Vehicle Accessibility Innovation

“Barrier-Free Mobility” Research Insights

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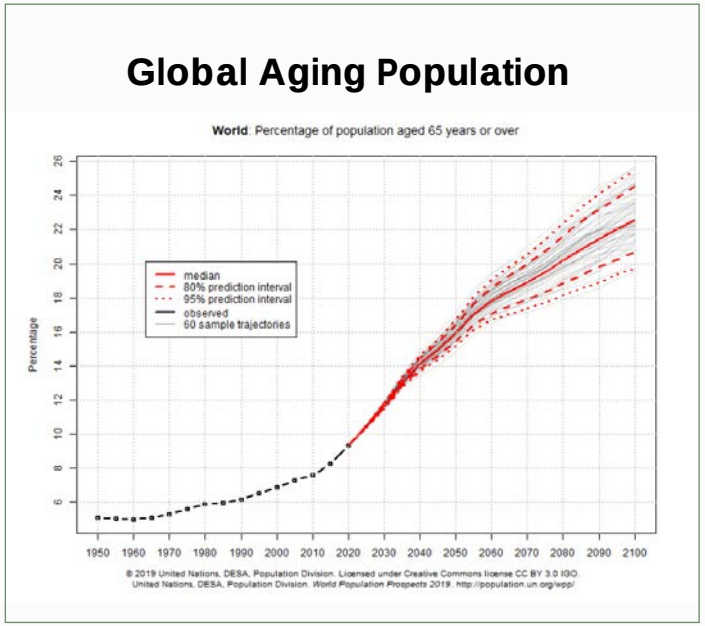
GM Global Market Research

Who are People with Accessibility Issues

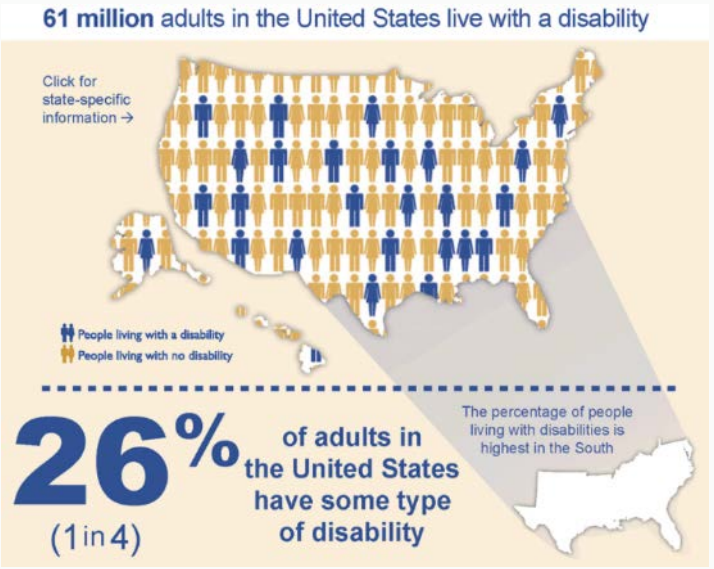
By the Numbers

20% of Global Population have a Disability

26% of US Population have a Disability



Data Source: UN World Population Data



CDC: Disability Impacts All of Us

+ Aging Population 65+, set to double to 1.5 billion globally by 2050

+Temporary Disability 5.6%/year

+Caregivers 20% of US adults

+Intersectionality

This is NOT a niche market

2021 Barrier-Free External Workshop :
Key External Stakeholders are also focused on Barrier-Free Mobility

In addition to our own “Barrier-Free Mobility” research, GM has been invited to participate, discuss, and explore the Barrier-Free Mobility insights in a series of presentations & discussions with external consortiums that are focused on Accessibility.

- Including:
  - Autonomous Vehicle Alliance (AVA): https://pocolabs.com/ava/
  - U.S. Department of Transportation https://www.transportation.gov/accessibility/inclusivedesign
  - Intelligent Transportation Society of America (ITSA): https://itsa.org/
  - U.S. Access Board: https://www.access-board.gov/av/
  - MCity: https://mcity.umich.edu/our-work/research/impact/accessibility/
  - AARP: https://www.aarp.org/
  - Mobility on Demand Alliance: https://www.modalliance.org/

Department of Transportation

Inclusive Design Challenge

Designing solutions to enable people with disabilities to use automated vehicles

Barrier-Free Research Project

An in-depth approach to identify opportunities, define common needs and understand market potential for Barrier-Free Mobility Solutions

Three Phases of Research Completed:

Phase 1: Literature Review ~ summary of previous studies, white papers, etc., associated with the subject matter

Phase 2: One-on-one expert interviews with key industry stakeholders

Phase 3: Ethnographic research with targeted consumer ~ end user feedback, & journey mapping

You can access more about the "Barrier-Free Mobility" research consortium & watch a recording of the external workshop here: https://itsa.org/event/accessible-and-barrier-free-mobility-workshop/

What does it mean to be “Barrier-Free”?

Barriers to mobility may be associated with:

- Physical Limitations/Disabilities
- Cost Barriers
- Coverage / Access Issues
- Technical Limitations
- Design Limitations

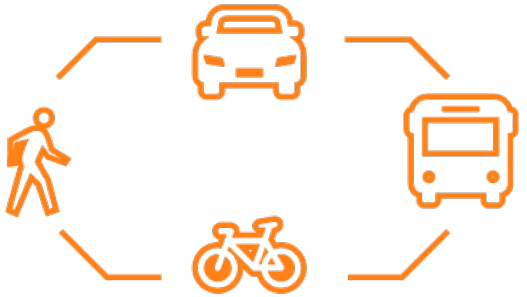
Phase 1: Barrier-Free Literature Review

Key Insights

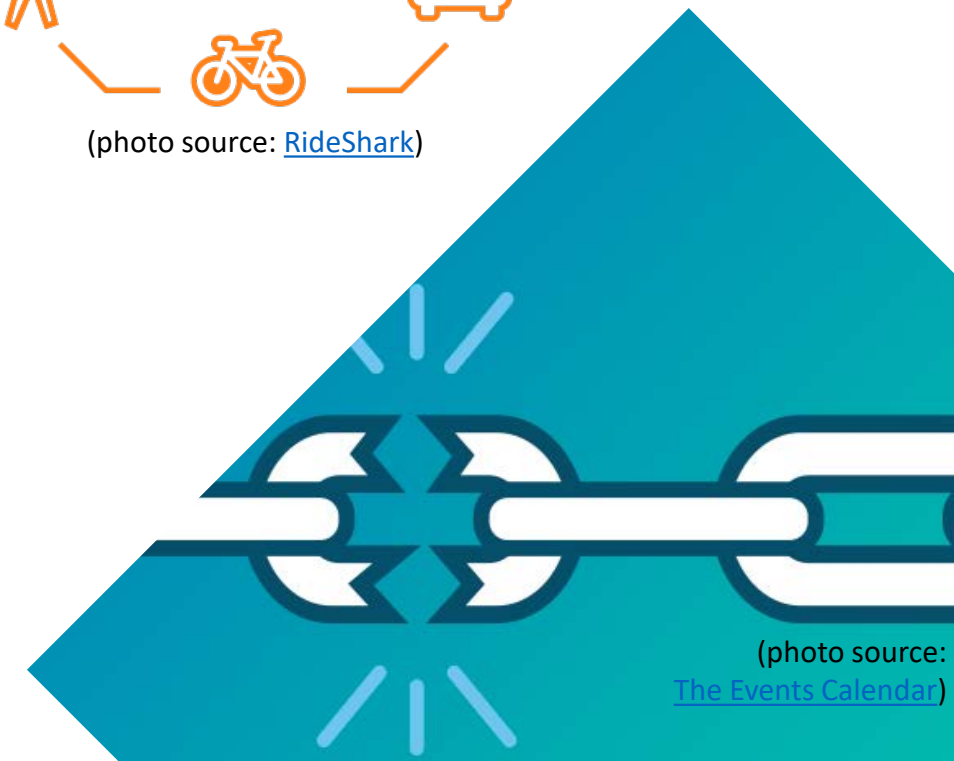
- The ability to **move independently is critical** to a healthy, productive lifestyle.
- Every **piece of a trip – from start to finish – must be accessible**.
  - Identifying gaps in service, using the Complete Trip philosophy, can help identify & address barriers.
  - Leveraging technology to identify accessible and inaccessible routes and issues can help users with disabilities to safely and efficiently reach their destinations.
- **Evolving technologies & services** offer the potential to significantly transform the transportation ecosystem and reduce existing mobility barriers.
  - Connectivity, mobile applications, and semi/full autonomous applications provide opportunities.
- Automobile manufacturers should **seek feedback and involvement** from the full range of potential users and experts.
  - Dynamic vehicles including accessibility features that accommodate wheelchairs & other mobility aids help to make vehicles more widely utilizable.
- **Identifying potential biases,** and being vigilant about addressing them when discovered, is important.
- **Mobility On Demand** can help to in fill gaps in transit services, by providing first/last mile service to and from transit centers.
- **Updates to curb management policies** and priorities can reduce congestion while improving accessibility for all users.

“The Complete Trip” ~ Accessible & Barrier-Free

- Accessibility from origin to destination
  - Trip planning
  - Travel to mobility mode
  - Vehicle boarding and off-boarding
  - Stops or transfers
  - Travel to final destination *(last mile/feet)*
- If one link is inaccessible, then access to subsequent links is broken and the trip cannot be completed



(photo source: RideShark)



(photo source: The Events Calendar)

Phase 2: Expert Interviews Completed

Valerie Lefler
Executive Director at Feonix Mobility Rising

Feonix MOBILITY RISING

Graeme Masterson
Global planning transit lead at Stantec

Stantec

William Purves & Mark Hynes
Planning & Program Development

ANN ARBOR Center for Independent Living

Dave Bullkowski
Executive Director at Disability Advocates of Kent County

DisabilityAdvocates

Patrick Parkes
Business Development Coordinator at Disability Advocates of Kent County

DisabilityAdvocates

Drennen Shelton
Planner at The Metropolitan Transportation Commission, San Francisco Bay Area

METROPOLITAN TRANSPORTATION COMMISSION

Elliott Doza
Project Manager of Service Planning at COTA

COTA CENTRAL OHIO TRANSIT AUTHORITY

Amy Hockman
Director of Mobility Services at COTA

COTA CENTRAL OHIO TRANSIT AUTHORITY

Claire Stanley
American Council of the Blind

ACB American Council of the Blind Together for a bright future

Carol Wright-Kenderdine
Assistant Vice President Mobility & Transportation

easterseals taking on disability together

Eric Sinagra
CEO of PathVu

pathVu

Eric Sinagra
ADA Trainer

ADA Americans with Disabilities Act

Phase 3: End-User Ethnographic Interviews Completed

Using a Wheelchair

Using a Wheelchair

Hearing Impaired, Cochlear Implants

Blind and uses a cane

Wheelchair Users: Want to be as independent as possible. Enabling independence builds self-esteem & non-reliance on others. Wheelchair users do not want to ask for help. They do not want to be made to feel different. They want to be viewed like everyone else. They want solutions to be quick and easy. And they do not want to slow down others in their party.

Hearing: Individuals with hearing impairments depend on visual cues that are clear and concise.

Cognitive: Individuals with cognitive issues are especially sensitive to noise and vibration issues.

"Barrier-Free Mobility" Research & Workshop: Identified 3 Key Areas of Opportunities

Opportunity 1:

Merging the Physical World with Digital Wayfinding Tools

- Personalization of The Mobility Experience
- Importance of Audio Cues
- Accessible Real Time Information
- Unbanked Alternatives
- On-Demand Booking
- Wayfinding for Curbs and Sidewalks

Opportunity 2:
Understanding How Universal Design Language Can Impact the Future of Mobility

- Vehicle Interior Features
- Zero Entry Importance
- Head Clearance Importance
- Vehicle Design Cues
- Designing for Usability by 85% of the Public

Opportunity 3:
Coordination of Design Languages Between Vehicles and Infrastructure

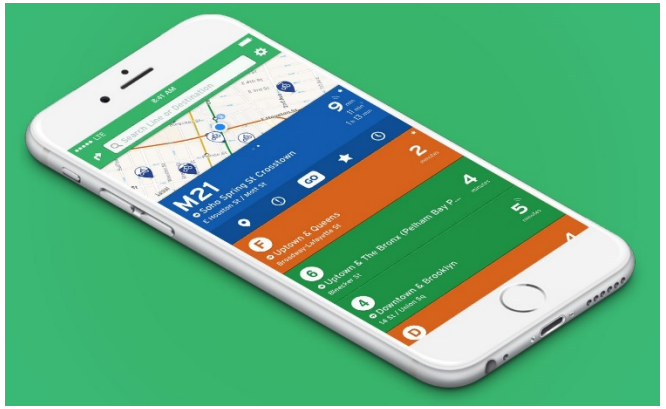
- Coordinating Vehicle and Infrastructure Design Language
- The Vehicle Creating its Own Infrastructure Where Needed
- Addressing Curb Opportunities and Pick Up / Drop Off Zones

Integrated, multimodal trip planning/payment

The expansion of integrated trip planning and payment platforms for multimodal, shared-mobility services is a notable mobility trend that offers the potential to make it easier for travelers to understand their mobility options and make informed, personalized travel decisions.

e.g.) Utah Transit Authority (UTA) & Transit app partner:

- Real-time information on nearby bus & rail options.
- Transit departure times
- Real-time tracking
- Route-specific push notifications
- Go feature: step-by-step navigation and information on other modes – including Lyft, Uber, GREENbike, and Spin – for their first/last mile travel needs. Lyft and Uber rides can be booked and paid for within the app.



(photo source: Columbus Underground; Transit)

Opportunity 2:
Understanding How Universal Design Language Can Impact the Future of Mobility

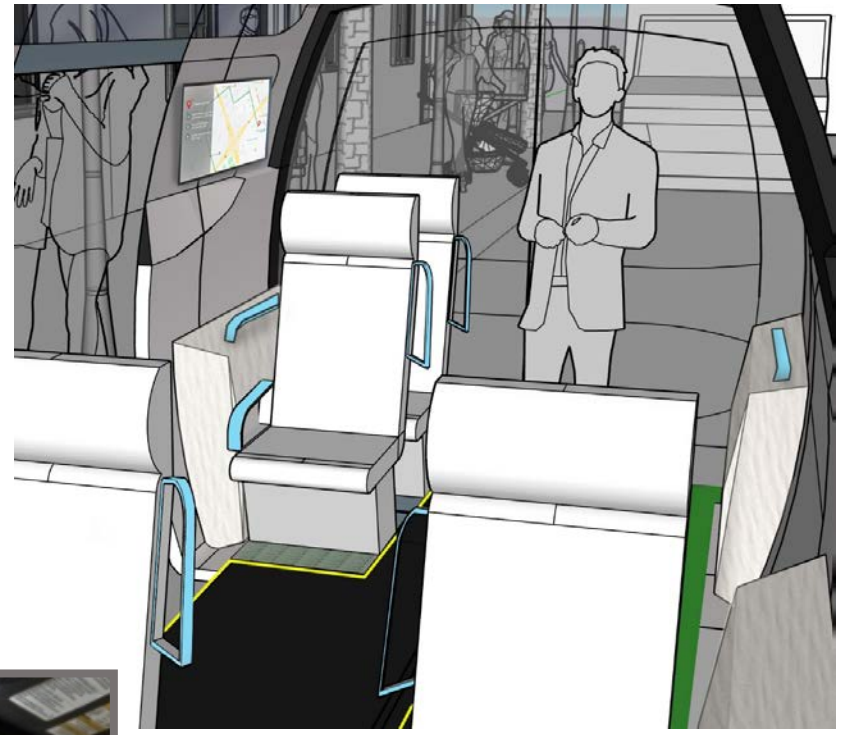
Vehicle design was top of mind when discussing important vehicle qualities, including:

- **Entry / egress – Zero Entry**
- **Flexible seating** that assists entry/egress for drivers and to keep people from feeling excluded from their group for riders.
- **Grab bars** for easy maneuverability.

It is noted that when people with limited abilities travel with others, they are often separated because of their special seating accommodations. It is preferable that a vehicle could accommodate anyone in any seat so a group can stay together. They do not want to feel "different" and want the same respect as the other passengers.

"Seeing a new mode of transportation with how we live life (TNCs), not one was accessible in the beginning and didn't serve people with disabilities. Nobody tried to have something that was for everybody. So many people are shut out. Unforgivable."
–Drennen

Vehicle Design Features



Barrier-Free Mobility ~ Key Consumer Needs

Areas of Vehicles to Focus on Improvements

- **Entry & Egress** – *zero entry, better access, no lift-over*
- **Assistance** – *assistance such as grab handles, cargo lifts, etc.*
- **Seating** – *easy to get in/out, feeling secure, comfort, etc.*
- **Storage / Cargo** – *better access and no lift-over for small & large items*
- **Visibility** – *better visibility, no obstructions, help with night-vision*
- **Safety & Security** – *lighting, security features, less vulnerable (esp. at night)*
- **Info / Displays** – *easy to see, read, understand, & use*
- **Dignity** – *designs & features that have appeal and provide dignity*

Entry/Egress: Balance Issues

Aging populations & those with balance issues:

Issue: Increasing number of aging consumers and those, of any age, with physical issues, cannot enter/exit a vehicle by the “lift your leg” method…with one leg lifted they are unbalanced and/or put further strain on their bodies.

Step 1: get as close to the vehicle interior as possible
Step 2: turn around and “fall” into the vehicle (leaving both legs on the ground)
Step 3: turn legs into the vehicle *(reverse steps to get out)*

Vehicle Needs: accessible entry/egress areas, assistance features, head clearance, seating that allows for easy entry/egress yet secured when moving, etc…

Video of “balanced” entry/egress method:
https://www.youtube.com/watch?v=tmkfrJnTA9o

Entry/Egress: Manual Wheelchair User

Video of wheel-chair user's vehicle entry/exit:
https://www.youtube.com/watch?v=b7biVXVemdU

Wheel-chair users:

Step 1: get as close to the vehicle interior as possible
Step 2: Use grab handles, door, &/or steering wheel to pull up and into vehicle

Step 3: take wheels off and place in vehicle

Step 4: fold down wheelchair and swing over body to place in 2nd row seating

NOTE: Utilizes covers to protect for dings & dirt

Step 5: Place in secured position in 2nd row
(places in 2nd row close to within reach)
(keeps front passenger seat empty for other passengers)

Vehicle Design Cues

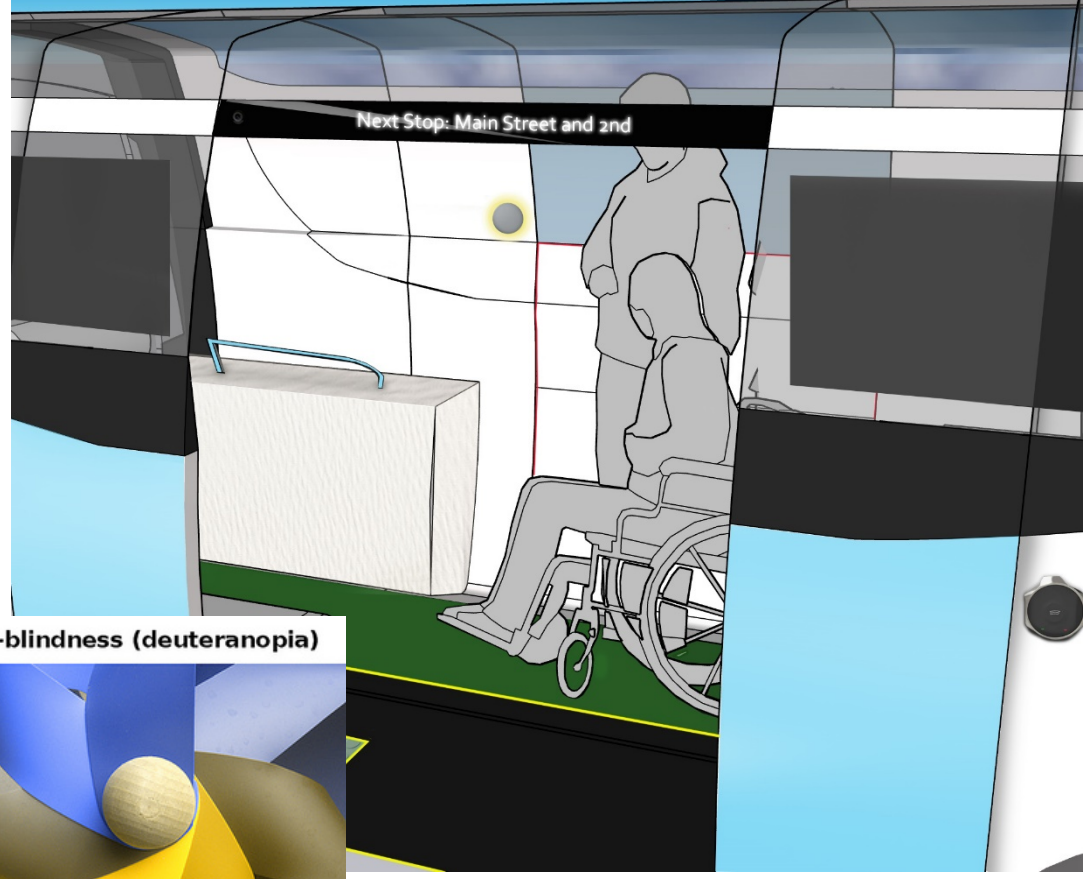
Establishing a **design language for the vehicle interior that can be intuitive and informational for all users.**

The use of sound, textures, colors, materials and lights could be improved across vehicles for all types of users.

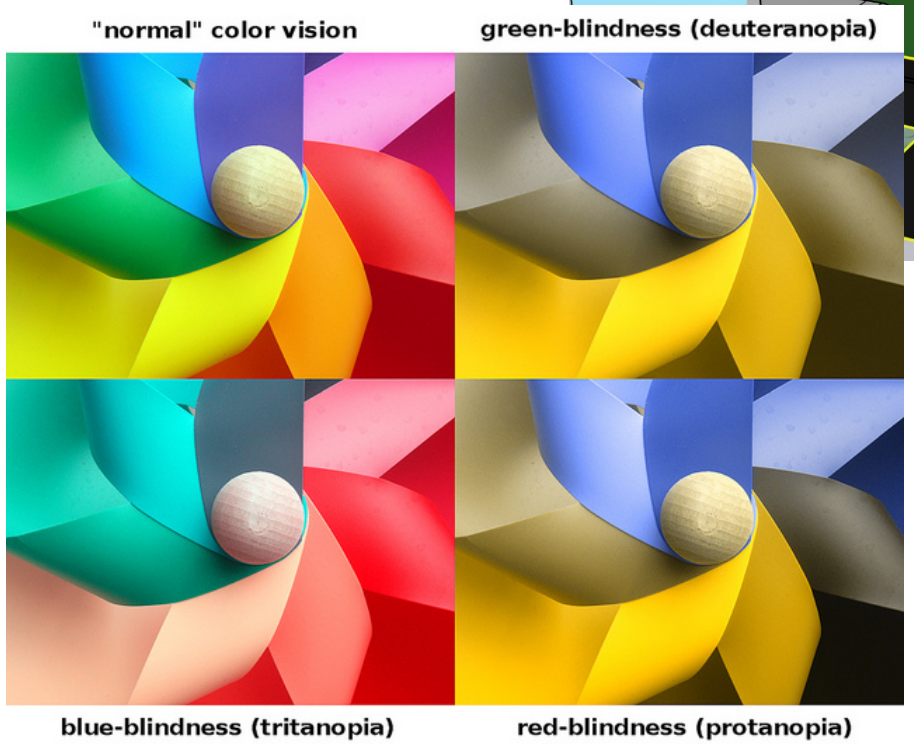
<u>Supported by Proven Needs:</u>

Chris Downey, a blind architect in San Francisco promotes the use of universal design because it not only accommodates people with disabilities, but it is also just as appealing to people without them.

https://www.cbsnews.com/news/architect-chris-downey-goes-blind-says-hes-actually-gotten-better-at-his-job-60-minutes-2020-07-05/



Color Blind



Opportunity 3:
Coordination of Design Languages Between Vehicles and Infrastructure

There is an opportunity for **vehicles and infrastructure to work together as one unified ecosystem and design language**.

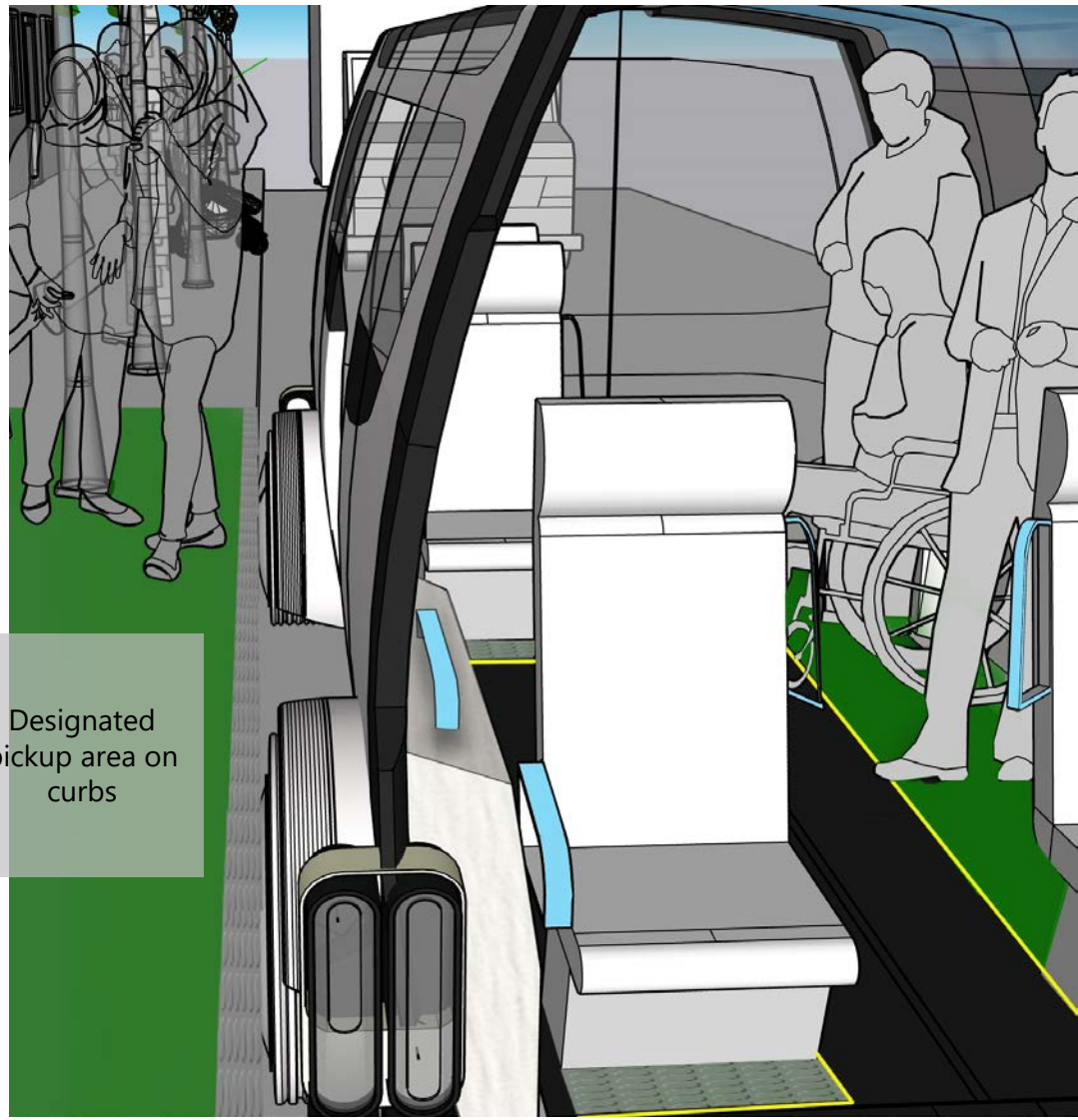
One way this could be accomplished is using the same design cues from the vehicle interior (such as color, texture or lights) at the onboarding areas as well.

The use of technology could also be a key factor to use in coordination with a unified design language. Sensors at the onboarding area could interact with the connected pickup vehicle before it's arrival, speeding up the onboarding process.

Ground clearance disparities

Limited sidewalk availability

Ramp heights are often uncomfortably high from the ground for the user and service animals

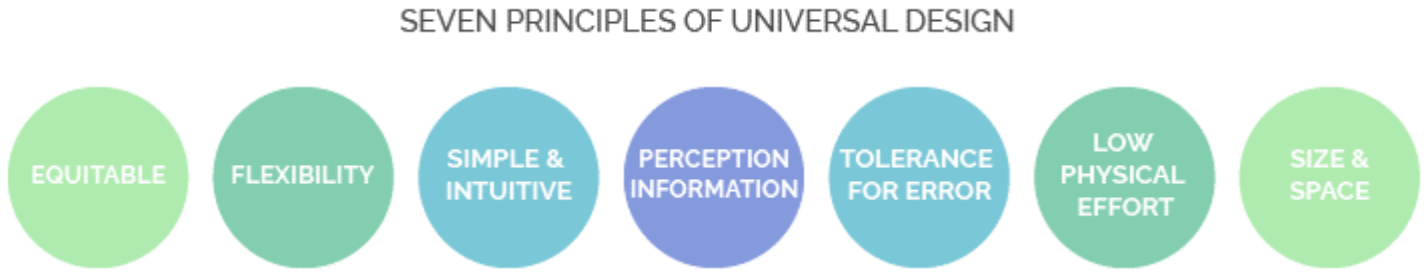


Universal Design Principles ~ Designing for Usability by the 85%

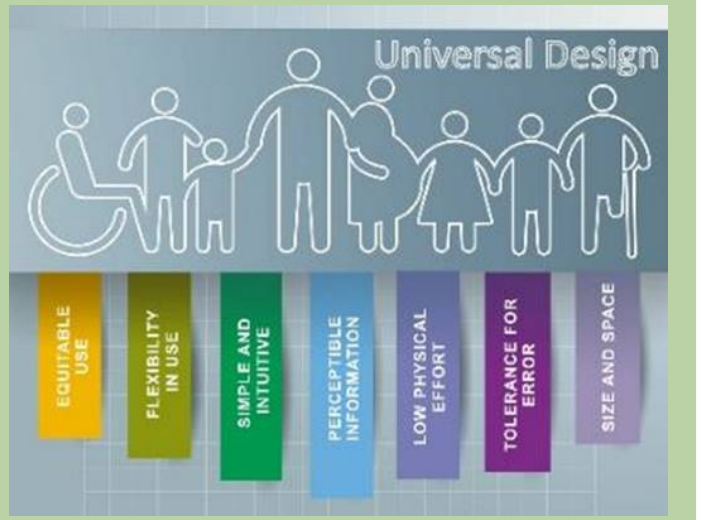
Universal design is the design of buildings, products or environments to make them accessible to more people, regardless of age, disability or other factors.

This could benefit the users:

- Quality of life.
- Self esteem.
- Work and social life.



"The biggest issue overall is **getting away from thinking about accessibility as being something targeted to a specific group (cognitive or physical disabilities) and getting to solve it as more of a universal application**. If you made it easier for everyone to use, would it solve 80-85% of the problem? The last 15% is going to take double the effort of the first 85%"
Graeme Masterson- Global planning mobility lead at Stantec



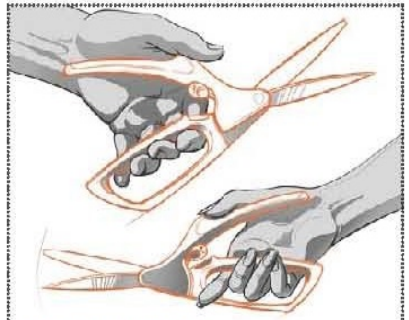
The Principles of

Universal Design

Equitable Use

The design is useful and marketable to people with diverse abilities.

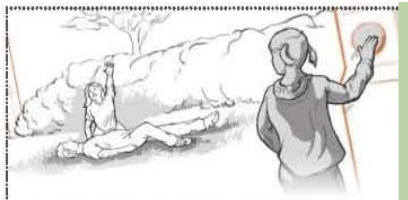
1a. Provide the same means of use for all users: identical whenever possible; equivalent when not.
1b. Avoid segregating or stigmatizing any users.
1c. Provisions for privacy, security, and safety should be equally available to all users.
1d. Make the design appealing to all users.



Flexibility in Use

The design accommodates a wide range of individual preferences and abilities.

2a. Provide choice in methods of use.
2b. Accommodate right- or left-handed access and use.
2c. Facilitate the user's accuracy and precision.
2d. Provide adaptability to the user's pace.



Simple and Intuitive Use

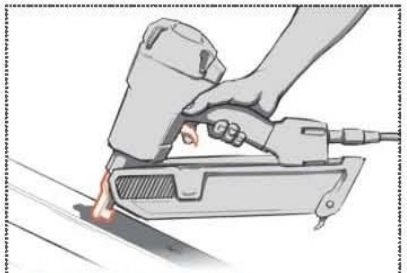
Use of the design is easy to understand, regardless of the user's experience, knowledge, language skills, or education level.

3a. Eliminate unnecessary complexity.
3b. Be consistent with user expectations and intuition.
3c. Accommodate a wide range of literacy and language skills.
3d. Arrange information consistent with its importance.
3e. Provide effective prompting and feedback during and after task completion.

Perceptible Information

The design communicates necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities.

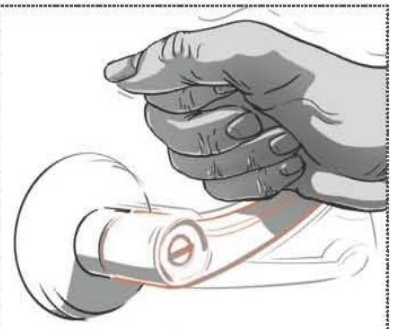
4a. Use different modes (pictorial, verbal, tactile) for redundant presentation of essential information.
4b. Provide adequate contrast between essential information and its surroundings.
4c. Maximize "legibility" of essential information.
4d. Differentiate elements in ways that can be described (i.e., make it easy to give instructions or directions).
4e. Provide compatibility with a variety of techniques or devices used by people with sensory limitations.



Tolerance for Error

The design minimizes hazards and the adverse consequences of accidental or unintended actions.

5a. Arrange elements to minimize hazards and errors: most used elements, most accessible; hazardous elements eliminated, isolated, or shielded.
5b. Provide warnings of hazards and errors.
5c. Provide fail safe features.
5d. Discourage unconscious action in tasks that require vigilance.



Low Physical Effort

The design can be used efficiently and comfortably and with a minimum of fatigue.

6a. Allow user to maintain a neutral body position.
6b. Use reasonable operating forces.
6c. Minimize repetitive actions.
6d. Minimize sustained physical effort.

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.

7a. Provide a clear line of sight to important elements for any seated or standing user.
7b. Make reach to all components comfortable for any seated or standing user.
7c. Accommodate variations in hand and grip size.
7d. Provide adequate space for the use of assistive devices or personal assistance.

https://guides.masslibsystem.org/inclusive/universaldesign

Questions?