

The event will begin momentarily.

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Inclusive Design of Autonomous Vehicles: A Public Dialogue



Accessibility for Passengers with Sensory and Cognitive Disabilities: Part 2
Continued discussion of ride hailing and on-board communication.



Agenda

- Dr. Aaron Steinfeld, Carnegie Mellon University
- Dr. Gregg Vanderheiden, University of Maryland, Trace Center
- Darryl Cooper, Federal Communications Commission (FCC)
- Ted Guild, World Wide Web Consortium (W3C)
- Bruce Bailey, U.S. Access Board
- Q&A and Open Dialogue

PowerPoint slides are available for download from:

www.access-board.gov/av

How to Participate

- Ask Questions to Presenters
 - Submit questions using Zoom's Q & A feature throughout the event
 - Ex. "Question – What are wheelchairs?"
 - Ex. "Question for the first presenter – Did your study look at scooters?"
 - Moderator will paraphrase question to presenters
 - We may not get to all questions
 - As an alternative, you may submit questions via email: events@access-board.gov
- Contribute to the Open Discussion Today
 - Request to speak using Zoom's Q & A feature
 - Ex. "Microphone – I'm Beth from XYZ Company and would like to talk about automated doors"
 - Ex. "Microphone – I'm Alex and I'd like to share my experience using an AV"
 - Host will unmute you (in Zoom), but please check your microphone
 - Moderator will call on you by name to speak
 - ASL – If you wish to be visible for signing, please put that in your request
- Continue the Online Dialogue
 - <http://transportationinnovation.ideascale.com>
 - For assistance, email: ePolicyWorks@dol.gov



Dr. Aaron Steinfeld

Carnegie Mellon
University

TBD Lab

Communication Accessibility in Hailing and Interacting with Autonomous Vehicles

Aaron Steinfeld, *et al*

Transportation Bots & Disabilities (TBD) Lab

Robotics Institute

Carnegie Mellon University

Many Pieces of the Puzzle

NIDILRR

- DRRP on Robotics and Automation for Inclusive Transportation
- RERC on Accessible Public Transportation

US DOT

- Projects from the ATTRI Program

NSF National Robotics Initiative

- NRI: FND: Mutually Aware Social Navigation
- NRI: FND: Human-Robot Collaboration with Distributed and Embodied Intelligence

Additional insights drawn from ONR and NASA projects

Requesting Service

Leverage existing knowledge on making apps, websites, and touchscreens accessible (other talks in this series)

Users often need help discovering service options

- Unfamiliar transportation mode options and capabilities
- Hidden features

Conversational agents still need key advances

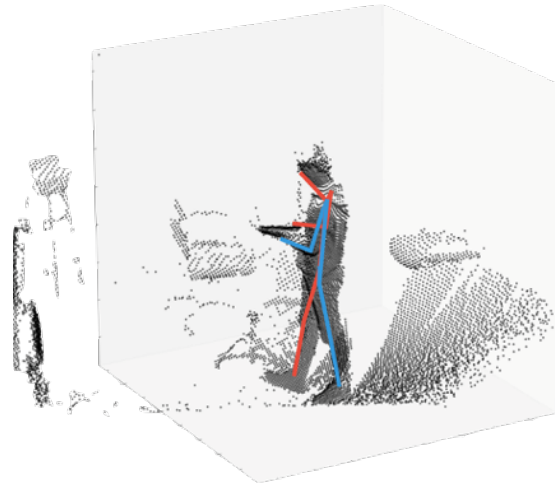
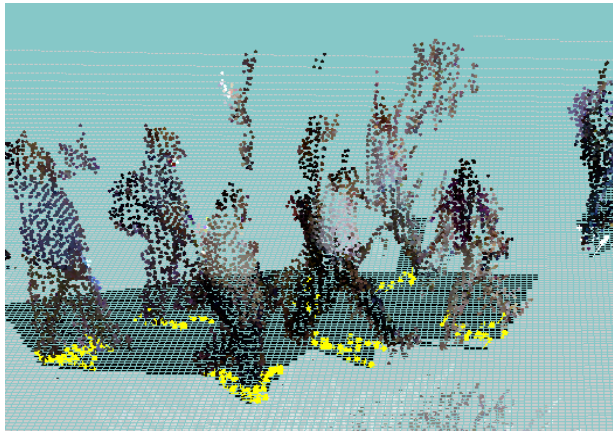
- “Please be here 15 minutes before 5.”
- “Will my bus reach the station in time for my train?”
- (also, Christian Vogler’s comments in last session)

Navigating to/from the Curb

Moving through transportation hubs to the correct curb location

Move through and around crowds

Vehicle pickup/drop-off spots



Rendezvous



Audible signals identify the user as having a disability

- (Anil Lewis in last session)

Visual signals not always effective

- Dense curbs
- Users who cannot see them due to abilities or obstructions

Currently looking at using smartphones and vehicle sensors together to close the gap

Artificial Intelligence Assistance

Learn user preferences

- Macro level: interaction preferences
- Micro level: commonly used destinations and services

Are these preferences shared with third-party systems?

- Privacy
- Data retention

The screenshot shows a mobile application interface for a transit system. At the top, there is a search bar with the text 'Search map' and a 'Map' button. Below the search bar, a blue header displays 'Closest Stop : Forbes Ave At Morev'. A navigation bar contains buttons for 'IN', 'OUT', '61A', '61B', '61C', '61D', and '28X'. The main content area lists four transit options, each with a route ID, a description, and arrival times. The first option is '61A IN: North Braddock Downt...' with arrival times 9, 24, and 39. The second is '61B IN: Braddock-Swissvale Dc...' with arrival times 5, 17, and 32. The third is '61C IN: Mckeesport Homestear...' with arrival times 6, 22, and 44. The fourth is '61D IN: Murray Downtown Via C...' with arrival times 17, 27, and 43. Each entry includes a star icon for favorites and a signal strength icon.

Route ID	Description	Arrival Times
61A	IN: North Braddock Downt...	9, 24, 39
61B	IN: Braddock-Swissvale Dc...	5, 17, 32
61C	IN: Mckeesport Homestear...	6, 22, 44
61D	IN: Murray Downtown Via C...	17, 27, 43

Additional Lessons from Robotics

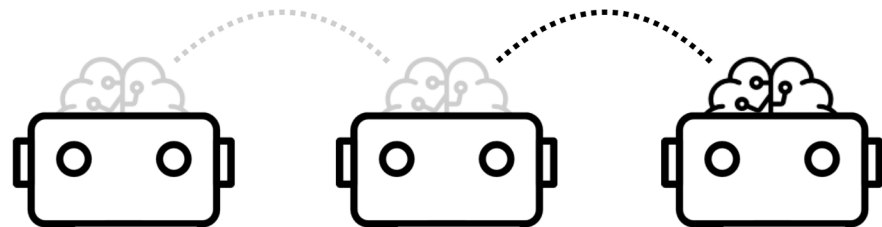
Human trust in autonomy

- Inertia
- Trust calibration

Self-assess performance and communicate to users and bystanders

AI assistants

- AI jumps into the car
- Speech in public settings
- Disclosure of status



Aaron Steinfeld, steinfeld@cmu.edu



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A grant from the Office of Naval Research (ONR N00014-18-1-2503).



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U.S. Department of Transportation

Support from the US DOT through the T-SET University Transportation Center, Mobility21 University Transportation Center, and the Accessible Transportation Technologies Research Initiative (ATTRI) program.



A grant from the National Aeronautics and Space Administration (80NSSC19K1133).

Other lab support from Disney Research Pittsburgh, IBM, and Traffic21 at Carnegie Mellon University, a program developed with the support of the Hillman Foundation.



Dr. Gregg Vanderheiden

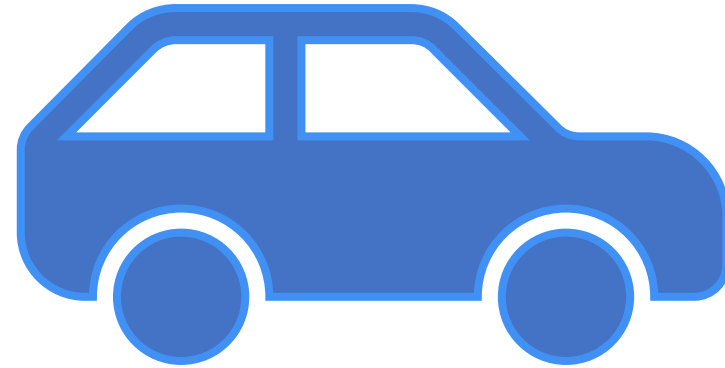
University of
Maryland
Trace Center

Cognitive Access to Autonomous Vehicles

Gregg Vanderheiden Ph.D.

Trace R&D Center

University of Maryland,
College Park



Goal of the presentation

- To highlight some of the many things that need to be considered when designing autonomous vehicles for use by people with cognitive disabilities
- Much more complicated than first appears
- But if / when we can crack the problems - it will be a great advance for these user groups

Cognitive Disabilities do not occur in a vacuum.

- **Often the person will have other disabilities as well**
 - Physical
 - Vision (low vision, blindness)
 - Hearing (Hard of hearing or Aphasia)
 - Deaf and only speak sign language
 - Speech disability (non-vocal, dysarthria, aphasia, stutter/stammer,...)
- **For these individuals, many of the 'general' solutions won't work**
 - Speech interfaces (requires speech)
 - Select from displayed destinations (requires reach and vision)
 - They insert (or touch with) something (requires reach and manipulation)
- **Need to have a spectrum of interface solutions**
 - So that something is available that is within abilities of each person

Problems occur en-route

- **People may change mind en-route**
 - Changing trip is cognitively more complicated / complex than just going somewhere
- **People may panic en-route**
 - Maybe something happens / changes
 - May be spontaneous panic

Best solution to en-route problems - will most likely involve people

- Someone from ride service always available a button press
 - Including signers
 - With access to information about person ?
- Someone very familiar to person, is always 'on call'
 - Perhaps invoke "user's on-call person" BEFORE release of info on person.

Interface issues / design spaces

The Designs & interface options need to cover travelers who:

- may have no memory
- may be easily confused
- may have no ability to give clear instructions
- may speak with words or phrases that are only meaningful to themselves
- may have no speech – or have foreign or deaf accent that can't be handled
- may not speak English
- may (only) use sign language (can vehicle understand sign language?)
- may not be able to “see” that the car has arrived – or assist vehicle in finding the passenger
- may not be familiar with or be able to use “apps” at all
- may be hard of hearing and need direct-coupling to audio to hear over noise
- may be mixed (multiple people with different needs and abilities)

Interface strategies / options

- Ultra simple interface - No need for instructions for anyone - obvious
- Layered interface - Very simple, limited interface, with more options (complexity) layered behind
- Not require reading - Verbal (vocal or visual)
or Non-verbal (pictures, illustrations, maps) (see also tags)
- Work with signer language users - Everything presented in voice, text, and sign
Sign language interpreters for the vehicle on call to allow two-way communication
- Use Cue and respond - Question and answer. Options presented until response.
- Provide (silence-able or optional) description of features (like bell hop) when you enter vehicle
- (someday) provide a full-natural-language, sufficiently-intelligent, artificial “driver”
- A feature for AV that points out passenger in crowded or confusing location so it can get close
 - Visual, auditory, tactile. Directional or ‘increasing as you get closer”
- A feature for passenger to guide them to vehicle – especially if many cars arrive at a location.
Phone version of this feature for those who can’t use “apps
- An interaction TIPS feature – for AV “live assistants” interacting with a person with their particular disability for 1st time
- A trained-human-in-the-loop option – that is instantly invocable in problem situations
- Trip Tags

Trip Tags

- **Vehicle takes instructions from a Tag**
 - Tag presented by traveler - or person sending
 - Physical token - or Electronic Device (e.g. phone)
- **Possible tag instructions (in addition to destination) might include**
 - Option – Automatically send progress texts to sender or destination
 - Option – Traveler not able to change destination after starting
 - Option – Traveler is tagged as protected passenger
 - Option – Visual/auditory monitoring en-route (of passenger - of surrounds)
 - Option – Doors locked until tagged with special tag at destination.
 - (variation on package deliver – but with extra considerations)
 - Tricky – need secure overrides (Central?, Sender? First responder? In emergency?)
- **Tricky to implement**
 - The vehicle is delivering people – not packages
 - ABUSE POTENTIAL here as well
 - (e.g. You get in and someone walks up and tags you to a location with doors locked and you locked out – kidnapping you.)


Huge privacy and data abuse potential

- **Any data collected about users with special accommodations – can be used in many ways to the detriment of the traveler**
 - Used to discriminate
 - Employment
 - Housing
 - Travel
 - Anyone wanting to avoid risk
 - Used to target them
 - Easier to confuse – deceive (e.g. for selling things to them)
 - Easier to attack
 - and more...
- **Solution?**
 - Really tough issue
 - Perhaps – all data and use of data on user's abilities is overseen by *external* Privacy and Data Ethics Council.



Thank You

This work was funded in part by grant #90REGE0008 from the National Institute on Disability, Independent Living, and Rehabilitation Research (NIDILRR) of the Administration for Community Living (ACL), Dept of Health and Human Services (HHS)



A circular portrait of Darryl Cooper, a man with short brown hair and glasses, wearing a blue shirt and a blue life jacket with a yellow patch. The background of the portrait is a green, textured surface.

Darryl Cooper

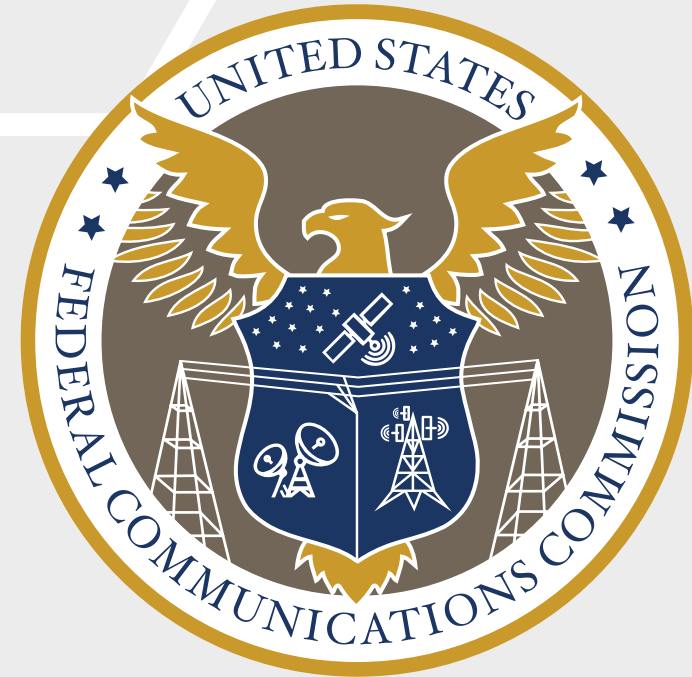
FCC

Disability Rights
Office

Inclusive Design of Autonomous Vehicles

Passengers with Sensory and Cognitive Disabilities

Darryl Cooper, Attorney Advisor,
Disability Rights Office



What Are Communications?

Hallmarks of Communications

- Two-Way Interactions
- In Real or Near Real-Time
- Between Two or More People

Telecommunications Services and Equipment

- Wireline and Wireless Phone Service and Handsets
- Includes Voice over Internet Protocol

Advanced Communications Services and Equipment

- Non-Interconnected VoIP
- Email and Text Messaging
- Internet Browsing

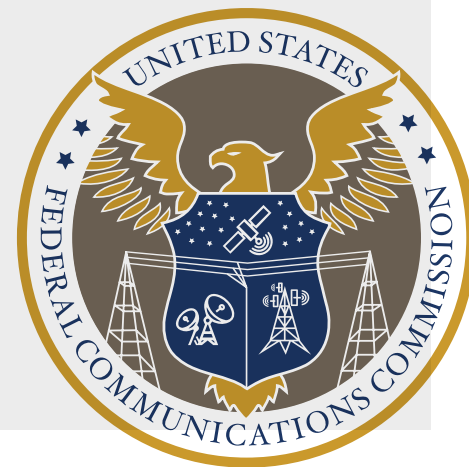
In-Car Entertainment

Closed Captioning for Video Programming

Audio Description

Emergency Information

User Interfaces, Devices, and Program Guides



FCC Accessibility Resources

Subscribe to AccessInfo@fcc.gov

Visit FCC Disability Rights Office webpage: www.fcc.gov/accessibility

DRO@fcc.gov, 844-432-2275 (videophone), 202-418-2517 (voice)





Ted Guild

World Wide Web
Consortium (W3C)

Communication background

Accessible Transportation

W3C Web Accessibility Initiative,
Automotive, Transportation and related
activities April 2021

What is W3C?

- World Wide Web Consortium
- Standards body for the Web
- Founded by inventor of Web
 - Tim Berners-Lee
- Hosts: MIT, Beihang, Keio, ERCIM
- ~450 members



W3C Web Accessibility Initiative (WAI)

- W3C as a helpful locus of accessibility expertise providing:
- Normative Specs, e.g. ARIA, WCAG
- Best Practices & Informative Notes
- [Accessible Platform Architectures \(APA\) WG](#)
- APA's mandate includes emerging technologies

Related works

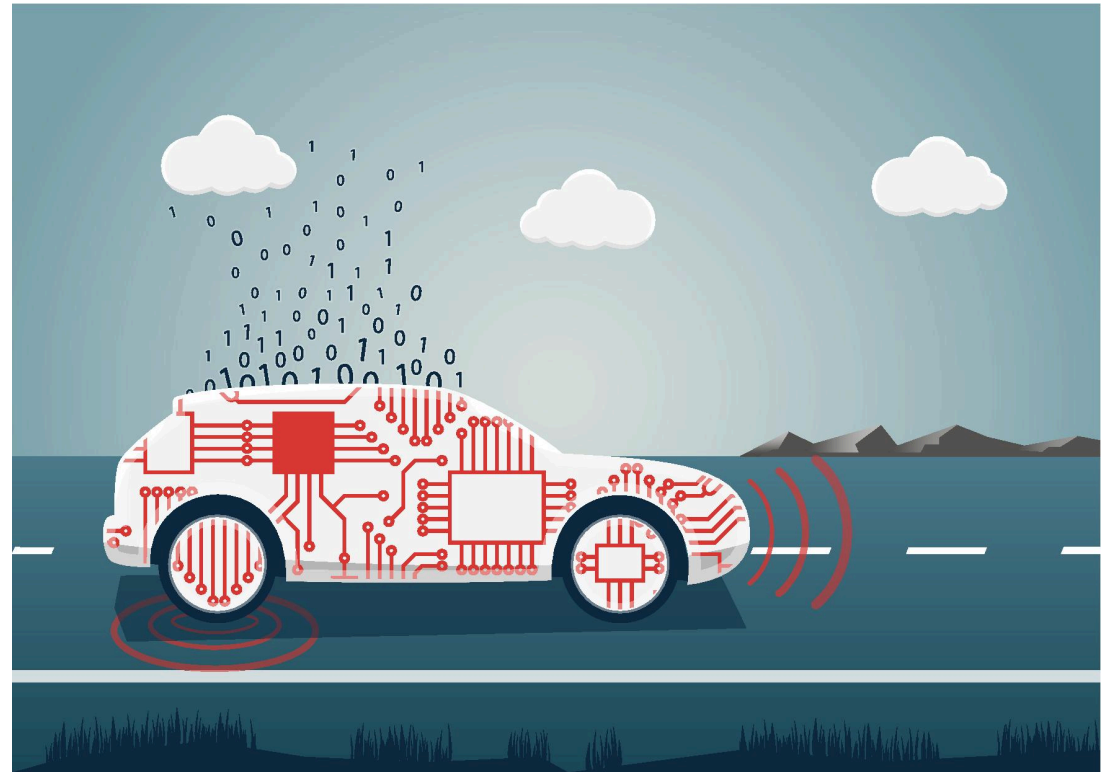
- Automotive Working Group
- Linked Building Data Community Group
- Linked Data for Accessibility Community Group
- Cross Standards Development Organization coordination on transportation ontologies

Accessibility and Travel experiences

- Relayed ride hailing experiences as well as other modes of travel
- Ted's cab sharing story that indirectly led to him joining W3C
- Hurricane Floyd, September 1999 left up to 13 inches (325 mm) of rain, wind gusts of up to 60 mph (95 km/h) affecting NYC

Transportation sector technical advances as an enabler

- Excitement around autonomous vehicles
- Importance of individuals' autonomy (independence)



Factoring in Accessibility into Data model design

- Profiles and individual needs, conveying to vehicle operators, rental and ride-share companies etc
- Vehicle capabilities
- Geospatial data considerations – granular location, building drop-off/pickup considerations
- “Intelligent Transportation Systems” would look rather stupid sending a [fill in the blank]
- Remapping of signals in vehicle to alternate controls or paired devices

Why introduce this topic now?

- Easier and cheaper to do up front than an afterthought
- Technologists generally like to do the right thing and improve lives
- Encourage you to make argument to management for including this in your designs
- Avoid costly litigation from lack of conformance to ADA, draw comparison to GDPR
- Marketshare not negligible – Estimated 15% of Americans have some form of accessibility concerns
- Good and bad examples – only name the good (e.g., Apple iPhone)

Question and follow up

- www.w3.org/wai
- www.w3.org/auto



A portrait of Bruce Bailey, a man with grey hair, a beard, and glasses, wearing a dark suit jacket, a light blue shirt, and a red and blue striped tie. The portrait is set against a light beige background and is partially framed by a white curved line on the right side.

Bruce Bailey
U.S. Access Board

E103.4 Defined Terms “ICT” and “IT”

ICT – (Information and Communication Technology)

Information technology *and* other equipment, systems, technologies, or processes, for which the principal function is the creation, manipulation, storage, display, receipt, or transmission of electronic data and information, as well as any associated content.

Examples of ICT include, but are not limited to: computers and peripheral equipment; information kiosks and transaction machines; telecommunications equipment; customer premises equipment; multifunction office machines; software; applications; Web sites; videos; and, electronic documents.

IT (Information Technology) – same meaning as 40 U.S.C. 11101(6)

Covered by 508?

Truck – Not ICT

Principal function is not the creation, manipulation, storage, display, receipt, or transmission of electronic data and information.



“Clinger-Cohen Act of 1996”

40 U.S.C. 11101(6)

- (6) Information technology. — The term “information technology” —
- with respect to an executive agency means any equipment or interconnected system or subsystem of equipment, used in the automatic acquisition, storage, analysis, evaluation, manipulation, management, movement, control, display, switching, interchange, transmission, or reception of data or information by the executive agency, if the equipment is used by the executive agency directly or is used by a contractor under a contract with the executive agency that requires the use —
 - of that equipment; or
 - of that equipment to a significant extent in the performance of a service or the furnishing of a product;
- includes computers, ancillary equipment (including imaging peripherals, input, output, and storage devices necessary for security and surveillance), peripheral equipment designed to be controlled by the central processing unit of a computer, software, firmware and similar procedures, services (including support services), and related resources; but
- does not include any equipment acquired by a federal contractor incidental to a federal contract.

508 Standards and Autonomous Vehicles

- Consider modern vehicle dashboard and action verbs from CC IT definition:
 - ... used in the automatic acquisition, storage, analysis, evaluation, manipulation, management, movement, control, display, switching, interchange, transmission, or reception of data or information
 - Vehicle dashboard is not a “principal function” relative to the function of driving.
 - But what if no *person* is driving?

Open Discussion

- Request to share information, ideas, or comments using Zoom's Q & A feature:
 - Microphone – You will be allowed to speak
 - Question – You will not speak (moderator will read your question)
 - Name (and organization)
 - Brief description of content
- Host will enter you into queue
- Moderator will announce when it is your turn to talk
 - Host will unmute you in the Zoom platform
 - You may need to unmute locally (*6 by phone)
- Moderator will also announce next in queue
- Presenters may respond to some comments
- Alternative: events@access-board.gov
- ASL – note in request to comment
- Limit your comments to less than two minutes



Online Dialogue

- Continue the conversation Online

- <http://transportationinnovation.ideascale.com>
- Share ideas, comment, vote
- For assistance, email: ePolicyWorks@dol.gov

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Inclusive Design of Autonomous Vehicles: A Public Dialogue

Welcome to the U.S. Access Board's Inclusive Design of Autonomous Vehicles: A Public Dialogue. This online dialogue is hosted by the U.S. Access Board in partnership with the Office of Disability Employment Policy (ODEP), the U.S. Department of Health and Human Services' Administration for Community Living, and other agencies to promote accessibility for people with disabilities in the design of autonomous vehicles (AVs). Please join this important online conversation and share your thoughts, ideas and comments on considerations for the future design of AVs that will accommodate the needs of people with physical, sensory, and cognitive disabilities.

The dialogue is being held in conjunction with the U.S. Access Board's series of four virtual meetings on making AVs accessible to passengers with disabilities. The meetings are open to the general public and will focus on considerations, challenges, and solutions in designing accessible AVs.

[Information on the Virtual Session](#) [Share an Idea in the Online Dialogue](#)

Click on the appropriate box below to learn more and submit your ideas, comments, and votes.

OPEN NOW

Accessibility for Passengers with Mobility Disabilities: Entering and Exiting

Please share your ideas around the design and development of AVs to ensure accessible entering and exiting for individuals with mobility disabilities. This online conversation complements the U.S. Access Board's March 10, 2021 virtual public forum.

OPEN NOW

Accessibility for Passengers with Mobility Disabilities: Maneuvering and Securement

Please share your ideas for the design and development of AVs to ensure accessible onboard maneuvering and securement for individuals with mobility disabilities. This online conversation complements the U.S. Access Board's March 24, 2021 virtual public forum.

Thank you for
attending today's
session.

