SAFER-SIM Accomplishments

April 1, 2023 – September 30, 2023

1. Accomplishments

1.1 Research Accomplishments

1.1.1   Peer-reviewed journal publications

Published

1. Gaspar, J. G., Carney, C., Shull, E., & Horrey, W. J. (2021). Mapping drivers' mental models of adaptive cruise control to performance. Transportation research part F: traffic psychology and behaviour, 81, 622-638.
2. Subramanian, L. D., O'Neal E. O., Kim, N. Y., Noonan, M., Plumert, J. M., & Kearney, J. K. Deciding when to cross in front of an autonomous vehicle: How child and adult pedestrian respond to eHMI timing and vehicle kinematics. Manuscript submitted for publication.
3. Kim, N. Y., Plumert, J. M., Kearney, J. K., Clark, L. A., Dindo, L. & O'Neal E. O. Longitudinal and concurrent effortful control as predictors of risky bicycling in adolescence: Moderating effects of age and gender. Manuscript submitted for publication.
4. Subramanian, L. D., Sherony, R., Kearney, J. K., Plumert, J. M., & O'Neal E. O. (in press). How do bicyclists respond to vehicles with adaptive headlamp systems? A nighttime study in an immersive virtual environment. Journal of Safety Research.
5. Malik, J., Kim, N. Y., Parr, M. D. N., Kearney, J. K., Plumert, J. M., & Rector, K. (2023). Do simulated augmented reality overlays influence street-crossing decisions in non-mobility-impaired older and younger adults? Human Factors. https://doi.org/10.1177/00187208231151280
6. Di Napoli Parr, M. D. N, O'Neal, E. O., Zhou, S., Williams, B., Butler, K. M., Chen, A., Kearney, J. K., & Plumert, J. M. (2023). How children judge affordances when walking and bicycling across virtual roads: Does mode of locomotion matter? Developmental Psychology, 59(6), 1098–1108. https://dx.doi.org/10.1037/dev0001520.
7. Ghanbari, A., Hamann, C., Jansson, S., Reyes, M., Faust, K., Cavanaugh, J., Askelson, N. and Peek-Asa, C. (2023). Predictors of rural driver self-reported passing behaviors when interacting with farm equipment on the roadway, *Transportation Research Interdisciplinary Perspectives* 22. https://doi.org/10.1016/j.trip.2023.100926
8. O'Neal, E. E., Wendt, L., Hamann, C., Reyes, M.L., Yang, J., and Peek-Asa, C. (2023). Rates and Predictors of Teen Driver Crash Culpability. *Journal of Safety Research 86,* 185-190. Available online: https://doi.org/10.1016/j.jsr.2023.05.009
9. Subramanian, L.D., Sherony, R., Plumert, J.M., Kearney, J.K. & O'Neal, E.E. (in press). How Do Bicyclists Respond to Vehicles with Adaptive Headlamp Systems? A Nighttime Study in an Immersive Virtual Environment.
10. Peek-Asa, C., Zhang, L., Hamann, C., O'Neal, E.E., Yang, J., (2023). Direct medical charges of all parties in teen-involved vehicle crashes by culpability. *Injury Prevention.* Advance online publication. http://dx.doi.org/10.1136/ip-2022-044841

11. Carney, C., Gaspar, J. & Horrey, W. (accepted), Longer-Term Exposure vs. Training: Their Effect on Drivers' Mental Models of ADAS Technology, Transportation Research Part F.

12. Z. Wang, O. Zheng, L. Li, M. Abdel-Aty, C. Cruz-Neira and Z. Islam, "Towards Next Generation of Pedestrian and Connected Vehicle In-the-Loop Research: A Digital Twin Co-Simulation Framework," in IEEE Transactions on Intelligent Vehicles, vol. 8, no. 4, pp. 2674-2683, April 2023, doi: 10.1109/TIV.2023.3250353.

13. Z. Wang, M. Abdel-Aty, L. Yue, J. Zhu, O. Zheng and M. H. Zaki, "Investigating the Effects of Human-Machine Interface on Cooperative Driving Using a Multi-Driver Co-Simulation Platform," in IEEE Transactions on Intelligent Vehicles, doi: 10.1109/TIV.2023.3296678.

14. Pai, G., Zhang, F., Hungund, A. P., Pamarthi, J., Roberts, S. C., Horrey, W. J., & Pradhan, A. K. (2023). Frequency and Quality of Exposure to Adaptive Cruise Control and Impact on Trust, Workload, and Mental Models. Accident Analysis & Prevention, 190, 107130. https://doi.org/10.1016/j.aap.2023.107130

15. Pradhan, A.K., Roberts, S.C., Pai, G., Zhang, F. & Horrey, W.J. (2023). Change in Mental Models of ADAS in Relation to Quantity and Quality of Exposure (Technical Report). Washington, D.C.: AAA Foundation for Traffic Safety.

16. Zhang, Q., Esterwood, C., Pradhan, A. K., Tilbury, D., Yang, X. J., & Robert, L. P. (2023). The Impact of Modality, Technology Suspicion, and NDRT Engagement on the Effectiveness of AV Explanations. IEEE Access, vol. 11, pp. 81981-81994, 2023, doi: 10.1109/ACCESS.2023.3302261.

17. Wang, M., Parker, J., Wong, N. Mehrotra, S., Roberts, S. C., Kim, W., Romo, A., & Horrey, W. J. (under revision). The Effect of Human-Machine Interface Design on Driver Performance and Behavior While Using Vehicle Automation. *Accident Analysis & Prevention*.

18. Cesic, L., Christofa, E., and Knodler, M. 2024. Infrastructure and Driver Attitudes: Impact on E-scooter and Bicyclist Safety. Submitted to the Transportation Research Record: Journal of the Transportation Research Board.

19. Christofa, E., C. Ai, Deliali, A., Tainter, F., Cesic, L., Hannon, T., and Kostopoulou, E. 2023. Bicyclist and Motorist Behavior at Bike Boxes. Transportation Research Record: Journal of the Transportation Research Board. DOI: 10.1177/03611981231179473.

20. Pai, G., Zhang, F., Hungund, A. P., Pamarthi, J., Roberts, S. C., Horrey, W. J., & Pradhan, A. K. (2023). Frequency and Quality of Exposure to Adaptive Cruise Control and Impact on Trust, Workload, and Mental Models. Accident Analysis & Prevention, 190, 107130. https://doi.org/10.1016/j.aap.2023.107130

21. Figueroa-Medina, D. Valdés, B. Colucci, N. Cardona & A. Chamorro. 2022. Analysis of Walking Speeds and Success Rates on Mid-Block Crossings using Virtual Reality Simulation. Accident Analysis and Prevention Journal. Elsevier. February 2023.

22. Schwarz, C., Gaspar, J., & Yousefian, R. (2023). Multi-sensor driver monitoring for drowsiness prediction. Traffic Injury Prevention, 24(sup1), S100-S104.

23. Schwarz, C., Ahmad, O., Brown, T., Gaspar, J., Wagner, G., & McGehee, D. V. (2023). The long and winding road: 25 years of the national advanced driving simulator. IEEE computer graphics and applications, 43(4), 121-128.

<u>Accepted for publication</u>
>   Nothing to report.

<u>Submitted</u>
>   Nothing to report.

1.1.2 Book chapters
Nothing to report.

1.1.3 Edited books
Nothing to report.

1.1.4 Conference papers, posters, and symposia
<u>Presented</u>

1. Benson, A., But, J., Gaspar, J., Carney, C., & Horrey, W. J. (2021, September). Advanced vehicle technology: mapping mental model accuracy and system exposure to driver behavior. In Proceedings of the Human Factors and Ergonomics Society Annual Meeting (Vol. 65, No. 1, pp. 1072-1076). Sage CA: Los Angeles, CA: SAGE Publications.
2. Plumert, J. M., O'Neal, E. O., & Kim, N-Y. (2023, March). Parental scaffolding of children's prospective control in a dynamic perception-action task. In J. Plumert (Chair), Broadening the lens on parent-child interaction as a mechanism of developmental change in children's skills. Symposium at the 2023 Biennial Meeting of the Society for Research in Child Development, Salt Lake City, UT.
3. O'Neal, E. E., Subramanian, L.D., Noonan, M., Wang, J., Kim, N.Y., Kearney, J. K., and Plumert, J. M. (April, 2023). How do children respond to autonomous vehicle external human-machine interface cues? Paper presented at the Biennial Meeting of the Society for Advancement of Violence and Injury Research, Denver, CO.
4. Kruse, C., Brown, T. L., Schmitt, R., Gaffney, G., Milavetz, G., & Berka, C. (2024). Effects of Cannabis on Highway Driving Transportation Research Board Annual Meeting, Washington, DC.
5. Miller, R., Hodson, S., Le, T., & Brown, T. (2024). Detection of Cannabis Impaired Driving from Vehicle-based Inputs using Machine Learning Methods. Transportation Research Board Annual Meeting, Washington, DC.
6. **O'Neal, E.E.**, Subramanian, L.D., Noonan, M., Stoffel, J.A., Wang, J., Kim, N.Y., Kearney, J.K., & Plumert, J.M. (April 2023). *How do children respond to autonomous vehicle external human-machine interface cues?* Oral presentation accepted at the 2023 annual meeting of the Society for Violence and Injury Research, Denver, CO.
7. Afifah, F. and Guo, Z.(2024) Optimal Speed Limit Control for Network Mobility and Safety: A Twin-delayed Deep Deterministic Policy Gradient Approach. Presentation at the Transportation Research Board 103rd Annual Meeting, Washington D.C.
8. *Lenneman, J.K., Hungund, A.P., Pamarthi, J., Pradhan, A.K., (2023, pre-press) Enhancing ADAS Knowledge and Trust Through Consumer Education. Proceedings of 2023 FAST-zero conference.*
9. Pamarthi, J., Hungund, A. P., Wang, M., Sayer, T. B., Hallman, J. J., Roberts, S. C., & Pradhan, A. K. (2023). Risk-ATTEND (Risk Anticipation Training to Enhance Novice Driving): Pilot Evaluation of a Risk Anticipation Training Program for Teen

Drivers. *67th International Annual Meeting of the Human Factors and Ergonomics Society.*

10. Valdés, D., Figueroa-Medina, A, Perelló, C., Sierra-Betancur, C. L, Mori-Vargas, A. and Concepción-Carrasco, E., Use of Driving Simulation to Improve Safety on Innovative Intersection Designs: A Diverging Diamond Interchange Implementation. XXII Pan American Congress on Transport and Logistics (PANAM), Guayaquil, Ecuador, 2023

11. Ramos-López, I., Valdés, D., Development of Innovative Strategies to Improve Drivers and Workers Safety in Freeway Work Zones (Title in Spanish: Desarrollo de Medidas Innovadoras para Mejorar la Seguridad de Conductores y Trabajadores en Zonas de Trabajo en Autopistas.) XXII Pan American Congress on Transport and Logistics (PANAM), Guayaquil, Ecuador, 2023

12. Valdés, D., Figueroa-Medina, A, Perelló, C., Solano, A., Velasquez, G. A., and Concepción-Carrasco, E., Driving Simulation Study of the First Diverging Diamond Interchange in Puerto Rico (PR-30 & PR-189 in Gurabo). Plaza Las Americas Educational Activity, San Juan, PR, June 2023.

Accepted/Not yet presented
> Nothing to report.

Submitted
> Nothing to report.

1.1.5 Paper/poster awards
1. Z. Wang, O. Zheng, L. Li, M. Abdel-Aty, C. Cruz-Neira and Z. Islam, "Towards Next Generation of Pedestrian and Connected Vehicle In-the-Loop Research: A Digital Twin Co-Simulation Framework," in IEEE Transactions on Intelligent Vehicles, vol. 8, no. 4, pp. 2674-2683, April 2023, doi: 10.1109/TIV.2023.3250353.
2. Z. Wang, M. Abdel-Aty, L. Yue, J. Zhu, O. Zheng and M. H. Zaki, "Investigating the Effects of Human-Machine Interface on Cooperative Driving Using a Multi-Driver Co-Simulation Platform," in IEEE Transactions on Intelligent Vehicles, doi: 10.1109/TIV.2023.3296678.
3. Use of Driving Simulation to Improve Safety on Innovative Intersection Designs: A Diverging Diamond Interchange Implementation. XXII Pan American Congress on Transport and Logistics (PANAM), Guayaquil, Ecuador, 2023 (Valdés, Figueroa-Medina, Perelló, Sierra-Betancur, Mori-Vargas, and Concepción-Carrasco)

1.1.6 External grants related to SAFER-SIM
Awarded
1. Pilot funding for the project titled Advanced Eye Tracking of Moving Objects in Driving Simulation provided by UI Injury Prevention Research Center and the Iowa Initiative for Artificial Intelligence was extended for an additional year. The extension award totals $22,500 and will support time, effort, and computational resources in order to 1) train an existing machine learning algorithm to identify additional objects or areas of interest (AOIs) as AOIs move within a simulated driving environment and 2) derive measures of eye gaze using pupil coordinate data and the location of AOIs

that can be detected by the machine learning algorithm.

2. Reimagining Trucking: Forging an Equitable and Driver-Centered System in a Highly Automated World, National Science Foundation Future of Work, $2,000,000, 04/01/2022-09/30/2023, PI with co-PI Laurel Smith-Doerr, Shlomo Zilberstein, and Henry Renski. (Roberts)
3. New England University Transportation Center. U.S. Department of Transportation. (Christofa & Knodler)
4. NSF REU Site: Research for Inclusivity and Driving Equity (RIDE) (Roberts & Christofa)
5. Effectiveness of Two-stage Turn Queue Boxes in Massachusetts: A Comparison with Bike Boxes, Massachusetts Department of Transportation (Christofa, Ai, and Tainter)
6. Building a Bicycle Simulator to Study Bicyclist-Connected & Automated Vehicle Interactions, Robert B. Brack Endowment funds for research (UMass) (Christofa & Pradhan)
7. Consumer education for advanced vehicle technologies: Tailored training based on drivers' self-perceptions and knowledge (Pradhan)
8. PRLTAP Center (T2) at UPRM (Directors, Valdes-Diaz and Figuera)
9. Performance Evaluation of the PR-30/PR-189 Diverging Diamond Interchange Phase 3. Constructora Santiago, Inc. and Puerto Rico Highways and Transportation Authority. Final Report. October 2023. (Valdez-Diaz)

Submitted

1. HCC: Small: AUTOMATE - Advancing Underrepresented Groups Travel Opportunities by Mobilizing Automated Vehicle Technology for Equity, National Science Foundation, $600,000, 01/01/2023-12/31/2026, Roberts PI. This proposal is focused on building interfaces for driving automated systems that are inclusive and equitable. It logically builds on the current SaferSim work that is aimed at optimizing driving automation systems. (Roberts)
2. Evaluating the Effectiveness of Drivers' Education Modules on Safety, Massachusetts Department of Transportation, $370,000, 04/01/2023-09/31/2025, Roberts PI. This proposal is focused on evaluating the effectiveness of current drivers' education programs as well as a new component to be added to drivers' education that is focused on automated vehicle technology. It builds on this SaferSim work as they are both focused on how teenage drivers use automated vehicle technology. (Roberts)
3. Performance Evaluation of the PR-30/PR-189 Diverging Diamond Interchange Phase 3. Constructora Santiago, Inc. and Puerto Rico Highways and Transportation Authority. May 2023.

1.2 Leadership Development Accomplishments

1.2.1 Invited presentations
1. Hazard anticipation training: A parent-focused, teen-driving intervention. Illinois High School & College Driver Education Association 2023 Fall Workshop, Macomb, IL, September 20, 2023. (O'Neal)
2. Parent's/guardian's role in teaching their novice teen driver to anticipate roadway hazards. 2023 American Driver & Traffic Safety Education Association Annual Conference, Wichita, July 18, 2023. (O'Neal)

3. Impaired Driving and Advanced Driver Assistance Systems Crash Research. Iowa Traffic Incident Management Conference, Ames, Sept. 26, 2023. (Reyes)
4. Gender in Driver Behavior. TRB AME20 Mid-Year Meeting on September 6, 2023. (Roberts)
5. Effectiveness of Bike Boxes in Massachusetts, MassDOT Innovation Webinar Series, April 27, 2023. [virtual] (Christofa).
6. Demonstration of robotic vehicle for IGNITE engineering success conference
7. Discussed Quantifying Autonomous Vehicle Pedestrian Interactions at Intersections project and Evolution of User Trust in Autonomous Vehicles and Characteristics of Disengagements project along with development of automated vehicle program with the City of Racine at the Smart Cities Connect conference on May 18, 2023.

1.2.2 Invited papers
Nothing to report.

1.2.3 Invited workshops
1. Delivering the Next Generation Roads Using Active Traffic Management Technology, Keynote, Road to Tomorrow R2T Virtual Conference, International Road Federation, July 2021
2. AAAFTS, Toyota Collaborative Safety Research Center, and the University of Wisconsin Madison on Consumer Education and Advanced Vehicle Technology on May 8, 2023. (Pradhan and Roberts)
3. Expert panelist on NHTSA/UNC Workshop on novice drivers and vehicle automation (Pradhan)

1.2.4 Grant review panels
1. 2023 IPRC pilot grant proposal reviewer (Reyes)
2. BTSCRP panel for BTS-26 Advanced Driver Assistance Systems (ADAS) Education and Outreach. (Pradhan)
3. NSF proposal review panel (Roberts)
4. BTSCRP - Determining the State of Knowledge, Opportunities for Outreach, and Data-driven Tools for Consumer Education of ADAS (Pradhan)
5. Oversight Panel for NCHRP project 07-29: Development of the 8th edition of the AASHTO's A Policy on Geometric Design of Highways and Streets (Green Book). National Cooperative Highway Research Program, Transportation Research Board. (Member, Figueroa-Medina)

1.2.5 Advisory committees
1. Scientific Committee, Driving Simulation Conference 2023 (Kearney)
2. National Safety Council Impairment Advisory Board (Brown)
3. UI Injury Prevention Research Center Executive Committee (Reyes)
4. Iowa State Highway Safety Plan Advisory Team (Reyes)
5. Member Board of Directors (2020-2022) International Road Federation, Washington DC. (Abdel-Aty)
6. Board of Directors, National Safety Council (2021-2023) (Abdel-Aty)
7. ITF Roundtable on Artificial Intelligence in Road Traffic Crash Prevention, OECD, 2021 (Abdel-Aty)

8. Center for Research on Families Steering Committee (Roberts)
9. Internal Advisory Board for the Institute of Diversity Sciences (Roberts)
10. Applied Human Factors and Ergonomics (AHFE 2017-Present) Scientific Advisory Board (Valdés)
11. National Institute for Congestion Reduction (NICR) Executive Committee, University Transportation Center (UTC). Nov. 2021 - Present. (Valdés)
12. Panamerican Society for Research in Transportation and Logistics. Advisory Board. January 2023 – Present (Valdés)
13. Transportation Education Council, Institute of Transportation Engineers (ITE). (Figueroa-Medina)
14. Transportation Safety Council, Institute of Transportation Engineers (ITE) (Figueroa-Medina)
15. National Institute for Congestion Reduction (NICR) Executive Committee, University Transportation Center (UTC). Nov. 2019 - Present. (Figueroa-Medina)
16. Technical Committee of the Pan American Federation of Engineers Societies (UPADI), 2020-Present (Figueroa-Medina)
17. Friend of the Standing Committee on Performance Effects of Geometric Design AKD-10 (formerly known as Operational Effects of Geometrics AHB-65), Transportation Research Board, 2013-Present (Cruzado)
18. Coordinator of the Research Faculty for Faculty and Postdoctoral Fellows, UPRM (Cruzado)
19. Member of the Institutional Committee for Research, UPRM (Cruzado)
20. Co-Advisor of the Institute of Transportation Engineers, student chapter, at UPRM (Cruzado)
21. Institute of Transportation Engineers (Member, Cruzado)

1.2.6 Journal editing
1. Transportation Research Interdisciplinary Perspectives, reviewer (Kearney)
2. IEEE Transactions on Intelligent Vehicles, reviewer (Kearney)
3. Driving Simulation Conference, reviewer (Kearney)
4. Spatial Cognition and Computation (Plumert)
5. Journal of Experimental Psychology: Applied (Plumert)
6. Journal of Experimental Child Psychology (Plumert)
7. Executive Guest Editor, Accident Analysis & Prevention (Brown)
8. Injury Prevention (reviewer, O'Neal)
9. Transportation Research Board Annual Meeting (reviewer, Reyes)
10. Transportation Research Part F: Traffic Psychology and Behaviour (reviewer, Reyes)
11. Journal of Safety Research (reviewer, Reyes)
12. Accident Analysis and Prevention, Emeritus Editor, (Abdel-Aty)
13. ASCE Journal of Transportation Part A: Systems, Associate Editor (2021- current), (Abdel-Aty)
14. Journal of Transportation Research Record, handling editor (April 2021 – ongoing), (Yue)
15. Ergonomics (Editorial board, Roberts)
16. Transportation Research Record (Editorial Board, Pradhan)
17. Frontiers in Neuroergonomics (Editorial Board, Pradhan)
18. Journal of Law and Mobility (Contributing Editor, Pradhan)

19. Transportation Research Record Handling Editor (Christofa)
20. Editorial Advisory Board of Transportation Research Part C: Emerging Technologies (Christofa)
21. Applied Human Factors and Ergonomics (AHFE), Scientific Advisory Board, 2017-Present (Valdés)
22. 19th LACCEI International Multi-Conference for Engineering, Education, and Technology (Valdés)
23. 103rd TRB Annual Meeting, January 2024, Washington DC (Valdés)
24. Editorial Board Member of International Journal of Natural Disasters, Accidents and Civil Infrastructure (RIDNAIC), Scipedia, August 2020 - Present. (Valdés)
25. Highway Safety Committee Chair, Panamerican Society for Research in Transportation and Logistics, September 2022 – Present (Valdés)
26. 103rd Transportation Research Board (TRB) Annual Meeting, January 2024, Washington, DC (Figueroa-Medina)
27. Transportation Research Record, TRB Journal (Figueroa-Medina)
28. Accident Analysis and Prevention Journal, Elsevier (Figueroa-Medina)
29. Dimension Journal of the College of Engineers and Surveyors of Puerto Rico, 2019 – August 2022 (Figueroa-Medina)
30. International Journal of Natural Disasters, Accidents and Civil Infrastructure (RIDNAIC), Scipedia, September 2020 – Present (Figueroa-Medina)
31. Latin American and Caribbean Consortium of Engineering Institutions (Cruzado)
32. International Symposium on Highway Geometric Design (Cruzado)
33. The Open Transportation Journal (Cruzado)
34. Journal of Transportation Engineering (Cruzado)
35. Transportation Research Board, TRB Journal (Cruzado)

1.2.7 Leadership positions in professional organizations
1. Governor's Traffic Safety Board – Pedestrian Safety Initiative Committee Member (July 2022 – present) (O'Neal)
2. Co-chair - Society for the Advancement of Violence and Injury Research (SAVIR) - Science Committee (Oct 2021 – present) (O'Neal)
3. Committee Member - SAVIR – Conference Planning Committee (2021 – present) (O'Neal)
4. Committee Member – SAVIR - Science Committee (2019 – present) (O'Neal)
5. Scientific Program Committee, Annual Meeting Sub-committee Chair (Brown)
6. Transportation Research Board of the National Academies: Standing Committee on Vehicle User Education, Training, and Licensing (ACH60), Committee Research Chair and Member (Reyes)
7. Transportation Research Board of the National Academies: Young Driver Subcommittee (ACH60(1)), Member (Reyes)
8. Society for the Advancement of Violence and Injury Research, Science Committee Co-Chair and Conference Planning Committee member (O'Neal)
9. Surface Transportation Technical Group of the Human Factors and Ergonomics Society (Chair Elect, Roberts)
10. Executive Council of the Human Factors and Ergonomics Society (At-Large Member, Roberts)
11. TRB AME70 Transportation and Public Health Committee Member and Secretary

(Christofa)
12. TRB Committee on Vehicle User Education, Training, and Licensing (Paper Coordinator, Pradhan)
13. AutoUI 2020 – Work in Progress Committee (Co-chair, Pradhan)
14. Association for the Advancement of Automotive Medicine (Chair of Automated Vehicles Special Interest Group, Pradhan)
15. Technical Committee, Pan American Federation of Engineering Associations (UPADI), 2020-Present (Valdés-Díaz)
16. Panamerican Society for Research in Transportation and Logistics. Board Member. January 2023 – Present (Valdés-Díaz)
17. Executive Board of the Institute of Transportation Engineers Puerto Rico Section, 2022-Present (Figueroa-Medina)
18. Editorial Commission, Dimension Journal of the College of Engineers, and Surveyors of Puerto Rico, 2019 - June 2022 (Figueroa-Medina)
19. Pan-American Transport Systems Technical Committee, Pan-American Federation of Engineering Associations (UPADI), 2020-Present (Figueroa-Medina)

1.2.8 SAFER-SIM Webinars

SAFER-SIM holds both individual project webinars and organizes project webinars into symposia where projects may be grouped by subject matter to allow parties interested in specific topics to interact with several researchers and projects in a single session. Online presentations are open to all transportation professionals and the public, and are recorded, and posted on the SAFER-SIM YouTube channel so they are available to anyone who was not able to attend or would like to review.
1. 9/12/2023 The Gap Effect in Conditionally Automated Driving, Emily Shull, UI – approx. 25
2. 9/19/2023 Reinforcement Learning for Optimal Speed Limit Control Over Network, Fatima Afifah, UCF – 5 registrations
3. 9/26/2023 Investigating the safety effect of different sensors in various conditions in a connected vehicle environment – a Digital Twin approach, Zijin Wang, UCF – 13 registrations

1.2.9 Professional awards
1. Higher Education Resource Services (HERS) Leadership Institute (Christofa)
2. Civil and Environmental Engineering (CEE) Faculty Service Award, University of Massachusetts Amherst (awarded to the whole Diversity, Equity, and Inclusion Committee) (Christofa)
3. Link Foundation Fellowship (Pai)
4. AAAM Elaine Wodzin Award (Pradhan)

1.3 Education and Workforce Development Accomplishments

1.3.1 Peer-reviewed journal publications w/ student authors
1. Gaspar, J. G., Carney, C., **Shull, E.**, & Horrey, W. J. (2021). Mapping drivers' mental models of adaptive cruise control to performance. Transportation research part F: traffic psychology and behaviour, 81, 622-638.

2. **Subramanian, L. D.**, **O'Neal E. O.**, **Kim, N. Y.**, **Noonan, M.**, Plumert, J. M., & Kearney, J. K. Deciding when to cross in front of an autonomous vehicle: How child and adult pedestrian respond to eHMI timing and vehicle kinematics. Manuscript submitted for publication.

3. **Kim, N. Y.**, Plumert, J. M., Kearney, J. K., Clark, L. A., Dindo, L. & **O'Neal E. O**. Longitudinal and concurrent effortful control as predictors of risky bicycling in adolescence: Moderating effects of age and gender. Manuscript submitted for publication.

4. **Subramanian, L. D.**, Sherony, R., Kearney, J. K., Plumert, J. M., & **O'Neal E. O**. (in press). How do bicyclists respond to vehicles with adaptive headlamp systems? A nighttime study in an immersive virtual environment. Journal of Safety Research.

5. **Malik, J.**, **Kim, N. Y.**, Parr, M. D. N., Kearney, J. K., Plumert, J. M., & Rector, K. (2023). Do simulated augmented reality overlays influence street-crossing decisions in non-mobility-impaired older and younger adults? Human Factors. https://doi.org/10.1177/00187208231151280

6. Di Napoli Parr, M. D. N, **O'Neal, E. O.**, Zhou, S., Williams, B., Butler, K. M., **Chen, A.**, Kearney, J. K., & Plumert, J. M. (2023). How children judge affordances when walking and bicycling across virtual roads: Does mode of locomotion matter? Developmental Psychology, 59(6), 1098–1108. https://dx.doi.org/10.1037/dev0001520.

7. **O'Neal, E. E.**, Wendt, L., Hamann, C., Reyes, M.L., Yang, J., and Peek-Asa, C. (2023). Rates and Predictors of Teen Driver Crash Culpability. *Journal of Safety Research 86,* 185-190*.* Available online: https://doi.org/10.1016/j.jsr.2023.05.009

8. **Subramanian, L.D.**, Sherony, R., Plumert, J.M., Kearney, J.K. & **O'Neal, E.E**. (in press). How Do Bicyclists Respond to Vehicles with Adaptive Headlamp Systems? A Nighttime Study in an Immersive Virtual Environment.

9. Peek-Asa, C., Zhang, L., Hamann, C., **O'Neal, E.E.**, Yang, J., (2023). Direct medical charges of all parties in teen-involved vehicle crashes by culpability. *Injury Prevention.* Advance online publication. http://dx.doi.org/10.1136/ip-2022-044841

10. **Z. Wang**, **O. Zheng**, L. Li, M. Abdel-Aty, C. Cruz-Neira and Z. Islam, "Towards Next Generation of Pedestrian and Connected Vehicle In-the-Loop Research: A Digital Twin Co-Simulation Framework," in IEEE Transactions on Intelligent Vehicles, vol. 8, no. 4, pp. 2674-2683, April 2023, doi: 10.1109/TIV.2023.3250353.

11. **Z. Wang**, M. Abdel-Aty, L. Yue, **J. Zhu**, **O. Zheng** and M. H. Zaki, "Investigating the Effects of Human-Machine Interface on Cooperative Driving Using a Multi-Driver Co-Simulation Platform," in IEEE Transactions on Intelligent Vehicles, doi: 10.1109/TIV.2023.3296678.

12. **Pai, G.**, **Zhang, F.**, **Hungund, A. P.**, Pamarthi, J., Roberts, S. C., Horrey, W. J., & Pradhan, A. K. (2023). Frequency and Quality of Exposure to Adaptive Cruise Control and Impact on Trust, Workload, and Mental Models. Accident Analysis & Prevention, 190, 107130. https://doi.org/10.1016/j.aap.2023.107130

13. Pradhan, A.K., Roberts, S.C., **Pai, G.**, **Zhang, F.** & Horrey, W.J. (2023). Change in Mental Models of ADAS in Relation to Quantity and Quality of Exposure (Technical Report). Washington, D.C.: AAA Foundation for Traffic Safety.

14. **Wang, M.**, **Parker, J.**, **Wong, N. Mehrotra, S.**, Roberts, S. C., Kim, W., Romo, A., & Horrey, W. J. (under revision). The Effect of Human-Machine Interface Design on

Driver Performance and Behavior While Using Vehicle Automation. *Accident Analysis & Prevention*.

15. **Cesic, L.**, Christofa, E., and Knodler, M. 2024. Infrastructure and Driver Attitudes: Impact on E-scooter and Bicyclist Safety. Submitted to the Transportation Research Record: Journal of the Transportation Research Board.

16. Christofa, E., C. Ai, Deliali, A., Tainter, F., **Cesic, L.**, Hannon, T., and Kostopoulou, E. 2023. Bicyclist and Motorist Behavior at Bike Boxes. Transportation Research Record: Journal of the Transportation Research Board. DOI: 10.1177/03611981231179473.

17. **Pai, G.**, **Zhang, F.**, **Hungund, A. P.**, Pamarthi, J., Roberts, S. C., Horrey, W. J., & Pradhan, A. K. (2023). Frequency and Quality of Exposure to Adaptive Cruise Control and Impact on Trust, Workload, and Mental Models. Accident Analysis & Prevention, 190, 107130. https://doi.org/10.1016/j.aap.2023.107130

18. Figueroa-Medina, D. Valdés, B. Colucci, **N. Cardona** & A. Chamorro. 2022. Analysis of Walking Speeds and Success Rates on Mid-Block Crossings using Virtual Reality Simulation. Accident Analysis and Prevention Journal. Elsevier. February 2023.

1.3.2   *Book chapters w/ student authors*
Nothing to report.

1.3.3   *Conference posters and papers w/ student authors*
1. Plumert, J. M., **O'Neal, E. O.**, & **Kim, N-Y**. (2023, March). Parental scaffolding of children's prospective control in a dynamic perception-action task. In J. Plumert (Chair), Broadening the lens on parent-child interaction as a mechanism of developmental change in children's skills. Symposium at the 2023 Biennial Meeting of the Society for Research in Child Development, Salt Lake City, UT.

2. **O'Neal, E. E.**, **Subramanian, L.D.**, **Noonan, M.**, **Wang, J.**, **Kim, N.Y.**, Kearney, J. K., and Plumert, J. M. (April, 2023). How do children respond to autonomous vehicle external human-machine interface cues? Paper presented at the Biennial Meeting of the Society for Advancement of Violence and Injury Research, Denver, CO.

3. **Kruse, C.**, Brown, T. L., Schmitt, R., Gaffney, G., Milavetz, G., & Berka, C. (2024). Effects of Cannabis on Highway Driving Transportation Research Board Annual Meeting, Washington, DC.

4. **O'Neal, E.E.**, **Subramanian, L.D.**, **Noonan, M.**, Stoffel, J.A., **Wang, J.**, **Kim**

5. **, N.Y.**, Kearney, J.K., & Plumert, J.M. (April 2023). *How do children respond to autonomous vehicle external human-machine interface cues?* Oral presentation accepted at the 2023 annual meeting of the Society for Violence and Injury Research, Denver, CO.

6. **Afifah, F.** and Guo, Z.(2024) Optimal Speed Limit Control for Network Mobility and Safety: A Twin-delayed Deep Deterministic Policy Gradient Approach. Presentation at the Transportation Research Board 103rd Annual Meeting, Washington D.C.

7. Lenneman, J.K., **Hungund, A.P.**, Pamarthi, J., Pradhan, A.K., (2023, pre-press) Enhancing ADAS Knowledge and Trust Through Consumer Education. *Proceedings of 2023 FAST-zero conference.*

8. Pamarthi, J., **Hungund, A. P.**, **Wang, M.**, Sayer, T. B., Hallman, J. J., Roberts, S. C., & Pradhan, A. K. (2023). Risk-ATTEND (Risk Anticipation Training to Enhance

Novice Driving): Pilot Evaluation of a Risk Anticipation Training Program for Teen Drivers. *67th International Annual Meeting of the Human Factors and Ergonomics Society.*

9. Valdés, D., Figueroa-Medina, A, Perelló, **C., Sierra-Betancur**, C. L, Mori-Vargas, A. and **Concepción-Carrasco, E.**, Use of Driving Simulation to Improve Safety on Innovative Intersection Designs: A Diverging Diamond Interchange Implementation. XXII Pan American Congress on Transport and Logistics (PANAM), Guayaquil, Ecuador, 2023

10. Valdés, D., Figueroa-Medina, A, Perelló, C., Solano, A., Velasquez, G. A., and **Concepción-Carrasco, E.**, Driving Simulation Study of the First Diverging Diamond Interchange in Puerto Rico (PR-30 & PR-189 in Gurabo). Plaza Las Americas Educational Activity, San Juan, PR, June 2023.

1.3.4   *Paper/poster awards w/ student authors*

1. **Z. Wang**, **O. Zheng**, L. Li, M. Abdel-Aty, C. Cruz-Neira and Z. Islam, "Towards Next Generation of Pedestrian and Connected Vehicle In-the-Loop Research: A Digital Twin Co-Simulation Framework," in IEEE Transactions on Intelligent Vehicles, vol. 8, no. 4, pp. 2674-2683, April 2023, doi: 10.1109/TIV.2023.3250353.

2. **Z. Wang**, M. Abdel-Aty, L. Yue, **J. Zhu**, **O. Zheng** and M. H. Zaki, "Investigating the Effects of Human-Machine Interface on Cooperative Driving Using a Multi-Driver Co-Simulation Platform," in IEEE Transactions on Intelligent Vehicles, doi: 10.1109/TIV.2023.3296678.

3. Use of Driving Simulation to Improve Safety on Innovative Intersection Designs: A Diverging Diamond Interchange Implementation. XXII Pan American Congress on Transport and Logistics (PANAM), Guayaquil, Ecuador, 2023 (Valdés, Figueroa-Medina, Perelló, **Sierra-Betancur**, Mori-Vargas, and **Concepción-Carrasco**)

1.3.5   *Graduate students working on and supported by SAFER-SIM related projects*

Site	Number
University of Iowa	8
University of Central Florida	3
University of Massachusetts Amherst	5
University of Puerto Rico Mayaguez	9
University of Wisconsin Madison	2

1.3.6   *Undergraduate students working on and supported by SAFER-SIM related projects*

Site	Number
University of Iowa	8
University of Central Florida	1
University of Massachusetts Amherst	3
University of Puerto Rico Mayaguez	2
University of Wisconsin Madison	0

1.3.7 Student attendance and presentations at the SAFER-SIM symposium
Nothing to report.

1.3.8 Transportation-related M.A. and PhD theses
1. Understanding How Emerging Technologies Impact Pedestrian Street-Crossing Behavior, Department of Computer Science, University of Iowa. Malik, J. (2023).
2. "Maintaining Attention with Enhanced Human-Machine Interfaces in Conditionally Automated Driving" (Shull, 2023)
3. "Cooperative Driving Using an Integrated Co-Simulation and Digital-Twin Platform." (Wang)
4. "Development, Validation, and Integration of AI-Driven Computer Vision System and Digital-twin System for Traffic Safety Diagnostics." (Zheng)
5. "Optimizing Information Values in Smart Mobility" (Afifah, 2023)

1.3.9 Curriculum modules developed
1. A new transportation laboratory course TRANSPORTATION ENGINEERING STUDIES was approved at the University of Puerto Rico at Mayaguez. The description of this laboratory course is: "Studies performed by civil engineers to characterize, analyze, simulate, and estimate the performance, service quality, and condition of transportation systems. Discussion of data collection and analysis techniques. Demonstration of software tools used to plan, evaluate, operate, and maintain transportation systems. Techniques for presenting data and communicating results for transportation systems." One of the lab sessions included was related to Road user performance: driving and pedestrian simulation. In this session the students will learn about the use of simulation in studying road user behavior and the identification of safety countermeasures. This course is planned to be offered in the next academic year.

1.3.10 Student internships related to SAFER-SIM
1. Exploring Impaired Driving (UI)
   a. Hosted a summer intern to develop MATLAB code to detect facial shape and skin tone from a picture to support ongoing work examining Driver Monitoring System to detect impairment.
2. Volpe National Transportation Systems Center, Transportation Human Factors (Leila Cesic)

1.3.11 Presentations to student groups or classes
1. Panel focused on Women in STEM for undergraduate and graduate students (Roberts)
2. Presentation to UMass undergraduate students in the Honors College on "Driving Automation Systems – What's the Hype?" (Roberts)
3. Demonstrations of the UPRM Pedestrian Virtual Reality Simulator and the UPRM Driver Simulators. Mega Viernes Civil, Civil Engineering Institute of the College of Engineers and Surveyors of Puerto Rico. San Juan Convention Center. April 27, 2023. More than 500 engineers attended the activity and were exposed to the UPRM Simulation environments.
4. Presentation to the Global Road Safety class at The University of Iowa.
5. Guest lecturer on AVs for Global Road Safety class at The University of Iowa.

1.3.12 # Schools visited and # students present
1. 4/25/2023 Postville Senior High, Postville, IA Classroom visit, 120 K-12 students
2. 6/22/2023 Legos Activity for Summer Camp, Iowa City, IA, 20 K-12 students

1.3.13 # Career fairs visited and # of attendees
1. 4/6/2023 Penn Elementary Science Night, North Liberty, IA, STEM Night 250 K-12 students

1.3.14 Summer institutes and programs and # of students participating
1. Exploring Impaired Driving (UI)
   a. Worked with Prof Ryan Miller at Grinnell College on a Summer research program to look at predicting impaired driving based on vehicle data. The output of this was an abstract submitted to TRB's Impairment in Transportation Committee
2. REU Site – Research for Inclusivity and Driving Equity (RIDE) – wherein 10 undergraduate students from across the country spent 9 weeks (June 12- August 11) at UMass doing transportation safety & equity related research. (Roberts)
3. Demonstrations of the UPRM Pedestrian Virtual Reality Simulator and the UPRM Driver Simulators. Summer Transportation Institute Students. June 28 – July 27, 2023. The presentation included 12 rising junior and senior students plus five graduate students.

1.4 Technology Transfer

1.4.1 SAFER-SIM webinars
See 1.2.8 *SAFER-SIM Webinars*

1.4.2 Registrations for webinars
Forty-three (43) registrations were received for the three webinars presented.

1.4.3 Views of archived webinar content
There were 3178 views of archived content this period and 56,187 over the lifetime of the channe.

1.4.4 Press releases for SAFER-SIM related research
Nothing to report.

1.4.5 Media requests

Title	Publisher
1. Car crashes, alcohol consumption and vet visits: How legal recreational marijuana has ...	Cleveland Plain Dealer
2. "SR-22 Insurance Guide." or high-risk drivers quoted Shannon Roberts	Wallet Hub
3. The UPRM Mobile Driving Simulator was used as part of the Educational and	Pégate al Mediodía

Training Plan to be presented in the TV live show "Pégate al Mediodía" to demonstrate how to negotiate the new innovative interchange DDI open to the public during the summer of 2023.	

1.4.6 Tours of facilities
1. 3/3/2023 Siqi Liu (Iowa Writers' Workshop) (Plumert & Kearney)
2. 6/12/2023 lab tour for ~60 high school students in the Summer Engineering Institute (Roberts)
3. 8/3/2023 lab tour for ~15 high school students in the Massenberg Summer Institute on (Roberts)
4. (no date provided) tour of the driving simulator lab to prospective UMass undergraduate students during the Engineering Open House (Roberts)
5. 7/27/2023 The project team showed the Lieutenant Governor of Wisconsin, Sara Rodriguez, the automated vehicle and took her for a test drive.
6. 4/27/2023 Findley Elementary, Des Moines, IA toured DSRI facilities at UI, 54 K-12 students
7. 5/21/2023 Brownie Girl Scout Troup toured DSRI facilities at UI, Iowa City, IA , 10 K-12 students
8. 6/27/2023 Iowa National Summer Transportation Institute toured DSRI facilities at UI, 20 K-12 students
9. 7/7/2023 Iowa Summer Institute in Biostatistics toured DSRI facilities at UI, 16 college students
10. 7/12/2023 Trail Trekkers Group toured DSRI facilities at UI, 27 K-12 students
11. 7/13/2023 Perry Research Scholars toured DSRI facilities at UI, 15 K-12 students

1.4.7 Website traffic
Metric	This Period	Lifetime
Total Users	1361	Not reported
New Users	1355	Not reported
Sessions	2019	Not reported
Page Views	3182	Not reported

1.4.8 Patents filed
Nothing to report.

1.4.9 DOT requests for presentations or proposals related to SAFER-SIM
1. Phase II of DDI Simulation (UPR)

1.4.10 Practitioner attendance at events
Nothing to report.

1.4.11 Number of improved or new simulation technologies, software, methods, or processes
1. SaferSim contributed to demonstrating the importance of driving simulation and evaluating the best instruments to carry out DDI's education and training processes for the public. The generated and tested instruments were then implemented as part of the educational campaigns that were carried out to educate potential users before opening the project for public use. The improved process was the final design of an innovative intersection implemented for the first time in Puerto Rico. A series of experiments were conducted using the driving simulator in three phases. Several changes were recommended after the first phase of the study. These changes were incorporated into the design, and another round of experiments was carried out in the second phase with better results than those obtained with the original design. Given new recommendations, the design was adjusted, and a final design was reached, which was finally implemented. Before opening the project, the third phase included a series of events held as part of the educational campaign to use this type of innovative intersection. The events included presentations at professional activities such as the annual convention of the Institute of Civil Engineers of the College of Engineers and Surveyors of Puerto Rico (CIAPR, for its acronym in Spanish), presentation on a television program broadcast throughout Puerto Rico, presentation for a radio program widely broadcast throughout PR and educational activities in two shopping centers of high impact in the metropolitan area that are Plaza Las Américas in San Juan and Las Catalinas Mall in Caguas.

1.5 Collaboration

1.5.1 Attendance at the SAFER-SIM symposia
Nothing to report.

1.5.2 Interdisciplinary research projects within and across sites

1. The Impact of Driver's Mental Models of Advanced Vehicle Technologies on Safety and Performance – UI and UMass

1.5.3 Collaborative research projects across SAFER-SIM or other UTC sites
1. Driver Attitudes and Behavior in the Presence of E-Scooters versus Bicyclists (UMass & UPR)
2. Interfacing Synchrono and NADS for Virtual Simulation of Conventional & Connected and Autonomous Vehicles (UW & UI)

1.5.4 Collaborations with industry partners and government agencies

Organization Name	Location	Contribution
1. AAA Foundation for Traffic Safety	Washington D.C.	Financial support Collaborative research

2. Grinnell College	Grinnell, IA	Collaborative Research with Ryan Miller & 2 undergraduate students
3. UI Injury Prevention Research Center and the Iowa Initiative for Artificial Intelligence	University of Iowa	Financial support and Collaborative research
4. Recreative Association of Sport Buenaventura	Mayagüez, Puerto Rico	Provided facilities at low cost to perform data collection activities for the project.
5. Mayagüez Bureau of Highway Patrol	Mayagüez, Puerto Rico	The Mayaguez Bureau of Highway Patrol provided Equipment and experienced police officers to measure BAC during the project data collection.
6. City of Racine	Racine, WI	Financial support to help with the purchase of AV. In-kind support facilities to operate the AV shuttle in Racine.
7. Gateway Technical College	Racine, WI	In-kind support facilities to house and operate the shuttle in Racine.

1.5.5 Collaborative peer-reviewed journal publications
Nothing to report.

1.5.6 Collaborative book chapters
Nothing to report.

1.5.7 Student exchanges with other SAFER-SIM sites
Nothing to report.

1.5.8 Students pursuing advanced degrees at other SAFER-SIM sites
Nothing to report.

1.5.9 Programs involving community colleges
Nothing to report.

1.5.10 Graduates hired at SAFER-SIM, other UTC sites, or external organizations
Nothing to report.

1.6 Diversity

1.6.1 *# SAFER-SIM projects involving underrepresented/minority (U/M) students*
Twenty-five (25) project projects involving 28 students were active this period.

1.6.2 *# U/M events attended*

	# of students
1. 6/22/2023 Perry Research Scholars Institute (PRSI) through Belin-Blank summer program	20 students
2. 5/12/2023 Project HOPE (Healthcare Occupations Preparation and Exploration	16 students

1.6.3 *# U/M students at attended events*
36 students

1.6.4 *Graduating U/M student placement*
1. Jaheen Malik, Apple Computer
2. Leila Cesic graduated with a BSc in Civil Engineering at UMass, started as an MS Student at UMass in Fall 2023.
3. Emily Shull, NHTSA

1.7 Outcomes

1.7.1 *Number of improved or new technologies, software, methods, or processes adopted*
1. Evaluation of Driver Workload and Training Strategies on a Diverging Diamond Interchange
    a. SaferSim contributed to demonstrating the importance of driving simulation and evaluating the best instruments to carry out DDI's education and training processes for the public. The generated and tested instruments were then implemented as part of the educational campaigns that were carried out to educate potential users before opening the project for public use. The improved process was the final design of an innovative intersection implemented for the first time in Puerto Rico. A series of experiments were conducted using the driving simulator in three phases. Several changes were recommended after the first phase of the study. These changes were incorporated into the design, and another round of experiments was carried out in the second phase with better results than those obtained with the original design. Given new recommendations, the design was adjusted, and a final design was reached, which was finally implemented. Before opening the project, the third phase included a series of events held as part of the educational campaign to use this type of innovative intersection. The events included presentations at professional activities such as the annual convention of the Institute of Civil Engineers of the College of Engineers and Surveyors of Puerto Rico (CIAPR, for its acronym in Spanish), presentation on a television program broadcast throughout Puerto Rico, presentation for a radio

program widely broadcast throughout PR and educational activities in two shopping centers of high impact in the metropolitan area that are Plaza Las Américas in San Juan and Las Catalinas Mall in Caguas.

1.7.2 Stakeholders who adopt, implement or deploy SAFER-SIM research findings or technologies through policy, practice, regulation, rulemaking or legislation

1. Evaluation of Driver Workload and Training Strategies on a Diverging Diamond Interchange
   a. The Puerto Rico office of the Federal Highway Administration (FHWA) and the Puerto Rico Highways and Transportation Authority (PRHTA) decided to integrate driving simulation into the design process for implementing innovative intersections in Puerto Rico. The case in which this new process was implemented is the first Diverging Diamond Interchange (DDI) built at the intersection of highways PR-30 and PR-189 in Gurabo, PR. The agencies in charge of implementing transportation projects decided that in the case of the first implementation in PR of a DDI, the simulation could contribute to fine-tuning the design to benefit users. Thanks to SaferSim and the previous projects presented in PR, the decision-makers found it helpful to do a series of experiments to review the final design being built.

1.7.3 Number of projects that reach adoption, implementation or deployment
Nothing to report.

1.8 Impacts

1.8.1 Expected reductions in crashes from implemented policy, practice, regulation, rulemaking, or legislation

1. Reinforcement Learning for Optimal Speed Limit Control Over Network
   a. This project is expected to reduce the crash risks by dynamically selecting optimal speed limits. Metrics will be available when case studies are finished.
2. Driver Attitudes and Behavior in the Presence of E-Scooters versus Bicyclists
   a. This research is expected to set the stage for determining factors and infrastructure design affecting e-scooter safety and understanding how attitudes towards e-scooter riders compare with those towards bicyclists.
3. Evaluation of Driver Workload and Training Strategies on a Diverging Diamond Interchange
   a. The reduction in crash potential obtained in the simulation is notable. In the case of direct maneuvers, representing the most remarkable geometric change, the number of instances with critical errors was reduced from (8/48) 17% to (1/48) 2% of the maneuvers performed by the subjects in the study. Potential crashes are associated with critical errors in the different maneuvers performed at the intersection. Critical errors include steering against traffic, stopping in the middle of the road, reversing when realizing a wrong maneuver was made, going off the road, and crashing with curbs or concrete barriers. Moreover, the main impact generated by this project is the reduction in the construction costs of the DDI project. In reviewing the design using the driving simulator,

important changes were made to the geometry, pavement marking, and signage. New safety features and overhead signs were included that required the installation of structural support for the new signage. These changes were detected in time, avoiding costly interventions that would have been necessary once the intersection was opened to the public. Likewise, the drivers' safety when traveling through this intersection was increased, and, above all, the public's confidence in implementing innovations to reduce congestion and improve safety. All this was achieved thanks to the simulation experiments done before implementation.

1.8.2 Expected reduction in congestion and traffic conflicts from implemented policy, practice, regulation, rulemaking or legislation

1. Driver Attitudes and Behavior in the Presence of E-Scooters versus Bicyclists
    a. Reduction of traffic conflicts is expected from implementation of infrastructure treatments and regulations for e-scooter riding that improve safety. Improved safety for e-scooters could motivate increased e-scooter mode share which would consequently reduce congestion.
2. Evaluation of Driver Workload and Training Strategies on a Diverging Diamond Interchange
    a. The reduction in congestion, in this case, is mainly due to the implementation of the innovative intersection itself. It is unclear how much congestion was reduced because of the changes generated by the implementation of the SaferSim project and the design process integrating driving simulation to fine-tune the detailed design. However, it was clear that reducing crashes would reduce the non-recurrent congestion generated by such events. In addition, clearer signage and pavement markings made the transition process more straightforward from a Conventional Diamond Interchange (CDI) to a Diverging Diamond Interchange (DDI), reducing congestion.