HUMAN FACTORS TEAM | biannual highlights

FAST LANE

Exploring Human Behavior

Turner-Fairbank
Highway Research Center

Safety R&D Program

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Hot Off the Press

Arnold, M., and J. Eisert. 2024. "FHWA's Human Factors Vehicle Automation Research." *Public Roads* 88, no. 2: 12–16. https://highways.dot.gov/public-roads/public-roads-magazine-summer-2024, last accessed October 2, 2024.

Chao, S. F., S. Roldan, and M. Arnold. 2024. *Effects of Signing and Configuration of Partially Automated Truck Platooning on Light-Vehicle Driver Behavior*. Publication No. FHWA HRT-24-071. Washington, DC: Federal Highway Administration. https://highways.dot.gov/research/publications/safety/FHWA-HRT-24-071, last accessed June 5, 2024.

Chao, S. F., S. Roldan, M. Jannat, and M. Arnold. 2024. *Human Factors Issues Related to Truck Platooning Operations*. Report No. FHWA-HRT-24-065. Washington, DC: Federal Highway Administration. https://highways.dot.gov/research/publications/safety/FHWA-HRT-24-065, last accessed June 12, 2024.

Katz, B., E. Kissner, E. Filler, and S. Jackson. 2024. *Evaluation of Advisory Exit and Ramp Speed Signs*. Publication No. FHWA-HRT-24-071. Washington, DC: Federal Highway Administration. https://highways.dot.gov/research/publications/safety/FHWA-HRT-24-138, last accessed October 2, 2024.

Sanchez, R. R., S. Weaver, and S. F. Chao. 2024. *Response to Emergency Vehicles When Driving in a Mixed Vehicle Fleet*. Report No. FHWA-HRT-24-063. Washington, DC: Federal Highway Administration. https://highways.dot.gov/research/publications/safety/FHWA-HRT-24-063, last accessed June 5, 2024.

Sanchez, R. R., S. Weaver, S. F. Chao, and M. Arnold. 2024. *Effects of Work Zone Infrastructure on Transitioning From Automated to Manual Driving for Work Zones With Lane Reductions*. Report No. FHWA-HRT-24-117. Washington, DC: Federal Highway Administration. https://highways.dot.gov/research/publications/safety/FHWA-HRT-24-117, last accessed June 5, 2024.

Weaver, S. M., A. Ahmed, M. Jannat, S. Olko, and M. Arnold. 2024. *A Systematic Approach on CMS Messaging Selection During Nonrecurring Events: Decision Tree*. Report No. FHWA-HRT-24-139. Washington, DC: Federal Highway Administration. https://highways.dot.gov/research/publications/safety/FHWA-HRT-24-139, last accessed October 2, 2024.

TRAVEL LANE

Current Research:

- **Investigating Key Automated Vehicle (AV) Human Factors Safety Issues Related to Transportation System Management and Operations (TSMO),** led by Michelle Arnold.
  - » **Merging Behavior When Driving in a Mixed Vehicle Fleet.** The research team completed data collection and is writing the final report anticipated to be published in Winter 2025. This simulator study aims to help transportation agencies assess the effect of mixed fleets on traffic safety and congestion at onramp merge points.

- **Traffic Control Device (TCD) Consortium Pooled Fund Study (PFS). Transportation Pooled Fund (TPF)-5(447),** led by Laura Mero.
  - » **Pedestrian Signing at Uncontrolled Crossings.** The research team completed data collection and analysis and is currently drafting the Technical Brief. The goal of the study is to use human factors experiments to test various pedestrian signing options at uncontrolled crossings to determine signs with high comprehension and that lead to driver yielding.
  - » **Comprehension and Legibility of Selected Symbol Signs, Phase V.** The research team finalized the list of alternatives for each sign category and the visualizations for the laboratory study. The objective of this research is to evaluate the legibility and comprehension of new and existing symbol- and text-based signs and related plaques, as appropriate, to determine the signs that are best understood and most effective at conveying intended meanings.

- **Evaluation of Aesthetically Treated Crosswalks Phase II,** led by Laura Mero. The research team started data collection in August 2024. The objectives of the project are to determine if crosswalks with surface treatments affect road user (drivers, pedestrians, and pedestrians with low vision) behavior compared with standard crosswalk markings and what conditions or aspects of crosswalks with surface treatments affect road user behavior; this project will take place in the field. The project is a follow-on to *Evaluation of Aesthetically Treated Crosswalks*, which shared the same objectives and took place in closed-course environments.

- **Investigating Nighttime Pedestrian Safety and Conspicuity Using Bollard Lighting,** led by Michelle Arnold, was initiated in September 2023, and the team has started data collection. This closed-course study examines the feasibility of a bollard-based lighting system to provide enhanced visibility for pedestrians in crosswalks as a viable safety strategy for nighttime use.

- **Lighting for Vulnerable Road Users,** led by Michelle Arnold, was initiated in September 2024. This study will build on previous work related to the need for detection of vulnerable road users, develop a set of recommendations and an implementation policy for lighting, and further evaluate lighting and vulnerable road user safety.

Announcement

We are excited to announce the retirement of our esteemed colleague, Ann Do, after her nearly 35 yrs of dedicated service at the Federal Highway Administration. Ann's commitment and passion have left an enduring mark on our agency and its mission. We extend our heartfelt congratulations and best wishes to Ann as she embarks on this exciting new chapter of her life. Thank you, Ann, for your remarkable service!

TRAVEL LANE *(continued)*

- **Enhanced Lighting Treatments for Improving Vulnerable Road User Detection Within Mixed Fleets,** led by Jesse Eisert, was awarded in November 2023. This closed-course study is examining how various light treatments can help improve both conventional and automated vehicles' ability to detect vulnerable road users. Data collection for this project is nearing completion, with data analysis likely to start in early 2025.

- **Influence of Automated Vehicles (AVs) on Speed Selection of Manual Drivers in Mixed Traffic,** led by Michelle Arnold, was awarded in September 2024. This research will investigate whether and to what extent manual drivers adjust their driving behaviors in mixed traffic with the presence of automated vehicles on the highway. The results of this work will support vehicle automation applications, development, and testing and will expand the knowledge base of interaction between AV and manual drivers in a mixed-fleet environment.

Source: FHWA.

Figure 1. Photo. Individual testing a virtual reality bicycle at University of Virginia in July 2024.

- **Intelligent Transportation Systems (ITS) Use Cases in Complete Streets,** led by Douglas Cobb, was awarded in September 2024. This research will investigate how ITS can help create a safe and equitable transportation system for all users. The project will help develop specific use cases for varying users and specific problems users face within a Complete Streets environment. The results should help guide and expand the knowledge of ITS use cases in Complete Streets to help with potential simulation and field testing.

THE ROAD AHEAD

Looking Forward

- **Ensuring Cooperative Driving Automation (CDA) and Vulnerable Road Users' Safety Through Infrastructure: Phase 2,** led by Jesse Eisert. This project examines how an infrastructure based Intersection Safety System could potentially warn pedestrians of an impending conflict with a vehicle. The research team completed data collection by using the Virtual Reality Pedestrian test bed at Turner-Fairbank Highway Research Center. A final report on this project will be available by March 2025.

- **Investigating Key Automated Vehicle (AV) Human Factors Safety Issues Related to Infrastructure,** led by Jesse Eisert.
  - » **Lane-Change Response to Infrastructure Warning About Lane Closure in a Mixed Vehicle Fleet.** This simulator study aims to help transportation agencies assess the effects of mixed fleets and connected infrastructure on traffic safety at lane closures. A final report is anticipated to be available by March 2025.

MILEPOSTS

Recent Activity

- **Investigating Key Automated Vehicle (AV) Human Factors Safety Issues Related to Transportation System Management and Operations (TSMO),** led by Michelle Arnold.
  - » **Cooperative Driving Automation Alerts During Rainy Weather Conditions** project is complete. The final technical report was published in fall 2024. This field study using a novel rain simulation system explores the influence of CDA alerts on driver behavior and perspectives when driving in simulated heavy-rain conditions.

- **Traffic Control Device (TCD) Consortium Pooled Fund Study (PFS). TPF-5(447),** led by Laura Mero. The TCD PFS 2024 Annual Meeting took place in Virginia in September 2024. Members initiated the project selection process, and the new problem statements will be posted to the TCD PFS web page when they become available.

MILEPOSTS *(continued)*

- » **Evaluation of Advisory Exit and Ramp Speed Signs.** The technical brief is published. The objectives of this project were to evaluate advisory exit and ramp speed warning signs—including the basis for speed designation, use of "exit" versus "ramp," the effects of sign placement, and optimization of sign sequence—and provide information for designers.

- **FHWA's Human Factors Vehicle Automation Research Article in Public Roads Summer Issue,** led by Michelle Arnold and Jesse Eisert. This article was published in summer 2024. The article summarizes the role human factors play in automation research and provides a high-level outline of the research tools the team uses.

- **FHWA Highway Driving Simulator Indefinite Delivery Indefinite Quantity (IDIQ),** led by Michelle Arnold, was awarded in fall 2023. The contract allows for onsite technical support to operate, maintain, and, as required, enhance the Highway Driving Simulator (HDS) in support of human factors research. As part of the enhancement of the HDS, a task order was awarded to upgrade the operation console and test bed area of the HDS lab.
  - » **Highway Driving Simulator Virtual Reality Driver Upgrade.** This task order was awarded in summer 2024 to upgrade the current virtual reality (VR) driving system and integrate it into the HDS and other VR systems in the Human Factors laboratory. The VR driver will enable researchers to conduct human factors experiments in an immersive, three-dimensional environment.

- **FHWA Human Factors On-Site Support Services (IDIQ),** led by Jesse Eisert, was awarded to toXcel in summer 2024. The IDIQ enables specific work to be performed and set forth under individual task orders across the duration of the IDIQ (5 yrs). Task orders under this IDIQ contract will be determined and issued on an as-needed basis by FHWA and will generally consist of work as outlined across multiple task areas.

- **Development of a Virtual Reality (VR) Bicycle Simulator,** led by Jesse Eisert. The research team successfully delivered a high-fidelity VR-based bicycle simulator with open-sourced and upgradable capabilities and full experimental control (figure 1). The team plans to have a VR bike on display at the Transportation Research Board conference in 2025 and at ITS America 2025.

- **Enhancing Vulnerable Road User (E-VRU) Detection and Volume Data Through Advanced Imaging Techniques,** led by Jesse Eisert. The project evaluated the ability of thermal sensors and light detection and ranging (LiDAR) sensors to detect vulnerable road users and collect accurate count data. This project has been completed, and the Human Factors team anticipates the final report will be available in time for the Transportation Research Board conference.

- **Exploring Potential Contributors to Racial and Socioeconomic Disparities in Pedestrian and Bicyclist Morbidity and Mortality,** led by Jesse Eisert. This project has been completed, with the research team successfully convening multiple subject matter expert panels to provide input, recommendations, and feedback throughout the project. The final deliverable of this project is in the form of a report that includes the current state of the literature and several highlighted case studies. The Human Factors team anticipates this report will be available in time for the Transportation Research Board conference.

- **Investigating Key Automated Vehicle (AV) Human Factors Safety Issues Related to Infrastructure,** led by Jesse Eisert.
  - » **Driver Interaction With Partial Driving Automation Technology When Passing Bicyclists in a Shared Use Lane.** This study explored the impact of vehicle automation on drivers' interactions with bicyclists in both shared and dedicated lanes. The final report on this project is anticipated to be available in time for the Transportation Research Board conference.
  - » **Exploring the Effects of Automated Driving Systems and Cooperative Messaging on Mixed Fleet Eco Drive Interactions.** This study investigated drivers' reactions to following an SAE Level 3™ vehicle practicing eco-driving patterns in a signalized intersection. The final report on this project is anticipated to be available in time for the Transportation Research Board conference.
  - » **Comparing Intersection Crossing Behavior of Human Drivers and Automated Vehicles Below and Above 10 MPH (EZ Mile).** This study collected data on a low-speed automated shuttle crossing an intersection and on conventional vehicles crossing the same intersection using a CARMA℠ signal phase countdown timer prototype installed in a field research vehicle. The research team developed a model that compares the behavior of human drivers with that of a low-speed automated shuttle traveling on the same public roads to predict how a high-speed shuttle might behave. The final report on this project is anticipated to be available in time for the Transportation Research Board conference.

HUMAN FACTORS LABORATORY TOURS

The Human Factors team hosted numerous groups for tours throughout the past year, as follows:

- Pathway.
- WSP, Inc.
- FHWA Office of the Chief Counsel.
- FHWA Massachusetts Division.
- FHWA Maryland Division.
- Traffic Control Device Pooled Fund Study Annual Meeting.
- Office of Transportation and Infrastructure.
- Department of Energy.
- ITS America.

CONFERENCES

Conferences Attended

- **Transportation Research Board (TRB) Annual Automated Road Transportation Symposium, July 29–August 1, 2024, San Diego, CA.** Attended sessions at TRB's Automated Road Transportation Symposium in San Diego, CA.
- **ConnectX, September 24–25, 2024, East Liberty, OH.** Attended September 2024 ConnectX meeting to visit the Vehicle Research and Test Center.
- **American Association of State Highway and Transportation Officials Safety Summit and Peer Exchange, October 15–17, 2024, Houston, TX.** Attended sessions and presented a poster for implementing the Safe System Approach into projects and policies.

Upcoming Conferences

- **Transportation Research Board Annual Meeting, January 4–9, 2025, Washington, DC.**
- **National Committee on Uniform Traffic Control Devices Annual Meeting, January 8–10, 2025, Arlington, VA.**
- **American Traffic Safety Services Association Convention & Traffic Expo 2025, February 28–March 4, Orlando, FL.**
- **Lifesavers Conference on Roadway Safety, March 9–11, 2025, Long Beach, CA.**
- **FHWA Safety Peer Exchange, March 18–20, 2025, Louisville, KY.**

Source: FHWA.

Figure 2. Photo. Jesse Eisert, Ph.D., speaking at the Distraction Action Forum at U.S. Department of Transportation headquarters in August 2024.

Meet the Team

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