Collaborative Sciences Center for ROAD SAFETY

www.roadsafety.unc.edu

# Coffee and Conversation III

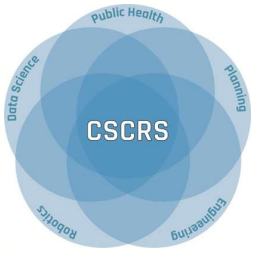
**Building Resilience into a Transportation System for All**



1

## CSCRS

**Mission:** To create and exchange knowledge to advance transportation safety through a multidisciplinary, Safe Systems approach.

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2

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# Designing for All
# (A human factors perspective)

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3

## What is a “disability”?

A physical or mental impairment that substantially limits one or more major life activity

(ADA)

The inability to accommodate poor design

(Ralph Caplan)



4

## Disability statistics

- 56.7 million people
  - 19% of the US population
  - 37% over 65
  - 71% if over 80
- 59% are *not* employed
  - 21% with severe disabilities experience persistent poverty (vs. 14% of general population)
  - Median monthly earnings 28% lower than for general population



5

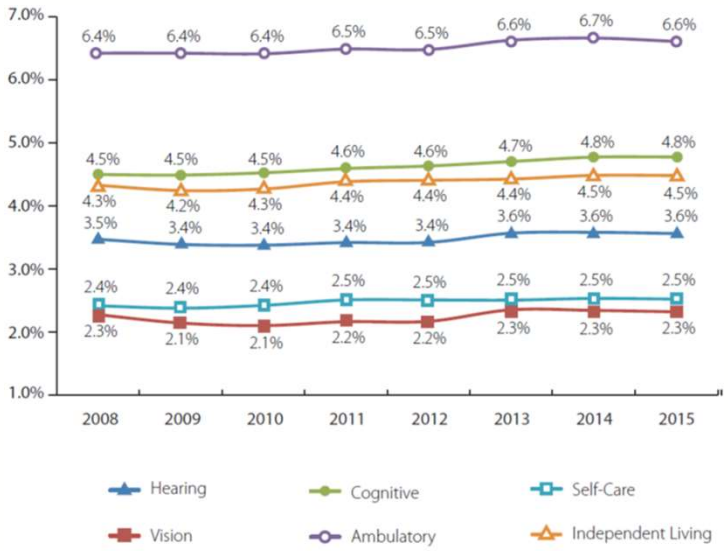
## More statistics

- Difficulty seeing: 8.1 million
  - 2 million "blind"
- Difficulty hearing: 7.6 million
  - 1.1 million "severe"
  - 5.6 million with a hearing aid
- Difficulty walking: 31 million
- Difficulty lifting or grasping: 20 million
- Difficulty with ADL: 9.4 million
  - 5 million require assistance
- Difficulty with IADL: 15.5 million
  - 12 million require assistance
- 7 million depressed or anxious



6

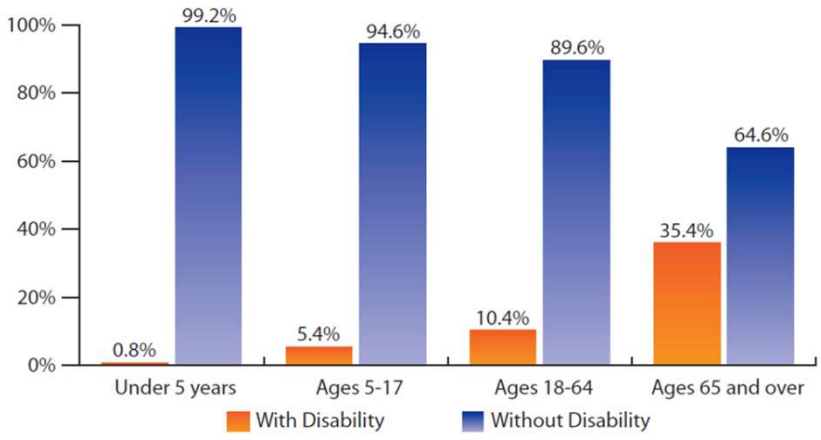
## Percent of Population with a Disability





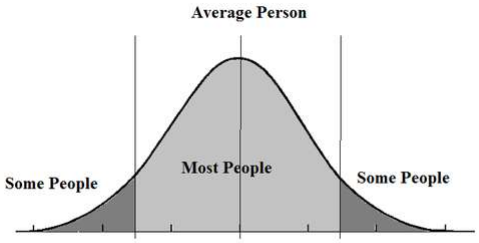

7

## Age distribution of Disability






8


Average Person
Some People
Most People
Some People



9


SAXBYS
BLOWOUT
FREEMANS
FREEMANS



10

## Hearing disability?



11

## Ambulatory, cognitive & hearing disability



12

## Case study: curb cuts

- Designed in 1945 for wheelchair access
- … Also useful for baby carriages, shopping carts, baggage carriers, bicycles, skateboards, eScooters, etc.

Designing for specific disabilities can provide new insights



13

## Design Approaches

- Change the person
  - e.g., surgery, education, skill development
- Provide bridging tools
  - e.g., devices to adapt individual parts of the world to match skills
- Change the way the world is designed
  - e.g., Universal and accessible designs

Universal design - The practice of designing products and environments to be usable by all people, to the greatest extent possible, without adaptation or specialized design.



14


15

## General needs


- Perceive
  - Controls, feedback, and displayed information
  - Passive and dynamic (e.g., status)
  - Multiple sensory modalities
- Understand
  - How to use
  - Interpret displayed information and output
- Operate
  - Safely carry out all the functions within the time allowed
    - Consider efficiency, competition & productivity requirements
  - With equivalent privacy and security to other users.
  - Some disabilities may pose additional risk if people have difficulty seeing, moving, or changing their behavior to avoid physical injury.
- (Compatibility with assistive technology)




16

## Example guidelines

- Maximize the number of people who can hear an auditory signal
  - Use sounds in middle to low frequencies (500-3000 Hz)
  - Use 2 middle to low frequencies (300-750 Hz, 500-3000 Hz)
  - Have a brief alert indicating a message is coming
- Communicate important information through redundant channels (audio, visual, tactile)
- Consider physical placement and line of sight
  - Visual information should be visible from multiple heights
  - Consider reach envelopes



17

## More guidelines

- Make controls easy to find and identify
  - Put labels with controls
  - Follow movement stereotypes
- Make visual information clear and readable
  - Maximize contrast
  - Large letters, mix upper and lower case
  - Color should not carry information (consider shapes instead)
  - Use filters and surface treatments to minimize glare (for all ages!)
  - Don't abbreviate
- Keep things simple!



18


19

## Universal Design Principles

- Equitable use
  - The design is useful and marketable to people with diverse abilities
- Flexibility in use
  - The design accommodates a wide range of individual preferences and abilities
- Simple and intuitive
  - Use of the design is easy to understand, regardless of the user's experience, knowledge, language skill or current concentration level
- Perceptible information
  - The design communicates necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities
- Tolerance for error
  - The design minimizes hazards and the adverse consequences of accidental or unintended actions
- Low physical effort
  - The design can be used efficiently and comfortably and with a minimum of fatigue
- Size and space for approach and use
  - Appropriate size and space is provided for approach, reach, manipulation, and use regardless of user's body size, posture or mobility

Center for Universal Design



20

## THE COMPLETE TRIP

After his doctor's appointment, Andy decides to take a spontaneous trip to meet a friend at a coffee shop in an unfamiliar part of town. Using ATTRI's **pre-trip concierge**, **wayfinding and navigation**, **robotics and automation**, and **safe intersection crossing** applications, Andy can travel with confidence throughout his trip.


**1. Plan and Book a Trip**
Andy uses a **pre-trip concierge application** to plan and book his trip from the doctor's office to the coffee shop.

**2. Travel to Transit Station**
An **automated shuttle** (rideshare service) is dispatched to take Andy to the transit station based on his booked trip. Once there, an **assistive robot** helps Andy to his bus platform.

**3. Ride the Bus**
While on the bus, Andy receives direction on when to pull the Stop Request cord from his **wayfinding and navigation application**. After he departs the bus, the application provides Andy with turn-by-turn walking directions to the coffee shop.

**4. Cross the Street**
As Andy approaches an intersection, his **safe intersection crossing application** communicates with the traffic signal to ensure sufficient time for him to safely cross the street, and notifies him when it is safe to begin crossing. The application also communicates with nearby cars to notify them of Andy's presence in the intersection.

**5. Arrival at Destination**
Andy safely arrives at his destination, while the **pre-trip concierge application** plans his return trip home.



21

## Further reading

- Principles of Universal Design (poster)
- https://projects.ncsu.edu/design/cud/pubs_p/docs/poster.pdf

- Universal design and accessible transit
- http://es.easterseals.com/site/EcommerceDownload/Universal_Design_FactSheet-5821.pdf?dnl=90752-5821-761N6ivu74JPUrFe

- Accessible Transportation Technologies Research Initiative (ATTRI)
- https://www.its.dot.gov/research_areas/attri/index.htm

- NACTO Universal Design elements
- https://nacto.org/publication/transit-street-design-guide/stations-stops/stop-design-factors/universal-design-elements/



22

## Questions?

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23