STRIDE | Southeastern Transportation Research, Innovation, Development and Education Center

Technology Transfer Final Report

STRIDE Project D2

UF & UAB's Phase 1 Demonstration Study: Older Driver Experiences with Autonomous Vehicle Technology

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1. Project Overview

The purpose of this project was to assess older drivers' (≥ 65 years of age) perceptions of autonomous vehicles (AVs). Study participants completed an Autonomous Vehicle User Perception Survey before and after being exposed to (a) an autonomous shuttle, operating in a closed and fixed loop, and (b) an automated driving simulator scenario. The first step of this project was to develop a survey to measure older drivers' perceptions of AVs. The survey was validated using a focus group, subject-matter experts, and psychometric testing. Survey responses were gathered from older drivers' at baseline (i.e., prior to exposure to AVs) and from participants via the Amazon Mechanical Turk system. The survey was used to quantify older adults' perceptions of AVs, and to determine if any differences existed before and after exposure, by group, and by time. We also examined the group by time interaction effects. We hypothesized that older adults will demonstrate an increase in safety, trust, and intention to use the technology—all important precursors of acceptance and adoption practices—after exposure to the technology. We also hypothesized that older drivers' perceptions would have the greatest magnitude of change after experiencing the autonomous shuttle (vs. simulator). Our findings generally support the hypotheses, but also indicated that important group by time interaction effects existed for older adult perceptions pertaining to safety, trust, intention to use, perceived usefulness, and control/driving efficacy. Moreover, both the autonomous shuttle and the simulator programmed to run in autonomous mode, were feasible modes for collecting data in a valid and reliable way. The attrition rate for this study was 0%, and none of the participants dropped out as a result of simulator sickness—which is an important finding as simulator sickness is highly prevalent among older adults.

To our knowledge, this was the first study to quantify older adults' perceptions of AVs, before and after lived experiences in two types of AV modes using a valid and reliable user perception survey. The main finding suggests that older drivers' perceived safety, trust, and usefulness increased after being exposed to autonomous vehicle technology. In conclusion, we surmise that older drivers need to be exposed to AVs if they are to accept and adopt this emerging technology— and both the autonomous shuttle and simulator programmed to run in autonomous mode can be used for this purpose.

2. Research Goals

This project's objectives were portioned into three tasks which included:

a) Developing and validating the Autonomous Vehicle User Perception Survey (AVUPS) to assess users' perceptions of AVs;

b) Developing and validating a simulated driving scenario that corresponded to the on-road shuttle route; and

c) Assessing older drivers' perceptions at baseline, after being exposed to the automated shuttle (Level 4 SAE), and after being exposed to the driving simulator in autonomous mode (Level 4, SAE)— using the AVUPS and validated driving routes.

For a) this study utilized focus groups, content experts and measurement theory to establish face and content validity; for b) this study utilized congruence validation using the feedback of national experts via a content validity index; and for c) this study used a randomized crossover design to randomize the order of exposure to autonomous vehicles and to control for order effect.

3. Findings

Using the validated AVUPS, we studied the perceptions of 104 older drivers in Florida before and after being exposed to an autonomous shuttle and a driving simulator running in autonomous mode. For between group differences— after exposure to the automated shuttle or the driving simulator, no group effects were evident, but time effects indicated the significance of *safety, trust* and *perceived usefulness* of AV technology in the acceptance practices of older drivers. The group by time interaction effects indicated the significance of older adult perceptions pertaining to *intention to use, trust, perceived usefulness, control/driving efficacy, and safety.* The study results are telling of the determinants of older adult AV technology acceptance practices. Certainly, future studies may want to build on the empirically validated perceptions in this study—but also need to reckon with different levels of vehicle automation (i.e., Level 1, 2, 3 and 5), varying circumstances (e.g., night driving), environmental characteristics (e.g., rainy conditions), and different political contexts (e.g., early stages vs. later stages of AV deployment) to achieve an enhanced understanding of older driver acceptance practices pertaining to AV technologies.

4. Performance Metrics

Metric	# Completed
OUTPUTS	
Product(s): Number of new or improved tools, technologies, products, methods, practices, and processes created or improved	5
Technical Report: Number of client-based technical reports published	STRIDE Final Report
OUTCOMES	
Body of Knowledge: Number of trainings for transportation professionals	13
Professionals Trained: Number of professionals participating in trainings	796
IMPACTS	
Stakeholders: Number of stakeholders you met with to encourage adoption or implementation of product(s)	12
Adoption/Implementation: Number of incidences outputs of research have been implemented or adopted	4

5. Products

1) **Autonomous Vehicle User Perception Survey (AVUPS)**
A 28-question survey was developed based on a conceptual model to assess participants' intention to use autonomous vehicle technology. Twenty-four questions used a visual analogue scale (VAS) ranging from disagree to agree and four questions were open-ended. Face, content, and construct validity and test-retest reliability were established. The survey can be downloaded from the supplementary material in an open-access publication in Frontiers.

2) **Autonomous Simulation Scenario**
A driving simulation scenario was developed for the Realtime Technologies Inc. (RTI) driving simulator (https://drivingsim.phhp.ufl.edu/). This simulation scenario was built to broadly represent geographic features to emulate the route of the autonomous shuttle. Five team members with experience in transportation, simulators, occupational therapy, engineering, driving rehabilitation, computer science, and exercise physiology developed the simulation. A video of the simulation scenario may be found on YouTube at (https://www.youtube.com/watch?v=kDObiycJUxA). Face and content validation of the simulation ensured congruence with the real-life scenario. The validation process is described in an open-access publication in Frontiers: https://www.frontiersin.org/articles/10.3389/ffutr.2020.596620/full

3) **Continuing Education Courses**
Two courses were developed and are available online.
1) Older Adults' Perceptions of Automated Vehicle Technology. 2020.
This course provides an overview of older adults' transportation needs, the potential benefit of autonomous vehicle technology (AVT) to their health and safety, and results from a study conducted to determine older adults' perception before and after being exposed to AVT (i.e. a driving simulator driving in autonomous mode and an automated shuttle). The presentation highlights implications for practice, policy and research.
See, https://ot.phhp.ufl.edu/category/online-education/ceu-courses/dr-classen-courses/
2) Autonomous & Connected Vehicles (ACV): Introduction to the Health Care Professional. 2020.
This course provides an overview of the current crash statistics in the USA, an introduction to autonomous vehicles (AV), including the levels of AV, how driving as an occupation may be affected/changed by AV, the pros and the cons of AV, a timeline for AV, as well as a discussion on the vulnerable road users and how they may benefit from AV. The presentation highlights that we are facing the greatest transportation revolution of the century and invite health care professionals to consider the opportunities of AV technology for mobility-disadvantaged people.
https://ot.phhp.ufl.edu/category/online-education/ceu-courses/dr-classen-courses/

4) **Handbook**
Classen, S., & Alvarez, L. Driver Capabilities in the Resumption of Control (Chapter 10). (2019). In Donald L. Fisher, William J. Horrey, Michael A. Regan, & John D. Lee (Eds.), Handbook of Human Factors and Automated, Connected and Intelligent Vehicles. In press.
5) **Smart Driver Course**
Dr. Classen was a subject matter expert and developed the AARP Smart Driver Course Research and Guidebook. Older drivers that successfully complete this course will receive a reduced rate for their drivers insurance. https://www.aarp.org/auto/driver-safety/

6. Who benefits/will benefit from your product(s)?

- Information from our products will inform engineers, city planners, and policy makers to enhance deployment of AV technologies.
- Our products and findings will also be useful for healthcare professionals seeking alternative mobility options for the transportation disadvantaged. For example, people who can no longer drive or who want to supplement driving with automated shared services, such as the autonomous shuttle.
- This information will also benefit the general public can be benefitted from a broader understanding of facilitators and barriers of accepting and adopting AV technology, especially for serving older adults' and those with disabilities' mobility needs.
- This information is also incredibly useful to industry and developers of the shuttle—to ensure that America with Disabilities Act (ADA) compliance standards are being met particularly for those persons with disabilities and age-related mobility impairments.
- The automated shuttles were manufactured in France and were thus designed based on their accessibility guidelines and policies. Transdev, City of Gainesville, and EasyMile meets weekly with our research team to discuss shuttle operations. Based on our feedback and those of our participants, they updated shuttle ramps and attachments (wheelchair securements) to serve participants with assistive mobility devices (i.e., walkers, canes, wheelchairs).So far, two of the shuttles have been remediated to be ADA compliant.

8. Body of Knowledge & Professionals Trained

1) The OT Department hosted the annual Sandra Edwards Colloquium, with about 80 attendees (40 professionals) from across the state of FL (see https://ot.phhp.ufl.edu/category/sandra-edwards-colloquium/). The colloquium's theme was *Driving Rehabilitation and Community Mobility*—with a special emphasis on autonomous vehicle technology. This venue was used to disseminate the ongoing research pertaining to this project. February 2, 2019.
2) The OT Department was well-represented at the National Conference for the American Occupational Therapy Association (AOTA) in April 2019. Roughly 7,500 professionals

attended the conference and 35 professionals visited our poster session titled, "A scoping review for the use of smart technology with older drivers". The research team presented their initial validation for the survey created for and utilized in this study. The poster was presented at PHHP Research Day, April 2019, to 20 professionals.

3) Dr. Classen presented the findings from the research team in July 2019, at the Brookings Institute, Washington DC. She shared the research team's initial findings (N=69) related to the UF & UAB's Phase I Demonstration Study: Older Driver Experiences with Autonomous Vehicle Technology. About 300 participants attended and the presentation was broadcasted nationally. The exact number of individuals impacted is not certain, but conservatively we estimate about 1000. The webcast is also published on the website of the Institute for Mobility, Activity and Participation.
4) Dr. Mason presented the research team's initial validation for the survey created for and utilized in this study. The poster was presented at the Automated Vehicles Symposium, July 2019, to 60 professionals.
5) Dr. Classen presented the findings from the research team in September 2019, at the I-STREET Stakeholder Meeting, Gainesville FL. She shared the research team's initial findings (N=69) related to the UF & UAB's Phase I Demonstration Study: Older Driver Experiences with Autonomous Vehicle Technology. 25 transportation professionals attended the meeting.
6) The research team presented the findings in October 2019, at the Road Safety & Simulation Conference, Iowa City, IA. They shared the initial findings (N=69) of to the UF & UAB's Phase I Demonstration Study: Older Driver Experiences with Autonomous Vehicle Technology to 50 transportation professionals.
7) Dr. Sisiopiku (UAB) presented the interim-findings in November 2019 at the Gulf Region Intelligent Transportation Society (GRITS) to 50 transportation professionals.
8) Dr. Classen presented the interim-findings from the research team in January 2020, to the AND30 Committee (Simulation and Measurement of Vehicle and Operator Performance) at Transportation Research Board (TRB). Fifty transportation professionals attended this meeting.
9) Dr. Mason presented the research team's initial validation for the survey created for and utilized in this study. This was presented at the TRB, January 2020, to 98 transportation professionals.
10) Two lectures were presented and four Driving Rehabilitation Therapy students graduated. See newsletter for more information: https://stride.ce.ufl.edu/2019/12/research-in-older-drivers-autonomous-vehicles-leads-to-educational-materials-in-occupational-therapy/. Eight transportation professionals receive this STRIDE newsletter which was sent to the Listserv.
    a. Lecture 1 - Autonomous vehicles and medically at-risk-drivers through the lifespan: Role, function and future directives for the Driving Rehabilitation Specialist (DRS).
    b. Lecture 2 - Vehicle automation technologies and medically at-risk drivers through the lifespan: Role, function and future directives for the DRS.

11) The results from this study have been accepted for presentation at 15 conferences. Conferences hosted by the Association for Driver Rehabilitation Specialists (ADED), RAND at the University of Oregon, AARP, University of Florida, Occupational Therapy Summit of Scholars, Transportation Research Board, Brookings Institution, Autonomous Vehicles Symposium, UF PHHP Research Day, Gulf Region Intelligent Transportation Society, Road Safety & Simulation, Lifesavers Conference, American Occupational Therapy Association (AOTA), and Florida Occupational Therapy Association, FAMU-FSU Transportation Day (See Table on pages 3-7). Due to COVID-19, the annual conference for AOTA, Lifesavers, and ADED have been postponed until the following year. Presentations and educational workshops were submitted in May 2020 to both AOTA and ADED for 2021.
12) Dr. Classen's doctoral student, James Wersal, presented a poster titled, A Scoping Review to Examine Brain Injury Interventions for Fitness to Drive, at the Sandra Edwards Colloquium in February 2020. Dr. Classen was the senior author and mentor for the poster. This poster and three other posters were presented by the research team at UF PHHP Research Day, February 2020.
13) Dr. Classen is the Keynote Speaker at the 6th Annual Transportation Day hosted by Florida State University Center for Accessibility and Safety for an Aging Population. This webinar is in partnership with Florida A&M University and the University of Northern Florida. Dr. Classen's presentation, "Autonomous Vehicle Technology and Older Adults: A Primer for Health Care Professionals and Engineers" was viewed by ~80 transportation professionals and students.

9. Stakeholder Engagement

MEETING DETAILS		NARRATIVE DESCRIPTION
STRIDE Rep.	Dr. Mason	Town hall meeting to recruit participants.
Date of Activity	1/25/19	
Type of Activity	in-person meeting	
Location	Gainesville, FL	
Stakeholder(s)	Oak Hammock	
STRIDE Rep.	Dr. Mason	Recruit participants from rotary club and surrounding areas in Gainesville
Date of Activity	1/31/19	
Type of Activity	in-person meeting	
Location	Gainesville, FL	
Stakeholder(s)	Rotary Club	
STRIDE Rep.	Dr. Mason	Discuss project with stakeholders (UFTI, FDOT, and City of Gainesville). Update with
Date of Activity	2/22/19	

Type of Activity	in-person meeting	progress and data collection. Additionally, we received information from FDOT and City of Gainesville regarding the waiver from NHTSA.
Location	Gainesville, FL	
Stakeholder(s)	I-STREET	
STRIDE Rep.	Dr. Mason	Meet with research team to discuss and assess our progress. Internal meetings (UF only) occur twice per month. The entire team (UF & UAB) meet once per month. UAB joins via Zoom.
Date of Activity	2/22/19	
Type of Activity	in-person meeting	
Location	Gainesville, FL & Zoom	
Stakeholder(s)	UF & UAB Project Researchers	
STRIDE Rep.	Dr. Mason	Social media outreach for participants recruitment
Date of Activity	3/14/19	
Type of Activity	in-person meeting	
Location	Gainesville, FL	
Stakeholder(s)	UF Area Health Education Centers	
STRIDE Rep.	Dr. Mason	Meet with HealthStreet recruitment specialist to discuss additional recruitment strategies.
Date of Activity	5/7/19	
Type of Activity	in-person meeting	
Location	Gainesville, FL	
Stakeholder(s)	HealthStreet	
STRIDE Rep.	Dr. Mason	Town hall meeting to recruit participants.
Date of Activity	4/26/19	
Type of Activity	in-person meeting	
Location	Gainesville, FL	
Stakeholder(s)	Oak Hammock	
STRIDE Rep.	Dr. Mason	Meet with CTSI recruitment specialist to discuss additional recruitment strategies.
Date of Activity	6/3/19	
Type of Activity	in-person meeting	
Location	Gainesville, FL	
Stakeholder(s)	CTSI	

STRIDE Rep.	Dr. Mason	Present to local teachers regarding OT, transportation, job opportunities for their students, and our research results.
Date of Activity	6/6/19	
Type of Activity	in-person meeting	
Location	Gainesville, FL	
Stakeholder(s)	STRIDE	
STRIDE Rep.	Dr. Mason	Rory was provided with an update of our research progress. Our findings will be disseminated to the Rotary Club upon completion of the study. Furthermore, Rory provided us with a letter of support for our application to fund phase 2 of the D2 project.
Date of Activity	8/3/19	
Type of Activity	phone meeting	
Location	Gainesville, FL	
Stakeholder(s)	Rory Causseaux, President, Sunrise Rotary Club	
STRIDE Rep.	Dr. Mason	An email was sent from Jesus Gomez to I-STREET/STRIDE members. Transdev received a NHTSA waiver until October 2nd. This waiver allows mapping of the shuttle. We will need to wait for the second waiver to begin participant testing.
Date of Activity	8/13/19	
Type of Activity	phone meeting	
Location	Gainesville, FL	
Stakeholder(s)	Jesus Gomez, Transit Director, City of Gainesville	
STRIDE Rep.	Dr. Mason	This phone call was set up to discuss the NHTSA waiver. The City of Gainesville has not received an update regarding the second waiver to allow for research testing on the shuttle.
Date of Activity	9/16/19	
Type of Activity	phone meeting	
Location	Gainesville, FL	
Stakeholder(s)	Malisa McCreedy, Director of Mobility, City of Gainesville	
STRIDE Rep.	Dr. Mason	We spoke with Andy Chatham regarding use of the shuttle. Andy has been given new responsibilities at Transdev and connected us with Neal Hemenover to organize use of the shuttle. Continuous conversation with Jesus Gomez and TransDev to determine status of the NHTSA waiver and next steps for testing participants.
Date of Activity	9/23/19-10/07/2019	
Type of Activity	phone meeting	
Location	Gainesville, FL	
Stakeholder(s)	Andy Chatham,Director, Transdev	

STRIDE Rep.	Dr. Mason	Justin and Malisa met to discuss the shuttle and waiver. The continued support of the City of Gainesville has been very much appreciated.
Date of Activity	11/21/19	
Type of Activity	in-person meeting	
Location	Gainesville, FL	
Stakeholder(s)	Malisa McCreedy, Director of Mobility, City of Gainesville	
STRIDE Rep.	Dr. Mason	We have continued to speak with Neal Hemenover and Jesus Gomez to determine the status of the NHTSA waiver and next steps for testing participants. The waiver was approved on December 20th, 2019. We are currently discussing when the shuttle will begin operating in downtown Gainesville. Currently, the City of Gainesville is preparing the area (i.e., placing road signs) and the shuttle for operation.
Date of Activity	12/20/19-1/06/2019	
Type of Activity	other - please describe	
Location	Gainesville, FL	
Stakeholder(s)	Jesus Gomez, Transit Director, City of Gainesville	
STRIDE Rep.	Dr. Mason	AV Shuttle Inaugural Ride: The stakeholders and collaborators participated in the official kickoff of the shuttle in downtown Gainesville. This was covered by the news media and publicized to the public.
Date of Activity	2/3/20	
Type of Activity	in-person meeting	
Location	Gainesville, FL	
Stakeholder(s)	City of Gainesville, FDOT, STRIDE, EasyMile, Transdev	
STRIDE Rep.	Dr. Mason	Interim findings were presented at the UF Innovation HUB
Date of Activity	2/3/20	
Type of Activity	in-person meeting	
Location	Gainesville, FL	
Stakeholder(s)	City of Gainesville, FDOT, STRIDE	
STRIDE Rep.	Dr. Mason	During the meeting, interim findings were disseminated and discussed. Additionally, we discussed our approach to develop the
Date of Activity	2/17/20	
Type of Activity	Zoom meeting	

Location	New York City, NY and Gainesville, FL	study protocol and develop a collaborative team of stakeholders.
Stakeholder(s)	Arcadis	
STRIDE Rep.	Dr. Mason	Dr. Classen is meeting monthly with the CEO of Oak Hammock to update him on the study as well as answer any questions that he may have. A Town hall meeting was scheduled—and cancelled twice (AS waiver issues, COVID-19 issues), but will be held in future to make known the findings of the study to the residents of Oak Hammock.
Date of Activity	1/16/20-4/15/20	
Type of Activity	in-person meeting	
Location	Oak Hammock, Gainesville, FL	
Stakeholder(s)	Oak Hammock CEO, Gainesville, FL	
STRIDE Rep.	Dr. Mason	Justin Mason has been in constant communication with the City of Gainesville to plan and organize data collection. Jesus Gomez and Malisa McCreedy have been instrumental in providing us with updates related to the automated shuttle and their policies to mitigate the spread of COVID-19.
Date of Activity	5/5/2020, 6/29/2020, 7/2/2020	
Type of Activity	other - please describe	
Location	Email	
Stakeholder(s)	Jesus Gomez & Malisa McCreedy, City of Gainesville	
STRIDE Rep.	Drs. Classen & Mason	Dr. Sherrilene Classen, Justin Mason and Neal Hemenover (Transdev) have maintained communication to receive updates on COVID-19 best practice, NHTSA waiver approval, modifications of the automated shuttle to include seatbelts, and data collection.
Date of Activity	5/5/2020, 7/2/2020	
Type of Activity	other - please describe	
Location	Phone and email	
Stakeholder(s)	Neal Hemenover, VP of Innovation, Transdev	
STRIDE Rep.	Dr. Mason	Dr. Mason meets bi-weekly with the City of Gainesville, UF I-STREET, and Transdev for shuttle operation updates to plan and organize data collection. These meetings have been instrumental in providing us with updates related to the automated shuttle
Date of Activity	7/16/2020 - 10/15/2020	
Type of Activity	other - please describe	
Location	Zoom	
Stakeholder(s)	Jesus Gomez (CoG), Dr. Pruthvi Manjunatha (UF I-STREET),	

	& Neal Hemenover (Transdev)	and their policies to mitigate the spread of COVID-19.
STRIDE Rep.	Dr. Mason	Dr. Classen had various engagements with Dr. Olivera—that resulted in Dr. Classen being invited as Keynote speaker for an upcoming FSU-FAMU Transportation Conference. The 6th Annual Transportation Day – Webinar: Technology in Transportation. 16 October 2020.
Date of Activity	7/16/2020 - 10/15/2020	
Type of Activity	other - please describe	
Location	Zoom	
Stakeholder(s)	Deb Olivera—Chair, OT Department, FAMU	
STRIDE Rep.	Dr. Mason	Dr. Mason meets bi-weekly with the City of Gainesville, UF I-STREET, and Transdev for shuttle operation updates to plan and organize data collection. These meetings have been instrumental in providing us with updates related to the automated shuttle and their policies to mitigate the spread of COVID-19
Date of Activity	10/16/2020 - 1/15/2021	
Type of Activity	other - please describe	
Location	Zoom	
Stakeholder(s)	Jesus Gomez (CoG), Dr. Pruthvi Manjunatha (UF I-STREET), & Neal Hemenover (Transdev)	

10. Adoption/Implementation

1) **Autonomous Vehicle User Perception Survey (AVUPS)**
   The FDOT, Office of Safety, has funded a new project, using the survey developed with this STRIDE funding—to enhance the survey (Phase 1) and extend it to adults (i.e., 50+ years old) (Phase 2) who are using a variety of autonomous mobility services, including: ride hailing services, ride sharing services, taxis, shuttles and buses. FDOT (Classen) Total Award: $203,947. Barriers and facilitators pertaining to older drivers perceptions on the use of autonomous vehicle technology informs engineers, city planners, policy makers and health care professionals.
2) **Continuing Education Courses** are available online at https://ot.phhp.ufl.edu/category/online-education/ceu-courses/dr-classen-courses/.
3) **Handbook of Human Factors and Automated, Connected and Intelligent Vehicles** is in press.
4) **Smart Driver Course** available online at https://www.aarp.org/auto/driver-safety/

11. Broader Impacts

The University of Florida's Institute for Mobility, Activity and Participation is viewed as one of the national leaders in pursuing work in user perceptions of medically at risk,

disadvantaged, vulnerable and disabled people—related to adoption and acceptance practices related to Autonomous and Connected vehicles. Moreover, as a result of our unique collaboration with the TREND lab at UAB, we will be able to present information so that: a) decision makers and the AV industry may benefit from learning about perceptions of older drivers about AV adoption potential, and b) the general public can be benefitted from a broader understanding of facilitators and barriers of accepting and adopting AV technology, especially for serving older adults' and those with disabilities' mobility needs.