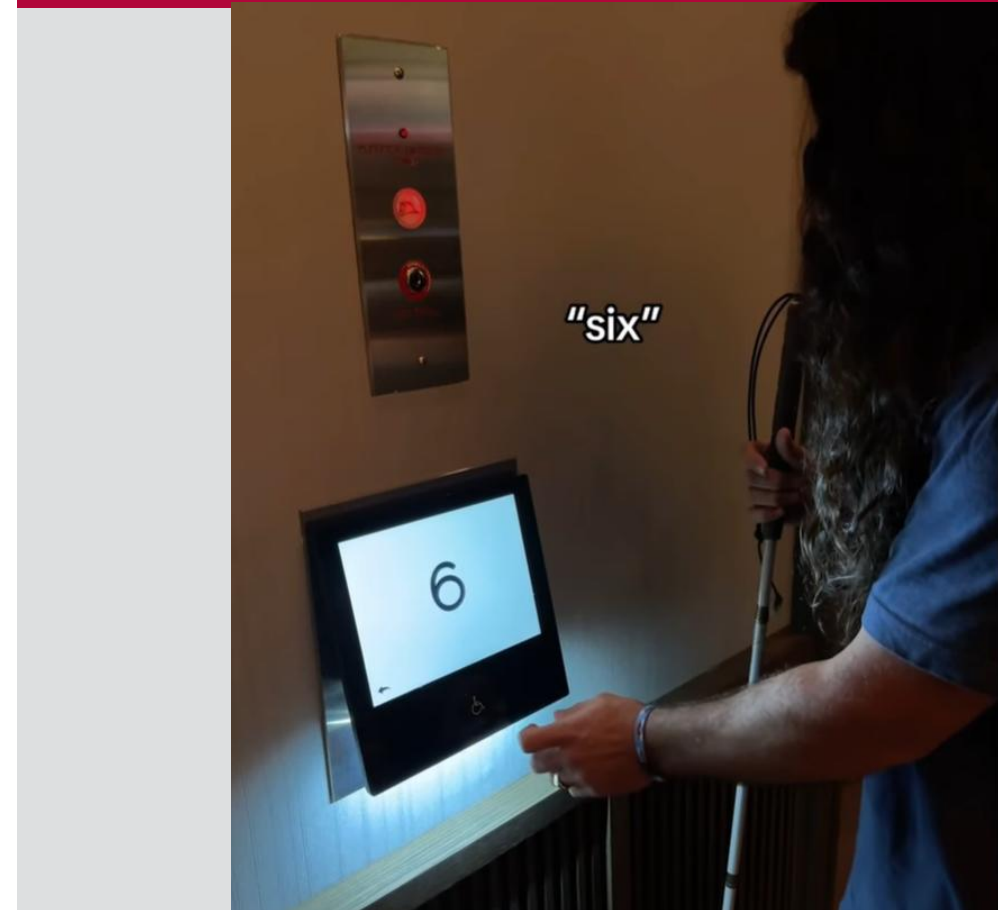
Example: Elevator 2

What are the differences between booth elevator examples?

Elevator 1 [Th23]



Elevator 2 [As23]



- **1. Recognise Exclusion**

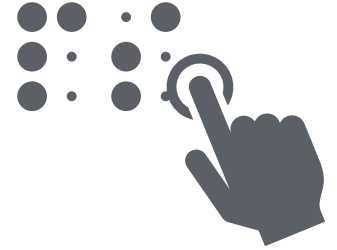
- E.g., software that is incompatible with assistive technology
- User testing helps finding points of exclusion

- **2. Learn from Diversity**

- Involve people from different communities, age groups, cultures, ability levels, socioeconomic backgrounds, education levels, etc.

- **3. Solve for One, Extend to Many**

- When designing a feature with one group in mind, expand it so that others benefit from it as well.



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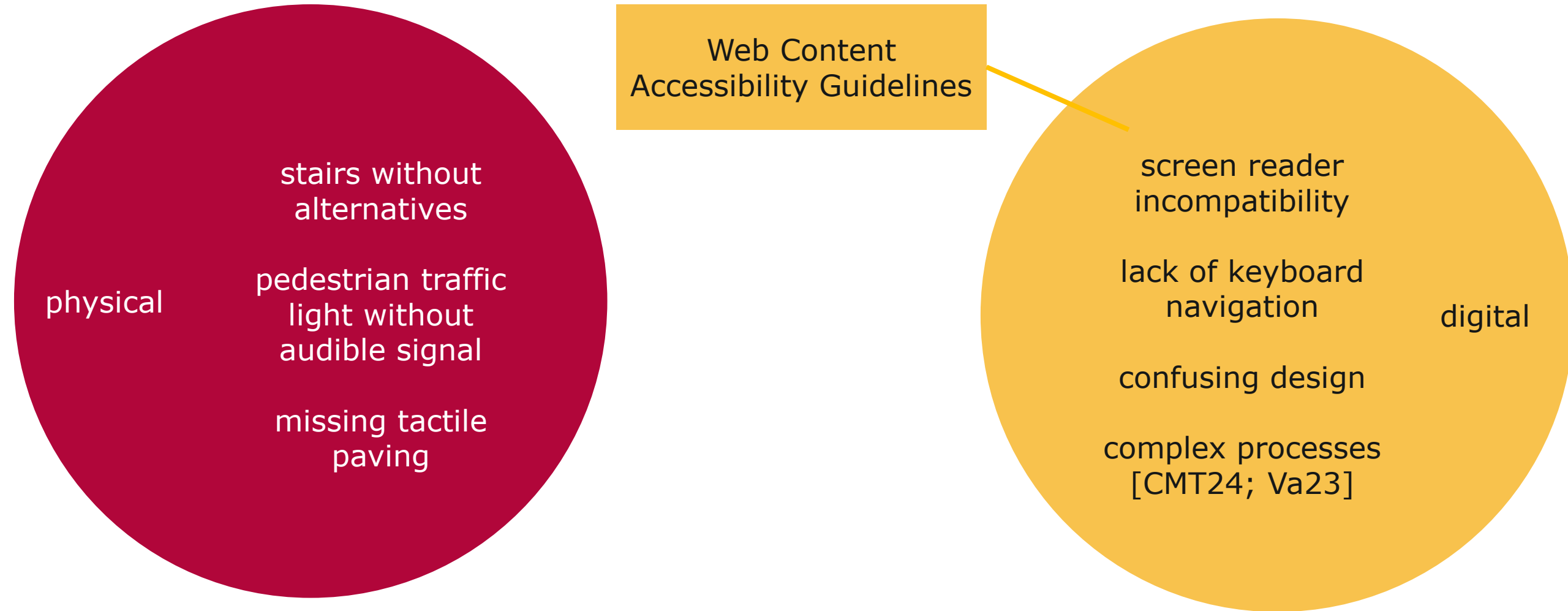
Accessibility through Assistive Technology

- Assistive technology helps overcome barriers.
- **Drawbacks** of assistive technology:
 - reactive in design
 - can be expensive [Hu25; IA22; OR16; VS25]
 - additionally, *"people with disabilities generally have less income than those without"* [DH06, p. 317]
 - can only be adopted by systems with open functionality



Refreshable Braille Display, \$3,748.50 [VS25]

Inaccessibility in Different Realms I



Web Content Accessibility Guidelines (WCAG)

- From the World Wide Web Consortium (W3C)
- Many of its points are in the legally binding European standard EN 301 549 [Bu25]
- Key Points [Bu25; W325]:
 - **Perceptibility:** All information must be perceivable via at least two sensory channels
 - **Operability:** Ensure keyboard accessibility, sufficient time limits, simple and clear navigation
 - **Comprehensibility:** Language should be as simple and clear as possible. Unavoidable technical terms should be explained. The design should be consistent and predictable.
 - **Robustness:** the content should be compatible with user technologies (e.g., screen readers)

TED

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→

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Haben Sie auf unseren Webseiten ein technisches Problem oder nicht-barrierefreie Inhalte gefunden?

Mit Ihren Angaben im Formular unten helfen Sie uns, das GI-Webportal hinsichtlich Funktionalität und Barrierefreiheit zu optimieren.

Persönliche Daten

Vorname*

Nicht-barrierefreie Inhalte /
Probleme / Meldungen

Seite mit nicht-barrierefreiem Inhalt / Problem*

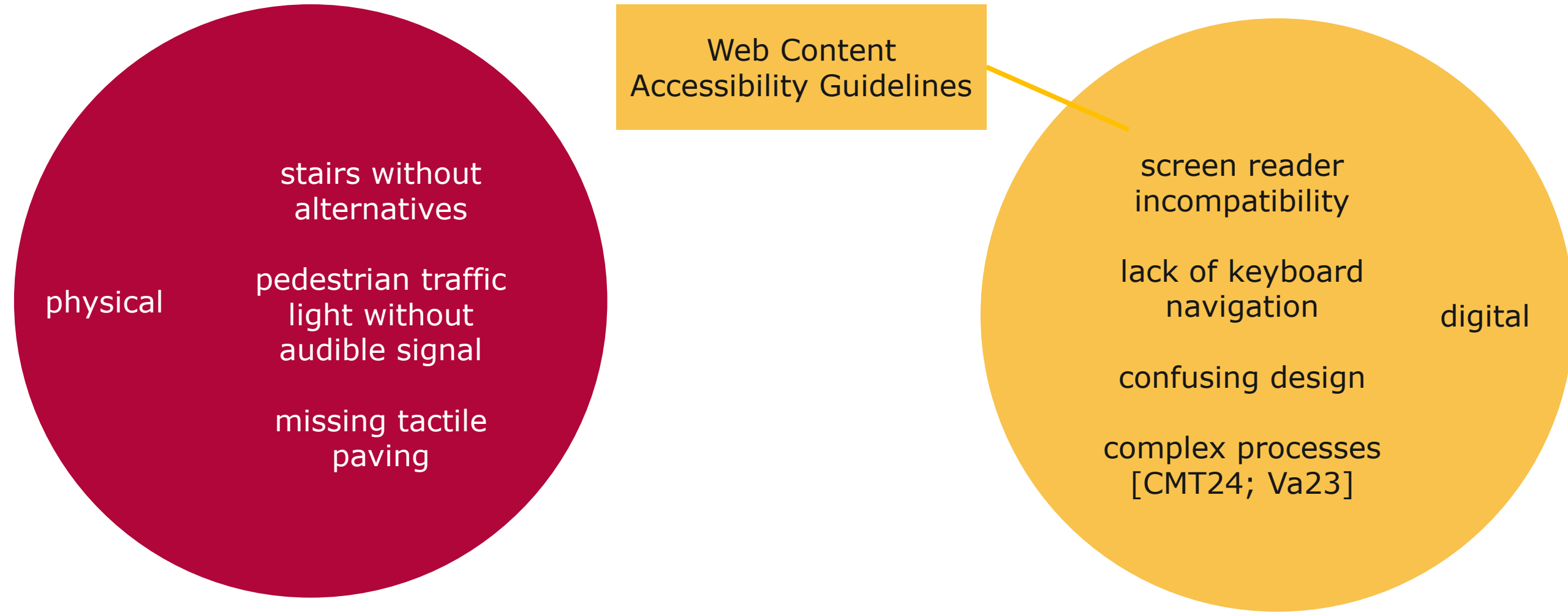
<https://gi.de/>

Welches Inhaltselement ist nicht barrierefrei / hat technische Probleme?*

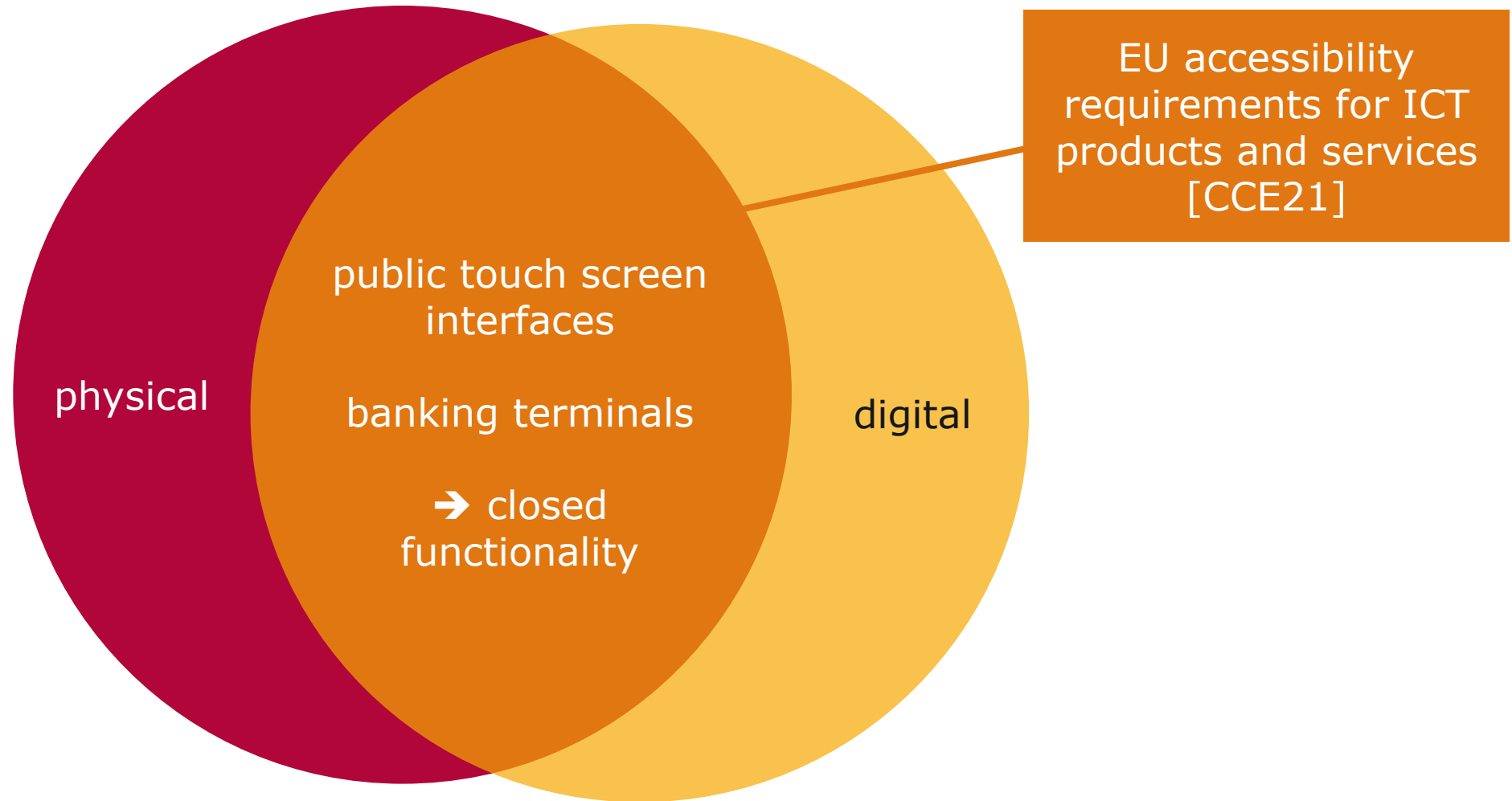
Cookie-Banner

(mit Keyboard-Navigation kann der Cookie-Banner zwar erreicht werden, aber das erfordert in etwa 40-42 mal die tab-Taste zu drücken. Ggf. kann darüber nachgedacht werden, den Tab-Index vom Cookie-Banner anzupassen, damit z.B. Menschen die mit der Maus nicht navigieren können aber noch etwas/wenig sehen können und deshalb Keyboard-Navigation nutzen, nicht während dieser ca. 40 tabs ca. 1/4 vom Bildschirm nicht sehen können.)

Inaccessibility in Different Realms I



Inaccessibility in Different Realms II



EU accessibility requirements for ICT products and services [CCE21]

- Similar to the WCAG, Information Communication Technology (ICT) must be operable
 - Without vision
 - With limited vision
 - Without the ability to see color
- Also focus on **physical characteristics and surroundings**, e.g.:
 - All control surfaces must be within reach
 - Private information (such as passwords) should not be read out loud. Instead, a private listening mechanism should be used.
 - Minimise photosensitive triggers
 - Accessibility features can be activated by the users who need it



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Missing Participation

- Disabled people are **rarely included** in the tech design process, because their expertise is devalued. [Va23]
- This **undermines the autonomy** and voice of disabled users, because they are not consulted about technologies that impact them.
- Even if all boxes are checked, a technology that is accessible in theory is **not necessarily accessible or easy-to-use in practice**
 - guidelines can be incomplete
 - lived-experience of disabled users is neglected
 - e.g., navigating <https://gi.de/> (as of 09.06.2026) requires 40+ tabs to reach the pop-up cookie banner – which is impractical for many users who rely on keyboard navigation



Nadia: Participation done right [Va23]

- existing digital government services were inaccessible/exclusionary
- Nadia was envisioned as a **digital assistant** by and for people with disability, designed to:
 - simplify access to services
 - reduce bureaucratic barriers
 - support independent interaction with government systems
- **Participatory design**
 - a diverse group of disabled people were involved right from the beginning (i.e., the problem definition)



Nadia: Participation done wrong [Va23]

- executive **managers and the disability board to be replaced** with *"corporate heavyweights from the banking and insurance sectors"* [Va23, p. 7]

"We're not interested in talking to a reference group anymore, we know what we're doing" [Va23, p. 7]

- Power imbalances were restored due to the discomfort of authorities to **share power**.
- As Nadia's release was **postponed indefinitely**, the collaboration collapsed, and the original vision could not be realised.



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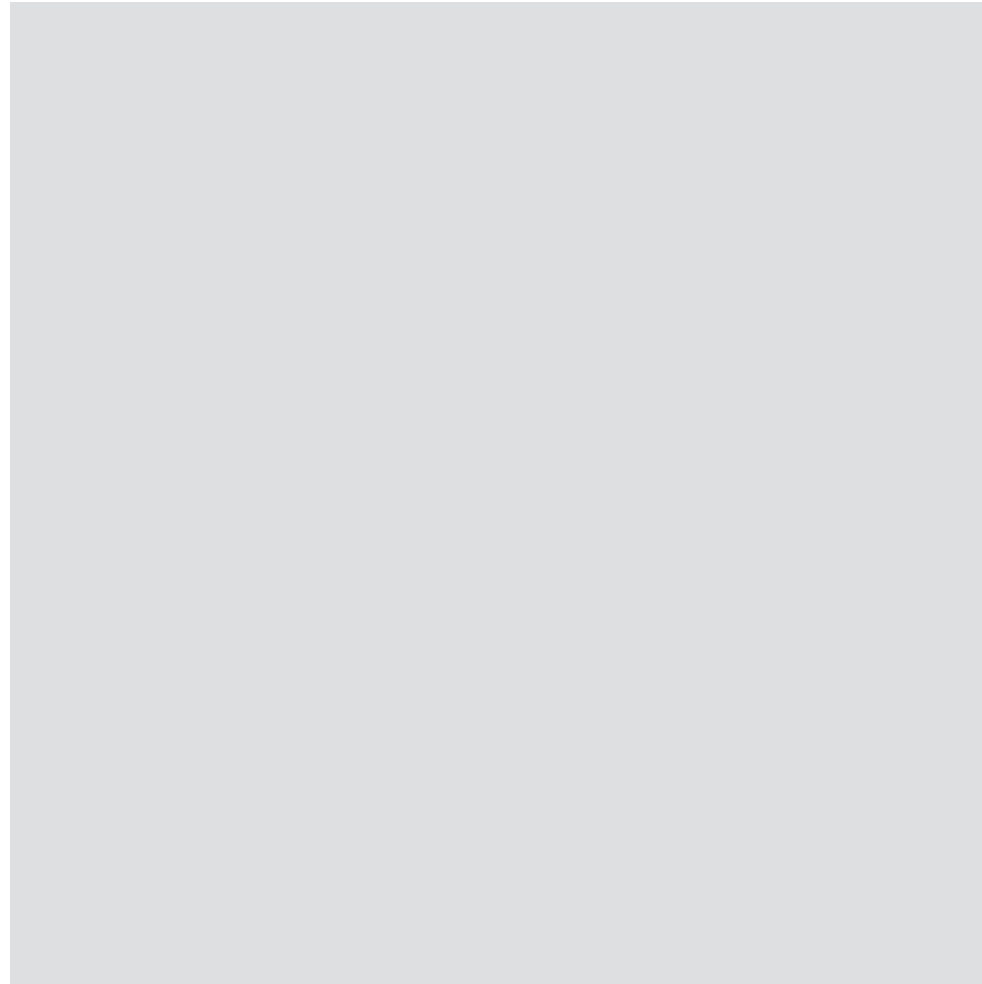
- Participation

Relationships between the Dimensions

Discussion

Participation

Bias



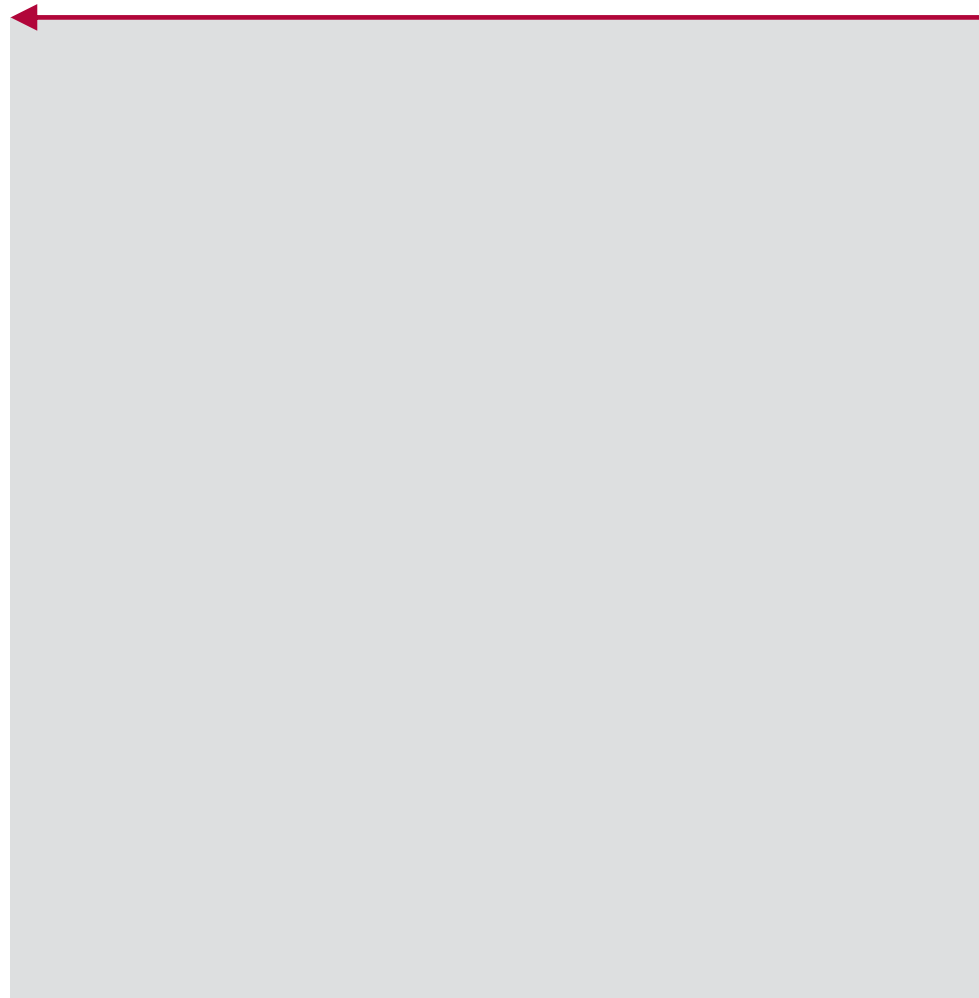
Accessibility

Design

Participation

hinders participation

Bias



Accessibility

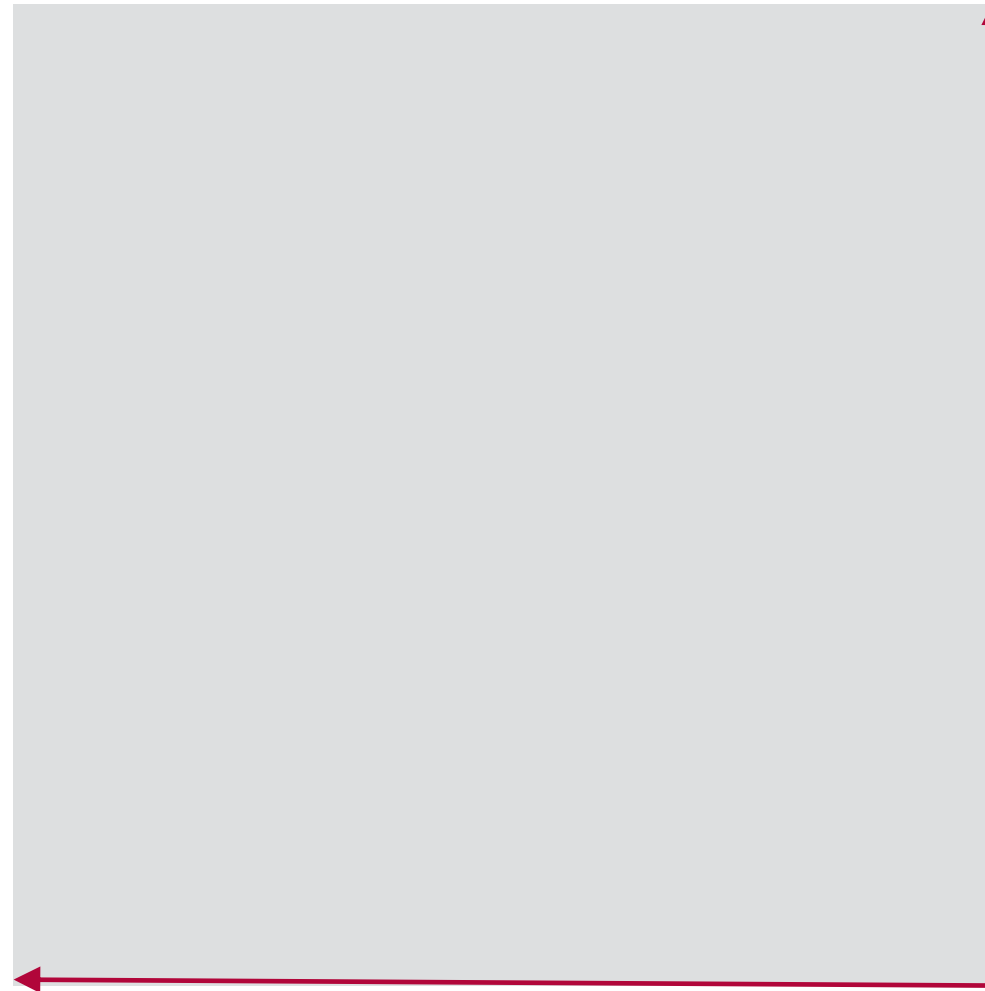
Design

Participation

Bias

Accessibility

Design



realises accessibility

caution:
might reinforce bias

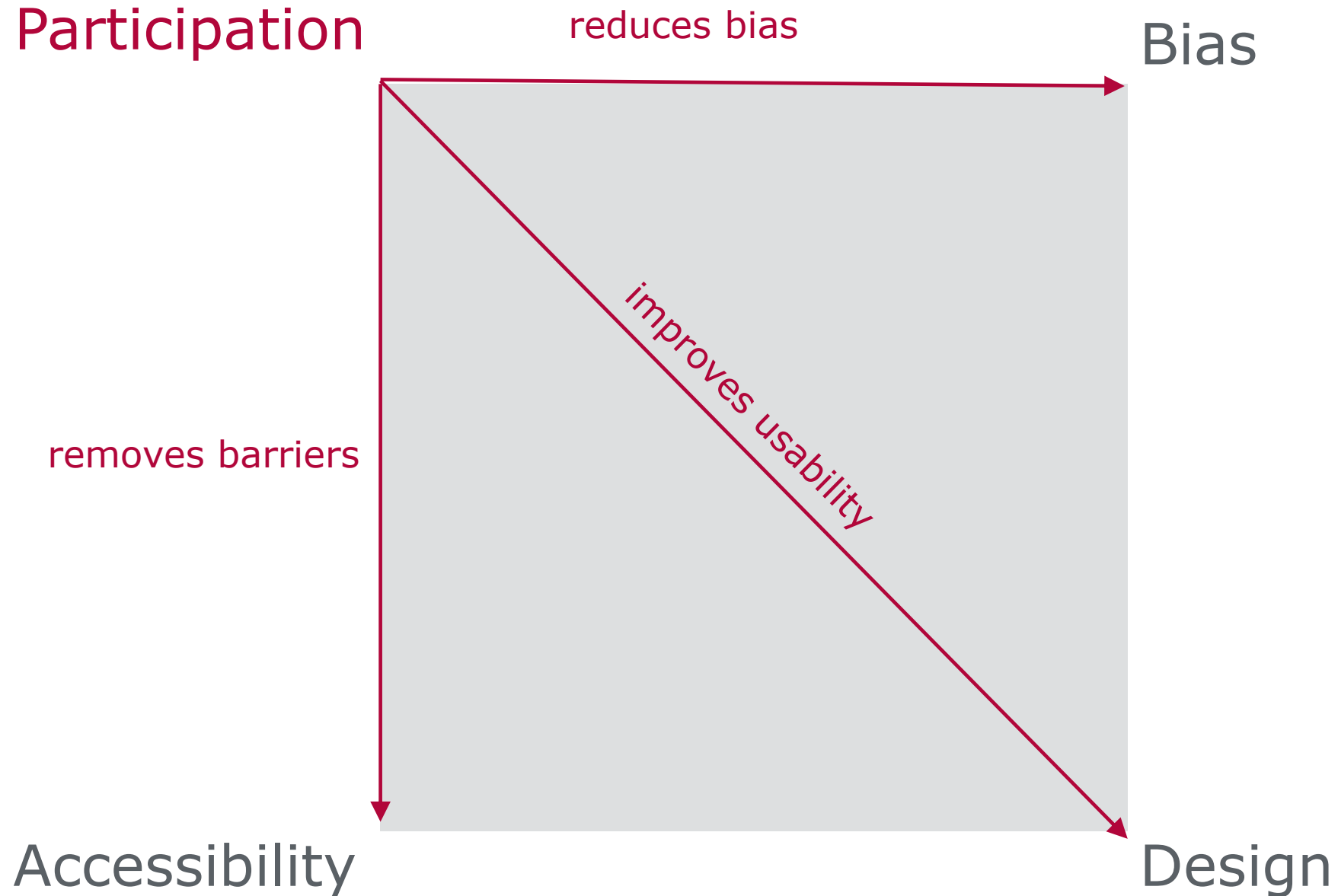
Participation

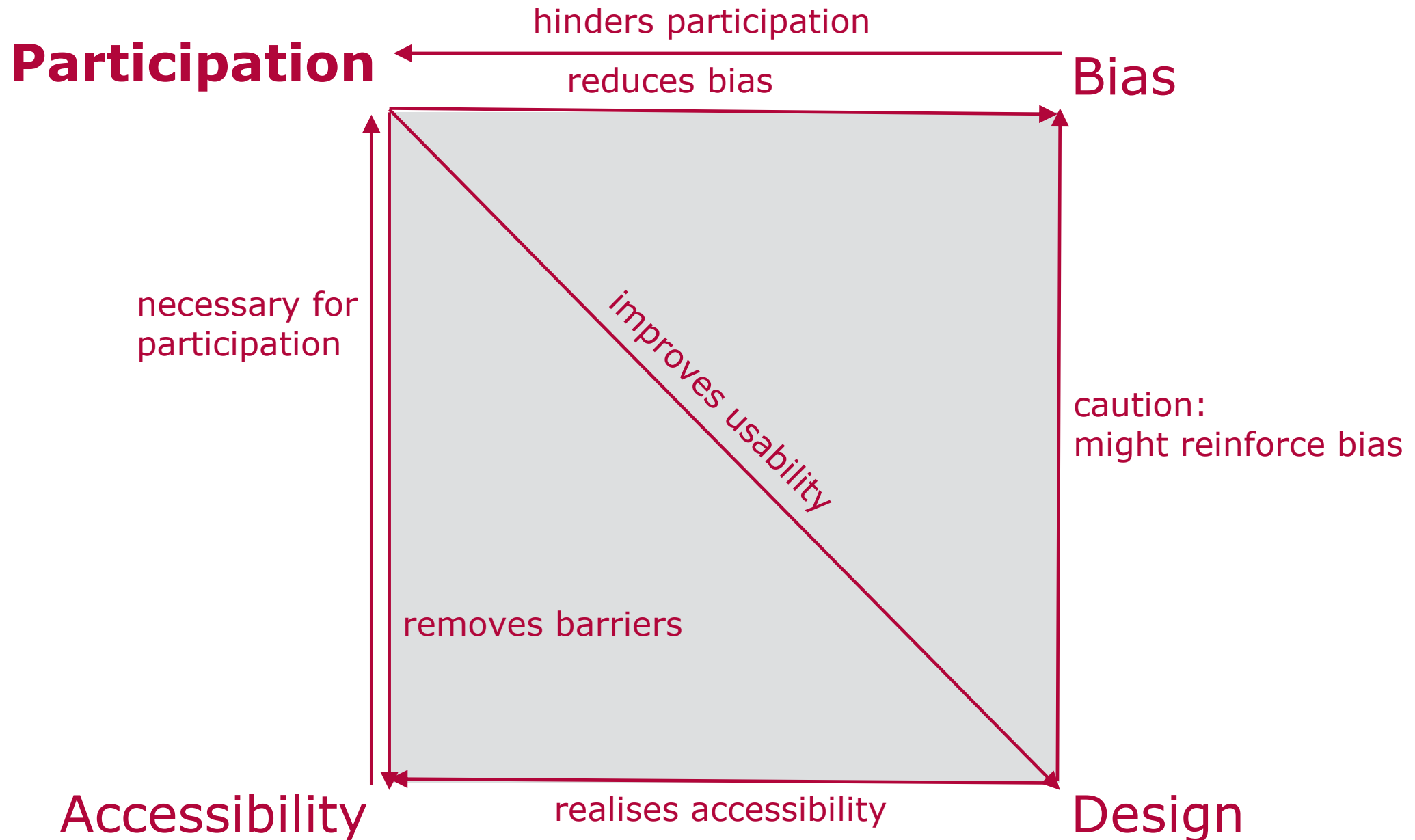
Bias

necessary for
participation

Accessibility

Design





Central Question:

What ethical responsibilities do computer scientists have to work toward inclusion of disabled people in digital systems, and what are the limits of these responsibilities?

Scenario 1

Scenario 2

Scenario 3

Central Question:

What ethical responsibilities do computer scientists have to work toward inclusion of disabled people in digital systems, and what are the limits of these responsibilities?

Scenario 1:

You are working on a software project at **university** and assume that the software will never be published. How much should you care about accessibility?

Scenario 2:

You develop **open-source** applications in your spare time. How much should you care about accessibility?

Scenario 3:

You are a middle **manager** at a well-known software company. One of your developers lets you know that your product is lacking many accessibility requirements; and solving them would require much time and resources. You are already behind with your current goals. What do you do? Where are your priorities?

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