



USDOT NATIONAL CENTER FOR UNDERSTANDING FUTURE
TRAVEL BEHAVIOR AND DEMAND

Semi-Annual Progress Report for University Transportation Centers

Submitted to: U.S. Department of Transportation
Office of the Assistant Secretary for Research and Technology
(OST-R)

Federal Grant No.: 69A3552344815 and 69A3552348320

Project Title: Center for Understanding Future Travel Behavior and Demand
(TBD)

Center Director: Dr. Chandra Bhat, Director
bhat@mail.utexas.edu, 512-471-4535

Submitting Official: Lisa Macias, Executive Assistant
lisaweyant@mail.utexas.edu, 512-232-6272

Submission Date: April 30, 2024

DUNS Number: 170230239

EIN Number: 746000203

Recipient Organization: The University of Texas at Austin
Office of Sponsored Projects
3925 West Braker Lane
Building 156, Suite 3.11072
Austin, TX 78759

Recipient Identifying No: AWD00002105

Grant Period: June 1, 2023 – May 31, 2029

Reporting Period End Date: March 31, 2024

Report Frequency: Semi-Annual

Signature: 

Section 1: Accomplishments

What are the major goals of the program?

The overarching goal of the Center, hosted within UT's Center for Transportation Research (CTR), is to undertake breakthrough research that will fundamentally re-examine and transform the scientific base for measuring, monitoring, modeling, and managing traveler behaviors to foster the design, development, and operation of a people-centric, multimodal, intelligent transportation system that meets the needs of the people, institutions, and businesses for generations to come. The TBD initiative aligns with the USDOT strategic goal of transformation, and anticipates significant contributions to equity and climate and sustainability goals. In particular, the Center, while pursuing a multitude of different activities, will undertake two flagship endeavors of national significance to bring about transformative impacts in planning and decision-making. One will be a *travel behavior data hub* that the public, transportation planners, and policy-makers alike can leverage to understand the state of the transportation system, with built-in *quality of life/well-being, energy footprint, and mobility poverty calculators* to aid in planning for equity, sustainability, and community well-being. The second will be a panel-based multi-year *Transportation Heartbeat of America Travel Behavior and Demand Survey, including a survey of individuals, businesses, and employers*, to understand how travel behavior and demand is evolving, which will provide critical insights on the future of transportation and the priorities of the nation.

Center-Wide Accomplishments

The past six months have been a productive and successful one for the TBD center, with multiple research projects continuing on (many of which have already started to be disseminated through presentations at TRB and beyond, with explicit acknowledgment to the USDOT grant), and research and efforts underway related to the two flagship endeavors listed earlier. The travel behavior data hub is under development, building on and substantially expanding an earlier effort initiated through the Tier 1 TOMNET Center. This effort is now fully integrated within the TBD Center. Similarly, the *Transportation Heartbeat of America TBD Survey efforts* also have been initiated, with ongoing biweekly meetings to which the program manager, Britain Bruner is also invited. The survey instrument design is progressing well, and discussions on how best to deploy the survey are currently being discussed.

From a non-technical perspective, a comprehensive and artful website (along with the Center logo), was developed during the reporting period. The web link is <https://tbd.ctr.utexas.edu/>. The site has already attracted about 1,500 visitors since its launch in late December.

From a workforce development and technology transfer perspective, there have been several efforts at participating institutions. A central flagship effort in this regard was The Austin Symposium on "Back to the Foundations of Travel Demand". Laynee Jones from USDOT and Brian Gardner from FHWA were participants. This event is discussed in some detail below.

The Austin Symposium: The Austin Symposium was organized by Eric Miller, Rolf Moeckel, Rachel Copperman, Ram Pendyala, and Chandra Bhat. The Symposium drew the "who's who" in the travel behavior and demand area from all over the world, including representation from Australia, Germany, Switzerland, Belgium, India, Chile, and England. The Symposium was motivated by five key observations, each then constituting a topic area of discussion for a full half-day of the symposium. Each topic area was assigned a duo of individuals to prepare a resource paper to kickstart discussions, and eminent travel behavior researchers were kindly asked to serve as moderators. The five topics were:

- (1) "Reflecting concepts of time use and monetary expenditures in modeling frameworks": Resource Paper Authors: Atiyya Shaw and Maren Outwater; Moderator: Sergio Jara Diaz
- (2) "Integration of emerging and future mobility services/technologies in activity-travel forecasting models": Resource Paper Authors: David Ory and Giovanni Circella; Moderator: Peter Jones
- (3) "The formation, evolution, and dynamics of activity-mobility-location choices and choice sets": Resource Paper Authors: Soora Rasouli and Brian Lee; Moderator: Aruna Sivakumar

- (4) “Leveraging the data revolution for advancing behaviorally robust activity-travel models”: Resource Paper Authors: John Gliebe and Alison Conway; Moderator: Michel Bierlaire
- (5) “Behavioral foundations of route choice and implications for models”: Resource Paper Authors: Jay Jayakrishnan and Pedro Camargo; Moderator: Hani Mahmassani

Through addressing the five topics identified above (and related issues), the Austin Symposium represented a “watershed” opportunity to rethink the foundations of our travel demand models, and how those foundations may be brought together into a conceptual guidance framework -- a pathway forward -- for our demand and policy analyses of tomorrow. This is particularly timely because planning professionals, and many decision-makers, are increasingly interested in shaping, not just forecasting, demand. There also is greater uncertainty in our forecasting ability, especially because communication substitution for travel, new and rapidly evolving mobility technologies, crime, disaster risk exposure, and even political culture are becoming increasingly important considerations, along with the traditional power of accessibility, in forecasting future land use and transportation. Reports from the Symposium have been posted at the website (with two of them in draft form; please see). The resource papers themselves are being prepared as papers for publication. In particular, the organizers prepared a proposal for a special issue from the TBD Symposium for the Journal of Transport Policy, and received approval. Papers, including resource papers (modified based on the discussions at the Symposium) are due May 25th, with the intent that the special issue papers will all be published in Fall 2024.

Some other overall accomplishments of the TBD Center in this reporting period are listed below.

Selected TBD Faculty Awards and Honors

- Georgia Tech Civil and Environmental Engineering Professor and TBD Associate Director Dr. Patricia Mokhtarian has been elected to the prestigious National Academy of Engineering in Feb 2024. ([link](#))
- TBD Associate Director Dr. Wen Cheng has been honored with the Traffic Safety Excellence Award by the National Highway Traffic Safety Administration (NHTSA) at the 2023 California Traffic Safety Summit in November 2023 for his work analyzing traffic design and crash data to help make California streets safer. ([link](#))
- Multiple TBD faculty members, including Ram Pendyala, Patricia Mokhtarian, and Chandra Bhat were recognized as top researchers globally in the combined field of transportation and logistics, based on Scopus and other sources, as extracted from Ioannidis, John P.A. (2023), “October 2023 data-update for "Updated science-wide author databases of standardized citation indicators", Elsevier Data Repository, V6, doi: 10.17632/btchxkztzyw.6 ([link](#)).
- The TBD Director Professor Chandra Bhat has been appointed as the **Satish Dhawan Visiting Chair Professor** at the Indian Institute of Science, an Institution of Eminence in India.

Selected TBD Student Awards and Honors

- Santiago Contreas, a CalPoly Pomona (CPP) student, was selected as one of the 19 recipients of the 2024 TRB Minority Fellowship and presented at the 2024 TRB Annual Meeting in Washington, DC ([link](#))
- Seven CPP students (Calvin Wong, Susanna Eng, Shawn Chen, Kirill Rogovoy, Daniel Uyematsu, Hetkumar Ghadia, Ziliang Wang) were chosen as the 2023-2024 DDETFP Fellowship recipients and presented at the 2024 TRB Annual Meeting in Washington, DC.
- The dissertation of Dr. Xinyi Wang (advisor: Patricia Mokhtarian) received the 2023 Best Ph.D. Thesis Award from the Georgia Tech School of Civil and Environmental Engineering in December 2023, and another Best Ph.D. Thesis Award from the GT chapter of the Sigma Xi Science and Engineering honor society in March 2024.
- PhD student Angela Haddad, received the Women in Transportation Seminar (WTS) Heart of Texas Chapter award based on her contributions to research and leadership, including her activities related to the TBD grant, March 2024.
- M.S. student, Vivek Verma, received the Charley V. Wootan Memorial Award for the best MS thesis in the Transportation Policy and Planning area, December 2023.

- PhD student and TBD researcher Amy Fong has been appointed as a member of the University of Michigan's Civil and Environmental Engineering department's Diversity, Equity, and Inclusion committee (CEE DEI committee). She has assisted in developing a survey on norms and values to develop a Values Statement to be adopted by the department.
- PhD student Feng (Ryan) Lin's paper titled "*Fair Collaborative Learning (FairCL): A Method to Improve Fairness amid Personalization*" was selected as a finalist of the 2023 INFORMS QSR Best Paper Competition.

Selected TBD Faculty Presentations (not project-specific technical presentations)

- TBD Center Senior Advisor, Dr. [Steven Polzin](#), served as a panelist for an event titled "The Imperiled Future of Big-City Mass Transit" organized by [American Enterprise Institute](#).
- Steven Polzin gave a keynote speech at the Indianapolis MPO Speaker Series, titled "Change and Uncertainty in Transportation," on November 8, 2023.
- On April 12, 2024, a group of 19 students, co-advised by Prof. Yongping Zhang and two senior engineers from Caltrans District 8, presented to the top management team of Caltrans District 8 at Cal Poly Pomona. The presentation was attended by the District Director, four deputy district directors, and three senior engineers. ([link](#))
- Prof. Seung-Nam Kim, Department of Urban Design and Studies, Chung-Ang University, South Korea, gave a seminar titled, "Urban and Transportation Studies Using VR Experiments", November 9, 2023.
- The TBD Director, Professor Chandra Bhat served as a keynote panelist for the launch of the Inaugural Mobility Summit hosted by the Mobility and Intelligent Transportation (MIInT) Collaborative of the [Indian Institute of Technology, Madras](#) (IIT-M). The panel, moderated by Professor [Gitakrishnan Ramadurai](#) of IIT-M, also included Professor [Hari Balakrishnan](#) of MIT as a keynote panelist. The recording of the panel discussion may be viewed [here](#) (between 5:00 and 59:00).
- Professor [Cynthia Chen](#) of the University of Washington, who serves as an Associate Director for the TBD National Center delivered a seminar on the promises and perils of big and small data for human mobility analysis. The seminar is organized by the UC Davis Institute of Transportation Studies ([link](#)).

Selected TBD Media Interviews and Blogs

- Steven Polzin also gave an interview to Fox10Phoenix about the EV charging network as charging stations expand across the nation ([link](#)).
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- In November 2023, Prof. Wen Cheng, Associate Chair of Civil Engineering at Cal Poly Pomona, joined KCAL News to talk about the challenges engineers are facing when it comes to repairing the I-10 freeway after the massive pallet fire ([link](#)).
- TBD Associate Director Dr. Patricia Mokhtarian was interviewed by The New York Times on November 6, 2023, on the teleworking trends ([link](#)).
- Dr. Mokhtarian is quoted in *Outside* article by Gloria Liu, March 12, 2024: "Colorado's I-70 Has America's Most Notorious Ski Traffic. Is There a Solution?" ([link](#)).
- Dr. Mokhtarian Interviewed for *Generating Buzz: Remote Work in a Post-Pandemic World*. Georgia Tech podcast, March 29, 2024. ([link1](#)) ([link2](#)).
- [UMich research news](#) also recently did a press release on a paper that Dr. Shaw published earlier this year, which is also shared on [X](#). The press release includes an acknowledgement of partial funding from the UTC since Amy Fong, the student who led the paper, was partially funded through the TBD Center this year. It is in line with theme of our first year effort which focuses on travelers who are less likely to be represented or prioritized in transportation infrastructure planning.
- TBD Director Dr. Chandra Bhat was interviewed by The New York Times on March 22, 2024, on the issue of safety in public transit ([link](#)).
- Dr. Chandra Bhat was interviewed by The Daily Texan (student newspaper of UT Austin) on March 27, 2024, on the benefit of using public transportation ([link](#)).

- [Andrew Maynard](#), Professor in the School for the Future of Innovation in Society at [Arizona State University](#) who serves as a co-PI for the TBD Center, has authored a thoughtful blog on the future of technology and humanity in the wake of the unfortunate incident in San Francisco where a Waymo vehicle was set on fire and destroyed. ([link](#)).
- Andrew Maynard authored yet another blog article on the safety of Autonomous Vehicles: [Waymo safety study shows not all self-driving cars are created equal](#).

Exciting Upcoming Workforce Development/Technology Transfer Events

- In April, the WTS-LA Transportation YOU Committee, in partnership with the Cal Poly Pomona WTS-CPP Student Chapter and its faculty advisor Prof. Yongping Zhang, will co-host about 90 high school girls for the 2nd Girl's Empowerment Day at Cal Poly Pomona. The event aimed to encourage young women to consider careers in Science, Technology, Engineering, Arts, and Math (STEAM), including transportation careers.
- This summer, TBD Associate Professor Dr. Atiyya Shaw's research lab will participate in the Community College Summer Fellowship Program at the University of Michigan, and mentoring an undergraduate engineering student from a local community college who is hoping to transfer to UMich in the future. See [here](#) for more on the program.
- In April, Dr. Shaw will collaborate with the Center for Socially Engaged Design at the University of Michigan to co-develop an active learning workshop on the Detroit I-375 Highway Reclamation Effort.
- TBD Director Dr. Chandra Bhat, along with his colleague Abdul R. Pinjari, are organizing "A Short Course on Multivariate and Multiple Discrete-Continuous Choice Modeling Methods," which will take place on May 22, 2024, in Atlanta, GA, in the heart of the Georgia Institute of Technology campus. This one-day, in-person course workshop is offered at no cost to attendees and will provide an excellent opportunity for attendees to learn advanced choice modeling methods.

Project-Specific Accomplishments

Project 1: Trends in Time, Travel, Transit, Telework, and Treasure (T5)

What was accomplished under these goals?

This multi-stage project is designed to analyze trends over the last few decades in time, travel, transit, telework, and treasure (referred to as T5) by utilizing data from the American Time Use Survey (ATUS), the Consumer Expenditure Survey (CES), the American Community Survey (ACS), and other publicly available sources. During this reporting period, the project team accomplished the following:

- Compiled and conducted extensive analyses of datasets focusing on vehicle ownership, commute mode choices, zero-worker households, commute durations, zero-trip making, and Vehicle Miles Traveled (VMT).
- Examined telecommuting patterns in the ATUS and ACS to determine the impact of work-from-home arrangements that have increased since the onset of the COVID-19 pandemic.
- Compared trends in telecommuting between ATUS and ACS to assess their consistency.

Key findings from these analyses are as follows:

- The shift to working from home (WFH) represents the most significant change in commuting patterns observed since the ACS began, exceeding the previous combined share of biking, walking, and public transit; Public transit's share dropped by approximately 50% from 2019 to 2021, with a minor recovery in 2022 (from 5% to 2.5%, then to 3.1%).
- Households without vehicles have remained below pre-COVID levels.
- The proportion of no-worker households has stabilized at 27.4%, the highest since 2011.
- Average commute times have slightly increased but are still lower than pre-COVID levels.
- Travel time and trip counts in 2022 were roughly 80% of their 2019 levels; the daily percentage of people making trips significantly decreased, from 86.6% in 2019 to 78.3% in 2022.
- VMT is nearing pre-COVID figures, with the 12-month total almost equaling those prior numbers.

How have the results been disseminated?

The team has drafted a policy brief summarizing these findings and circulated it among travel behavior experts, policymakers, and the general public through various channels ([link](#)).

What do you plan to do during the next reporting period to accomplish the goals?

The team will continue to analyze the datasets for deeper insights and aims to draft a journal manuscript detailing the comprehensive results of this analysis.

Project 2: Exploring the Changing Dynamics of Household Vehicle Ownership and Use in the U.S.

What was accomplished under these goals?

This project aims to address the gap in understanding how U.S. households are adapting their vehicle ownership and use in response to technological advancements, societal shifts, and the climate crisis. The project's goal is to design and deploy a comprehensive nationwide survey known as the Evolving Vehicle Ownership Preferences and Use Survey (EVOPUS). This survey will collect data on vehicle ownership, usage, and preferences in light of societal and environmental changes, including the impact of residential solar photovoltaics and battery storage on household energy use. During this reporting period, the project team accomplished the following:

- Conducted a review of existing surveys to understand various aspects such as survey design, sampling strategies, target populations, questionnaire design, and deployment channels. This review will inform the development of the EVOPUS.
- Held biweekly meetings to define the scope and goals of the survey and to design the survey instrument.
- Engaged with multiple survey firms to determine the most effective strategy and select a suitable vendor for deploying the survey and recruiting respondents.

How have the results been disseminated?

No dissemination activities to report at this time.

What do you plan to do during the next reporting period to accomplish the goals?

The team will finalize the survey instrument and vendor selection. The deployment of this nationwide survey is planned for the upcoming reporting period.

Project 3: City-Wide Strategic EV Charging Network Design: Demand-Supply Integration via Market Dynamics

What was accomplished under these goals?

One of the critical challenges to promoting electric vehicle (EV) adoption is establishing a well-developed charging infrastructure. The deployment of EV charging stations necessitates meticulous planning that considers demand distribution, traffic patterns, existing infrastructure, and user accessibility. This project conducts a comprehensive study EV station siting with a specific focus on the city of Avondale, AZ. The aim of this research is to provide insights into the strategic deployment of EV charging stations tailored to Avondale's unique characteristics and transportation needs. During this reporting period, the project team accomplished the following:

- Conducted a thorough review of existing algorithms and methodologies from operations research and optimization fields to guide the deployment strategies.
- Identified the pros and cons of these approaches.
- Started a detailed analysis of Avondale to understand its unique characteristics and transportation needs, which are crucial for the strategic placement of EV charging stations.

How have the results been disseminated?

No dissemination activities to report at this time.

What do you plan to do during the next reporting period to accomplish the goals?

The project team will continue the literature review and begin collecting data specific to Avondale. This includes identifying the best strategies for a network of EV charging stations. The team also plans to develop an algorithm to optimize the location selection of EV charging stations.

Project 4: Future Travel Foresight Catalyst: A Unique Approach to Exploring the Intersection of Transformative Technologies and Future Travel Behavior and Demand

What was accomplished under these goals?

To better understand the future of travel behavior and demand, there is an urgent need for initiatives that intentionally blur the lines between research, development, and knowledge mobilization, to catalyze new thinking and ideas while revealing novel and potentially transforming pathways forward. Such initiatives need to be unconstrained by conventional disciplines, while facilitating knowledge discovery and mobilization within areas of expertise that are substantially enhanced through exposure to ideas from other areas. By partnering with initiatives that include the ASU Future of Being Human initiative and the ASU Risk Innovation Nexus, and by drawing on leading expertise at the forefront of responsive and innovative knowledge mobilization, the Future Travel Foresight Catalyst project uniquely extends understanding around the future of travel behavior and demand. During this reporting period, the project team accomplished the following:

- Initiated engagement with potential partners, including the ASU Future of Being Human and the ASU Risk Innovation Nexus, to integrate their insights on future travel behaviors and technologies.
- The project PI authored a series of blog articles discussing the impact of autonomous vehicles and other emerging technologies on the future of technology and humanity. These articles aim to spark discussion and thought leadership in the field.

How have the results been disseminated?

The blog articles have been distributed through various online platforms, including TBD's LinkedIn [page](#).

What do you plan to do during the next reporting period to accomplish the goals?

The project team plans to organize public webinars and expert panels to further disseminate findings and stimulate discussion.

Project 5: Deep Learning with LiDAR Point Cloud Data for Automatic Roadway Health Monitoring

What was accomplished under these goals?

Our primary goal is to explore the effectiveness of various deep learning-based approaches utilizing point cloud data for automating the monitoring and assessment of roadway health.

- Major Activities: We have conducted extensive research into existing point cloud-based algorithms related to creation of point cloud maps from LiDAR scans and detecting road conditions.
- Specific Objectives: Our aim is to gain insights into the capabilities/limitations of current approaches and to develop an effective pipeline for leveraging point cloud data in evaluating roadway conditions.
- Significant results: Initial experiments and analysis have provided insights into the necessity of augmenting the density and quality of LiDAR data to accurately detect road damage and static objects such as road signs within point clouds.
- Key outcomes or other achievements: Evaluation of key deep learning and computer vision algorithms pertinent to our target applications is being undertaken.

How have the results been disseminated?

No dissemination activities to report at this time.

What do you plan to do during the next reporting period to accomplish the goals?

Our focus in the upcoming reporting period will be to further refine and test our pipeline for road condition detection and evaluation. Also plan to:

- Submit presentations for the TRB annual conference in January 2025 in Washington, DC.
- Integrate the research process and findings into teaching materials.
- Arrange meetings with agencies such as Caltrans to obtain feedback from the industry.

Project 6: The Effects of Changing Commutes on Home Delivery Activity

What was accomplished under these goals?

The goal of this project is to jointly model personal commuting behaviors and home delivery behaviors for specific product types to investigate the impacts of changing commute activity on home-based freight delivery and to inform urban freight policies in residential areas.

- A comprehensive literature search has been completed; synthesis of results into a written report is ongoing. The focus of this literature review has been to (1) identify the wide variety of specific metrics (including socio-demographic variables, activity variables, and commuting characteristics) used to characterize travel activity associated with commuting and home delivery, and (2) to identify statistical and machine learning approaches with potential application for joint behavioral modeling.
- Preliminary data exploration using the 2019 NYC Citywide Mobility Survey has just begun.

How have the results been disseminated?

No dissemination activities to report at this time.

What do you plan to do during the next reporting period to accomplish the goals?

During the next reporting period, the following tasks are expected:

- Complete the written synthesis of the literature review detailed in the previous section, undertake data processing and descriptive data analysis of all commuter characteristics and home-shopping characteristics in the Citywide Mobility Survey.
- Based on data characteristics and literature review results, select the most promising approaches for model estimation; Begin testing of most-promising modeling approaches to model interactions between commuting and home-shopping activities

Project 7: Measuring the Last-Mile: A Comprehensive Evaluation of Synthesis Approaches to Address Data Gaps for Local Freight Decision-Making (Phase 1)

What was accomplished under these goals?

The goal of this project is to identify a feasible approach to develop a synthetic local freight dataset to inform policy decision-making.

- Project kick-off meeting was held with the NYC DOT on Friday, March 22nd.
- A graduate research assistant was hired starting April 1, 2024.
- Several datasets or data samples for the project were transferred to CCNY researchers from NYC DOT on April 8, 2024 and April 12, 2024.
- Literature review focusing on two areas has been initiated: (1) review of machine learning models from all domains with potential application for freight data synthesis, and (2) review of freight data elements needed to inform specific local policy decisions.
- Planning is underway for a meeting with multiple NYC DOT divisions to discuss freight data needs.

How have the results been disseminated?

No dissemination activities to report at this time.

What do you plan to do during the next reporting period to accomplish the goals?

During the next reporting period, the following tasks are expected:

- Complete literature review(s) on (1) potential machine learning approaches for local freight data synthesis and (2) freight data metrics for local agency decision making.
- Organize stakeholder workshops with (1) multiple divisions of the NYC DOT and (2) multi-agency local and regional freight stakeholders to identify local freight data applications and data needs for informed decision making.
- Based on results from both the literature review and the stakeholder workshops, develop a comprehensive matrix of freight data metrics of interest for local decision-making.

Project 8: Analysis of Changes in the Activity Prisms of Individuals to Predict a Shared Life Experience (SLE) Metric Over Different Regions and Sociodemographic Groups

What was accomplished under these goals?

The goal of this project is to define a new SLE metric which is based on the activity prisms of individuals and analyze the changes in the SLE metric in the individual level over multiple years, using City Wide mobility data that is collected annually followed by performing some analysis. Following set of actions were performed since the beginning of the project:

- Several internal team meetings were held to establish the research roadmap.
- The team is currently analyzing the 2018 and 2019 NYC DOT Citywide Mobility Data to assess the feasibility of current research objectives.

How have the results been disseminated?

No dissemination activities to report at this time.

What do you plan to do during the next reporting period to accomplish the goals?

During the next reporting period, the following tasks are expected:

- Hire a new grad student to assist with the analysis
- Finish data cleaning and handling city wide mobility data (for year 2018 and year 2019- since data for later years is not accessible yet).
- Define and test our new model on new data to define activity prisms and SLE metric.
- Run probabilistic tests to address equity related research objectives

Project 9: How Effective are Marker Variables at Predicting Attitudinal Factor Scores? An Out-of-sample Evaluation

What was accomplished under these goals?

The objectives of this project are twofold: first, to see how well we can predict attitude factor scores (which were created from numerous attitudinal statements) from a small number of marker variables (MVs) (“internal evaluation”); and second, to see how well the predicted factor scores perform in a model of household vehicle ownership (“external evaluation”). To achieve these objectives, we conduct the following activities. Half the data are used to train a “learning function” using MVs. This function is applied to the other half of the data to predict attitude factor scores, and we internally evaluate how well the function predicts attitude factor scores for both halves. Next, household vehicle ownership (VO) models are estimated using the data subset that was not used to train the learning function, and we externally evaluate the models by measuring these models’ predictive accuracy. These activities are iterated multiple times to obtain a bootstrap-like distribution of the prediction accuracies of attitude factor scores and VO. If we are able to (1) predict attitudes well from a small number of marker statements, and (2) obtain useful explanatory power from the predicted attitudes, it will provide another step in the path forward toward incorporating attitudinal variables into practice-ready travel demand forecasting models.

How have the results been disseminated?

Preliminary results from this project were presented at the Annual Meeting of the Transportation Research Board in Washington, DC, in January 2024.

What do you plan to do during the next reporting period to accomplish the goals?

During the next reporting period, we plan to finalize the paper/report for this project, and submit it to a journal for peer review. We also expect to present the study at the International Association for Travel Behaviour Research conference in Vienna, Austria in July.

Project 10: A Pilot Experimental Project for Predicting Pedestrian Flows Using Computer Vision and Deep Learning

Georgia Tech received funding authorization from their internal contracting officer on March 6, 2024. So, there has not been much progress on this project. The next SAPR will report on this project.

Project 11: Promoting Sustainable Travel within Communities through Behavioral Interventions and Emerging Mobility Solutions

Georgia Tech received funding authorization from their internal contracting officer on March 6, 2024. So, there has not been much progress on this project. The next SAPR will report on this project.

Project 12: Investigating Travel Survey Representativeness: Who's missing and what can we do?

What was accomplished under these goals?

The goal of this project is to investigate household travel survey biases to identify the causes and propose potential solutions. This project comprises the following tasks:

- Task 1: a quantitative investigation of national and state transportation household survey biases across diverse metropolitan regions in the United States;
- Task 2: the documentation and comparison of the sampling methods, instrument evaluation, and post-processing correction methods utilized across these various household survey implementations;
- Task 3: a case study for the Detroit metro that seeks to define hard-to-reach populations and geographies, and provides targeted insight for sampling, outreach, and instrument design; and
- Task 4: the development of a methodological guide in the form of a white paper for reducing inaccuracies in observed transportation behavior due to sampling and response biases.

During the period for which this effort was active thus far, the team has: (1) engaged with the Detroit-area MPO (i.e., SEMCOG) and DOT to establish relationships with the planning and survey data teams; (2) participated in the initial stages of the household travel survey planning effort for the state of Michigan; (3) analyzed survey representativeness for past and current household travel surveys in the region and beyond.

How have the results been disseminated?

The University of Michigan team meets with SEMCOG and MDOT on a semi-regular basis, and as such, regular updates from this quarter have been shared with the SEMCOG travel demand team and the MDOT Section on Urban Travel Analysis. This has been the primary avenue for dissemination of findings thus far.

What do you plan to do during the next reporting period to accomplish the goals?

During the next reporting period, the team plans to continue to advance the quantitative and qualitative efforts described above (Tasks 2 and 3). This involves the continued collection of data and synthesis of findings. The team plans to submit a TRB paper on this effort.

Project 13: Enhanced Network Models for Multimodal Resiliency

What was accomplished under these goals?

We obtained data on maritime freight operations in the United States, and began to construct a simulation model of a port terminal, and a shipping channel involving vessel movements of different size and cargo type. The goal of such a simulation model is to develop an operational definition of "capacity" for maritime systems, and to ultimately use this definition to provide recommendations on system expansion and

resiliency. We have built a preliminary simulation model which is currently undergoing testing and additional feature development.

How have the results been disseminated?

To date, two guest presentations have been made in undergraduate civil engineering and transportation courses to provide outreach and promote awareness of maritime transportation issues. Most students in these courses are used to thinking of transportation only as vehicles on pavement, and these presentations provided students with a broader perspective.

What do you plan to do during the next reporting period to accomplish the goals?

We plan to conduct stakeholder interviews, obtain additional data, and continue to develop and test our port and waterway simulation model. By the end of the next reporting period, we plan to have a preliminary working definition of "capacity," and be positioned to develop network optimization models.

Project 14: Identifying Targets for Electric Vehicle Industry Improvement

This project received funding relatively recently, and so there have not been extensive activities during this initial reporting period. However, the project team has initiated internal discussions on student staffing plan, the research plan, and data collection methods.

Project 15: A Dynamic Analysis of the Built Environment-Travel Behavior Relationship Using Three Activity-Travel Surveys in the Austin, Texas Region

What was accomplished under these goals?

Researchers undertook three major activities during this reporting period: 1) compiling literature on investigating the built environment – travel behavior relationships in the most recent 15 years; 2) integrating data from three Austin Activity Travel Surveys (1998, 2006, 2016); 3) collecting land use data from Central Appraisal Districts for the five counties in the Austin region. Given that it is in the initial stage of research, there have been no study findings and achievements.

How have the results been disseminated?

No dissemination activities to report at this time.

What do you plan to do during the next reporting period to accomplish the goals?

Complete data collection and integration and starting initial modeling work as described in the proposal.

Project 16: Identifying Travel Needs, Barriers, and Solutions

What was accomplished under these goals?

A literature review and analysis of 2017 and 2022 National Household Travel Survey (NHTS) data related to transport poverty, transport disadvantage, transport justice, and transport-related social exclusion has been completed. The ultimate objective is to develop a more comprehensive, tailored, and reproducible understanding of transportation disadvantage than is available using current tools and data.

A limitation of earlier studies in this landscape is the lack of generalizability of findings due to the small sample sizes and specific geographical contexts of many studies. Moreover, there is a need for more longitudinal studies to track changes in transportation needs and barriers over time and to evaluate the effectiveness of interventions aimed at addressing these issues. In this regard, while the NHTS findings point towards differences and disparities, they do not enable a comprehensive understanding of transportation disadvantage. For example, one person's long commute may enable them to access a high-paying job, while another's may arise because housing close to their workplace is unaffordable. We have therefore categorized different types of travel problems and their direct impacts.

How have the results been disseminated?

An abstract has been accepted for presentation at the upcoming Conference on Advancing Transportation Equity to be held in Baltimore in July.

What do you plan to do during the next reporting period to accomplish the goals?

The next phase of research will focus on the direct measurement of travel problems using a mixed-method approach that combines quantitative surveys with qualitative interviews or focus groups.

Project 17: Telemedicine Adoption Before, During, and After COVID-19: The Role of Socioeconomic and Built Environment Variables

What was accomplished under these goals?

- Conducted a comprehensive literature review, extracted and cleaned data from the COVID Future Survey (April 2020 - November 2021), and estimated advanced multivariate econometric models to identify determinants of the shift toward telemedicine use in the after-COVID period relative to before- and during-COVID periods. The team also incorporated a multivariate probit model to examine the reasons for adopting and not adopting telemedicine in the after-COVID period.
- Introduced a new methodological and empirical framework to investigate telemedicine adoption trends and explore the factors driving use and non-use decisions.
- The results indicate disparities in access and adoption across different demographics, with continued post-pandemic use by certain groups. The outcomes also reveal the dynamic nature of adoption patterns and the critical role of accessibility, lifestyle preferences, privacy and security issues, technological confidence, and practical constraints. At the same time, the analysis highlights telemedicine's potential to reduce healthcare access disparities related to geographical barriers and emphasizes its potential for a more equitable, efficient, and sustainable healthcare system, while recognizing persisting adoption disparities across demographics.

How have the results been disseminated?

No dissemination activities to report at this time.

What do you plan to do during the next reporting period to accomplish the goals?

Over the next reporting period, the team will finalize the model specification and use the results to devise detailed policy implications on public health, infrastructure, transportation, and planning as they complete the final stages of paper production.

Project 18: Teleworking to Play or Playing to Telework? A Latent Segmentation Approach to Exploring the Relationship Between Telework and Nonwork Travel

What was accomplished under these goals?

During this reporting period, we have engaged in a people-centric exploration of travel behavior modeling. To do so, we have crafted an advanced econometric model framework capable of forecasting expected frequencies of remote work and nonwork activities during weekdays across diverse demographic segments. Our model distinguishes itself from existing literature through several key features, notably:

1. Investigating the causal relationship between nonwork travel and remote work,
2. Characterizing nonwork travel and remote work based on demographic attributes,
3. Employing a multi-day unit for nonwork travel, and
4. Disaggregating nonwork travel for various purposes, including leisure and maintenance.

The remaining objectives for this project entail finalizing and submitting the manuscript for publication, along with disseminating the research through presentations at various international conferences.

How have the results been disseminated?

No dissemination activities to report at this time.

What do you plan to do during the next reporting period to accomplish the goals?

During the upcoming reporting period, we will complete the fine-tuning of model specifications and conduct post-analysis explorations to quantify the impact of remote work engagement on both leisure and maintenance travel. Drawing from these findings, we'll finalize the manuscript and submit it to a journal, while also presenting our work at multiple international conferences.

Project 19: The Effect of Urban Infrastructure Change on Movement

What was accomplished under these goals?

The *major activities* include (1) conducting literature review, (2) defining the study area, (3) acquiring datasets, (4) developing workflows for data processing, (5) analyzing data and stating results.

The *specific objectives* are broken down to the list below.

- Conduct literature review: identify research gaps: While there is abundant literature examining the impact of the built environment on pedestrian behavior at the scale of census tracts or larger geographical units, there is limited research focusing on the census block group level. Additionally, there is a dearth of knowledge regarding how street furniture influences travel behaviors.
- Define study area: Ballard Avenue: The study area will be Ballard Avenue in the City of Seattle, which serves as an excellent testbed to evaluate the effects of street furniture installation.
- Acquire necessary datasets to assess the effects of Ballard Avenue street furniture installation on travel patterns: This study will involve a longitudinal dataset that allows comparison before and after street furniture installation to fill in the gap in existing literature. To that end, we will use privacy-protected GPS data generated from smartphone devices, to evaluate changes in travel patterns across multiple years from before to after the installation of street furniture.
- Develop a workflow to process the GPS data: First, we will develop critical functionalities. Second, we will develop associated Python code that will specify the desired input and output formats for each function to enhance the reproducibility and code reusability.
- Analyze data and stating results: The objective is to synthesize the data and statistics into knowledge about how street furniture has affected travel pattern in various ways.

How have the results been disseminated?

The developed utility functions will be stored on a GitHub Repository, a webpage designed for collaborative code development, review, and dissemination. Each utility function is an individual python file, with clear documentation and comments to explain the details and assumptions made for the function.

What do you plan to do during the next reporting period to accomplish the goals?

The tasks during the next reporting period are outlined as follows:

- Finish the development of the workflow;
- Finish the analysis of GPS traces; and
- Finish preparing the paper for journal submission and other presentations.

Project 20: The Differential Accessibility Effects of Work from Home: Travel Behavior Outcomes and Transportation Equity Implications

What was accomplished under these goals?

- We reviewed multiple studies to update key questions on accessibility and potential measures to account for shifts in the increased adoption of work-from-home, travel frequency, patterns, and mode choice in the new normal. Additionally, we have collected empirical datasets to support these measures, including data from the Seattle commute survey and the PSRC travel time matrices.

How have the results been disseminated?

No dissemination activities to report at this time.

What do you plan to do during the next reporting period to accomplish the goals?

First, we will refine research questions to make strong connections to current transportation planning and policy issues in the post-pandemic era. This study will evaluate employment accessibility and accessibility to non-commute destinations via various transportation modes in combination with potential virtual interaction. It will incorporate current urban activities and alternative transportation modes for different population groups. It will broadly categorize the population into two main groups: non-essential workers and essential workers. Furthermore, we will examine how accessibility influences travel behavior in the ‘new normal’ by employing regression models of mode choice and commute trip frequency.

Project 21: A Pilot Study to Integrate Mobility Data Collection APPs with Personalized Recommendation Systems

What was accomplished under these goals?

- We conducted a literature review to identify and evaluate (a) existing software which can gather mobility trajectories and user data and provide personalized recommendations; (b) existing recommender models and algorithms which can provide users with point-of-interest recommendations by using location-based data. One main finding is that most of public location-based datasets are check-in data, which provides a quite limited coverage of user mobility.
- We also established a partnership with National Renewable Energy Laboratory (NREL) to use their mobile application, NREL OpenPATH, to collect travel behavior data from real participants. We are conducting test runs with OpenPATH internally.

How have the results been disseminated?

No dissemination activities to report at this time.

What do you plan to do during the next reporting period to accomplish the goals?

During the next reporting period, the following tasks are expected:

- We plan to benchmark the current state-of-the-art recommender models using public location-based datasets, e.g., Foursquare, Gowalla, Brightkite, and Yelp. Our approach includes proposing an evaluation framework for location-based recommender systems.
- Depending on the outcome of the benchmark study, we will investigate expand data collection.

Project 22: Consumer Preferences for Restaurant and Grocery Delivery Services in Seattle: Impacts on Travel Behavior

This project has seen no progress. Will most likely be dissolved. Please see Section 6.

Section 2: Participating & Collaborating Organizations

What organizations have been involved as partners?

Organizations and partners the PIs are collaborating with are listed below.

- Maricopa Association of Governments (in-kind support, collaborative research, financial support)
- Arizona Department of Transportation (in-kind support, collaborative research, financial support)
- Maricopa County Department of Transportation (collaborative research)
- City of Phoenix (in-kind support, collaborative research, financial support)
- City of Mesa (collaborative research)
- Town of Queen Creek (collaborative research)
- The New York City Department of Transportation (NYC DOT), New York, NY (in-kind support, collaborative research), including access to several proprietary freight datasets, and is serving as a technical partner.

- Puget Sound Regional Council (collaborative research) to discuss the prospect of including a few attitudinal statements in the regional household travel survey that they are designing, for administration in 2025.
- Southeast Michigan Council of Governments, Detroit, Michigan (Collaborative research)
- Michigan Department of Transportation, Section on Urban Travel Analysis, Lansing, Michigan, (Collaborative research)
- National Renewable Energy Laboratory (NREL), Colorado (In-kind support. NREL provides mobile application, NREL OpenPATH, to collect users' trajectory data)
- Cintra (Austin, TX) (in-kind support), graciously donated \$200,000 of LiDAR and edge computing equipment to study use cases such as pedestrian-vehicle interactions and behaviors
- Texas Department of Transportation (financial support in the form of projects to examine land-use implications of e-commerce and the potential to fuse data from third party sources in travel modeling)

Have other collaborators or contacts been involved?

- CPP has partnered with the Women's Transportation Seminar's Los Angeles Chapter to co-host Girls' Empowerment Day. 90 high school girls visited CPP to explore transportation careers.
- Three visiting student interns from École Nationale des Travaux Publics de l'État (ENTPE) in Lyon, France arrived on April 8, 2024 to City College of New York (CCNY), and will be contributing to TBD projects through August 2024.
- A TBD project at the University of Michigan (UM) builds on a UM Graham Sustainability Institute Catalyst grant, designed to support start-up efforts and interdisciplinary collaboration. Through the Catalyst grant, the team has collaborated with Professor Joe Grengs from the Urban and Regional Planning Department and Dr. Sunghye Lee from the Institute for Social Research Program in Survey and Data Science.
- Director Chandra Bhat traveled to the Indian University of Texas at Austin Professor in his capacity as the Satish Dhawan Visiting Chair Professor at the Indian Institute of Science (IISc) to continue scholarly collaborations with Prof. Abdul Pinjari at IISc. He also traveled to the Indian Institute of technology, Madras, for a scholarly exchange, as well as to the University of Leeds.

Section 3: Outputs

Publications, conference papers, and presentations:

Journal publications:

- Asmussen, K.E., Mondal, A., Batur, I., Dirks, A., Pendyala, R.M., and Bhat, C.R. (2024). An investigation of individual-level telework arrangements in the COVID-era. *Transportation Research Part A: Policy and Practice*, 179, 103888.
- Fong, A., and F.A. Shaw. (2024). Well-Being Implications of Mobility of Care: Gender Differences among U.S. Adults. *Transportation Part D: Transport and Environment*, 129, 104109.
- Haddad, A., A. Mondal, N. Eluru, and C.R. Bhat (2024). A Novel Integrated Approach to Modeling and Predicting Crash Frequency by Crash Event State. *Analytic Methods in Accident Research*, 41, 100319.
- Kothawala, A., A. Haddad, B. Ozbilen, G. Circella, C. Saridakis, Z. Wadud, Y. Yang, S. Grant-Muller, S. Castellanos, and C.R. Bhat (2024). Investigating Objective and Subjective Factors Influencing the Frequency and Purpose of E-Scooter Trips. *Transportation Research Record*, in press.
- Haddad, A.J., A. Mondal, and C.R. Bhat, "Where and How Often are Consumers Eating Out? Implications for Transportation, Public Health, and Food Service Fields," *Transportation Research Part A*, under review.
- Robbennolt, D., A.J. Haddad, A. Mondal, and C.R. Bhat, "Housing Choice in an Evolving Remote Work Landscape," *Transportation Research Part A*, under review.

- Anderson, S.M., K.E. Asmussen, S. Saxena, I. Batur, R.M. Pendyala, and C.R. Bhat, “An Investigation of Dissonance in Telework Frequency,” *Transportation Research Part C*, under review.
- Wang, X. and P.L. Mokhtarian. “Examining the treatment effect of teleworking on vehicle-miles driven: Applying an ordered probit selection model and incorporating the role of travel stress”. *Transportation Research Part A*, in press.
- Wang, X., S. H. Kim, and P.L. Mokhtarian. “Identifying Teleworking-Related Motives and Comparing Telework Frequency Expectations in the Post-Pandemic World: A Latent Class Choice Modeling Approach”. *Transportation Research Part A*, in press.
- C. Cano-Calhoun, D. Abramson, C. Chen (2024) On Your Own, Together: Regional Perspectives on Community Resource-sharing for Disaster Preparedness in Washington State. *Journal of Urban Affairs* (accepted).
- E. Uğurel, X. Guan, Y. Wang, S. Huang, Q. Wang, C. Chen (2024). Correcting missingness in passively-generated mobile data with Multi-Task Gaussian Processes. *Transportation Research Part C: Emerging Technologies*, 161, 104523.
- E. Ugurel, S. Huang and C. Chen (2023). Gaussian Process Learning for Location-Based Service Data. *2023 Asia Pacific Signal and Information Processing Association Annual Summit and Conference (APSIPA ASC)*, Taipei, Taiwan, pp. 1204-1207.
- X. Guan, G. Jia, K. C. Kosaraju, V. Gupta, and C. Chen (2023). Underreporting in COVID-19 Case Data Causes Policy Objectives Being Unmet. *IEEE Transactions on Computational Social Systems*, ([link](#)) (November 2023).
- F. Lin, X. Qian, B. Mortazavi, Z. Wang, S. Huang & C. Chen (2023). Modeling User Choice Behavior under Data Corruption: Robust Learning of the Latent Decision Threshold Model, *IJSE Transactions*, DOI: 10.1080/24725854.2023.2279080.
- Idziorek, K., Abramson, D., Kitagawa, N., Yamamoto, T., and Chen, C. (2023). Factors influencing willingness to share resources post-disaster: a cross-cultural comparison between US and Japanese communities. *Natural Hazards Review*, 24(4), 04023044.
- Lin, J., Jenelius, E., Cebecauer, M., Rubensson, I., and Chen, C. (2023). The equity of public transport crowding exposure. *Journal of Transport Geography*, 110, 103631.
- Shea, K.; Chen, C.; and 76 other authors (2023). Multiple models for outbreak decision support in the face of uncertainty. *Proceedings of the National Academy of Sciences*, 120(18), e2207537120.

Books or other non-periodical, one-time publications: Nothing to report.

Other publications, conference papers and presentations:

- Pendyala, R. Emerging Transportation Technologies: A Panacea or Predicament?. *Clemson University Transportation Seminar Series*, October 6, 2023.
- Chen, Cynthia, Taipei, Taiwan, Multi-task, multi-kernel learning for location-based service (LBS) data, APSIPA (Asia-Pacific Signal and Information Processing Association), November 2nd, 2023.
- Chen, Cynthia, Boston, MA, Fusing multiple, biased datasets to recover missing trips: a behaviorally-informed likelihood-based approach, Northeastern University, November 27th, 2023.
- Polzin, S., Batur, I., and Pendyala, R.M. COVID Recovery? Changing Travel Behaviors? Insights From the 2022 ACS, ATUS, and CE Data Sets. Policy Brief, TOMNET-TBD University Transportation Centers. December 2023.
- Bhat, C.R., "Data Needs for Causal Analysis in Travel Modeling, with an Emphasis on the Telework-Residential Location Inter-relationship," *Keynote presentation, 7th Conference of the Transportation Research Group of India (CTRG2023)*, Surat, India, December 2023.
- C.R. Bhat and R.M. Pendyala. Some Recent Findings on Tele-Activity Adoption and the Effects of Tele-Activities on Travel Behavior. *Presented at the 103rd Annual Meeting of the Transportation Research Board* [Workshop: Hybrid Work, Activity Patterns, and Travel Choices in the Post-Pandemic Era], Washington, DC, January 2024.

- Anderson, S.M., K.E. Asmussen, S. Saxena, I. Batur, R.M. Pendyala, and C.R. Bhat. An Investigation of Dissonance in Telework Frequency. *Presented at the 103rd Annual Meeting of the Transportation Research Board*, Washington, DC, January 2024.
- Asmussen, K.E., A. Mondal, and C.R. Bhat, "The Interplay between Teleworking Choice and Commute Distance," *Presented at the Transportation Research Board (TRB) Annual Meeting*, Washington, DC, January 2024.
- Batur I., A. Mondal, V. O. Alhassan, K.E. Asmussen, C.R. Bhat, and R.M. Pendyala. The Induced Demand Implications of Alternative Adoption Modalities of Automated Vehicles. *Presented at the 103rd Annual Meeting of the Transportation Research Board*, Washington, DC, January 2024.
- Batur I., V. O. Alhassan, M.V. Chester, S.E. Polzin, C. Chen, C.R. Bhat, and R.M. Pendyala. Understanding How Extreme Heat Impacts Human Activity-Mobility and Time Use Patterns. *Presented at the 103rd Annual Meeting of the Transportation Research Board*, Washington, DC, January 2024.
- Biswas, M., A.R. Pinjari, C.R. Bhat, S. Ghosh, "Choice Models with Stochastic Variables and Random Coefficients," *Presented at the Transportation Research Board (TRB) Annual Meeting*, Washington, DC, January 2024.
- Haddad, A., A. Mondal, and C.R. Bhat, "Where and How Often are Consumers Eating Out? Implications for Transportation, Public Health, and Food Service Fields," *Presented at the Transportation Research Board (TRB) Annual Meeting*, Washington, DC, January 2024.
- Haddad, A., A. Mondal, N. Eluru, and C.R. Bhat, "A Novel Integrated Approach to Modeling and Predicting Crash Frequency by Crash Event State," *Presented at the Transportation Research Board (TRB) Annual Meeting*, Washington, DC, January 2024.
- Hwang, H., A. Haddad, I. Batur, S. Saxena, R.M. Pendyala, and C.R. Bhat. An Analysis of Walking Frequency Before and After the Pandemic. *Presented at the 103rd Annual Meeting of the Transportation Research Board*, Washington, DC, January 2024.
- Kothawala, A., A. Haddad, B. Ozbilen, G. Circella, C. Saridakis, Z. Wadud, Y. Yang, S. Grant-Muller, S. Castellanos, C.R. Bhat, "Investigating Objective and Subjective Factors Influencing the Adoption, Frequency, and Characteristics of E-Scooter Trips," *Presented at the Transportation Research Board (TRB) Annual Meeting*, Washington, DC, January 2024.
- Ramakrishnan, G.A., S. Saxena, K.K. Srinivasan, A.R. Pinjari, C.R. Bhat, "A Multiple Discrete Continuous Extreme Value (MDCEV) Model of Multi-day Mode Choice and Frequencies," *Presented at the Transportation Research Board (TRB) Annual Meeting*, Washington, DC, January 2024.
- Robbennolt, D., A. Haddad, A. Mondal, and C.R. Bhat, "Housing Choice in an Evolving Remote Work Landscape," *Presented at the Transportation Research Board (TRB) Annual Meeting*, Washington, DC, January 2024.
- Saxena, S., C.R. Bhat, A.R. Pinjari, "Analysing Household Vehicle Holdings and Usage in California using a Two-Stage Budgeting-Based Multiple Discrete-Continuous Model," *Presented at the Transportation Research Board (TRB) Annual Meeting*, Washington, DC, January 2024.
- Winkler, C., K.E. Asmussen, A. Mondal, C.R. Bhat, K.W. Axhausen, "Post-COVID-19 Work and Leisure Preferences in Switzerland: A Multivariate Multiple Discrete Continuous Probit Approach," *Presented at the Transportation Research Board (TRB) Annual Meeting*, Washington, DC, January 2024.
- Jia, G., E. Ugurel, K. Ng, R.M. Pendyala, and C. Chen. COVID-19 and Telecommuting-Induced Changes in Individual Activity and Travel Patterns. *Presented at the 103rd Annual Meeting of the Transportation Research Board*, Washington, DC, January 2024.
- Soria, J. and P. Mokhtarian. How effective are marker variables at imputing attitudes? An external evaluation using vehicle ownership models. *Presented at the 103rd Annual Meeting of the Transportation Research Board*, Washington, DC, January 2024.

- Fong, A. Z. and F. A. Shaw. “Chore or Cherish? Gender Differences in Stress, Happiness, and Meaningfulness during Mobility of Care among U.S. Adults”. *Presented at the 103rd Annual Meeting of the Transportation Research Board*, Washington, DC, January 2024.
- Pendyala, R. A Tale of Two Disruptions: Adaptation of Human Activity-Mobility Patterns in Response to the Pandemic and Extreme Heat. *The University of Texas at Arlington Seminar Series*, February 21, 2024.
- Polzin S. (panelist). *The Imperiled Future of Big-City Mass Transit*. Organized by the American Enterprise Institute (AEI). Wednesday, February 21, 2024.
- Bhat, C.R., "On the Intricate Linkage Between Telework and Housing Choices," *Invited Seminar*, Dept of Civil Engineering, Indian Institute of Science (IISc), Bangalore, India, February 2024.
- Bhat, C.R., "On the Intricate Linkage Between Telework and Housing Choices," *Invited Seminar*, Department of Civil Engineering, Indian Institute of Technology (IIT) Hyderabad, Hyderabad, India, February 2024.
- Bhat, C.R., "Where and How Often Are We Eating Out, with Implications for Transportation, Public Health, and Food Service," *Invited Seminar*, Institute for Transport Studies, University of Leeds, Leeds, U.K., March 2024.
- Batur I., V. O. Alhassan, M.V. Chester, S.E. Polzin, C. Chen, C.R. Bhat, and R.M. Pendyala. Understanding How Extreme Heat Impacts Human Activity-Mobility and Time Use Patterns. *Presented at the 2024 PSR Annual Congress*, Moving Forward: Improving Transportation in Region 9, March 11-12, 2024.
- Fong, A. Z. and F. A. Shaw. “Examining the Well-Being Implications of Mobility of Care: Gender Differences among U.S. Adults”. Accepted for presentation at the 17th International Conference on Travel Behavior Research, Vienna, Austria, July 2024.
- Lim, S., F. A. Shaw, and M. Z. Li. “Who Experiences Flight Delay? Ground to Air Data Integration for Human-Centered Performance Measures”. Accepted for presentation at the 17th International Conference on Travel Behavior Research, Vienna, Austria, July 2024.

Website(s) or other Internet site(s):

- TBD National Center official website: <https://tbd.ctr.utexas.edu/>
- TBD National Center official LinkedIn page: <https://www.linkedin.com/company/national-center-for-travel-behavior-and-demand/> (gained over 250 followers since its launch).
- TBD National Center official YouTube page: <https://www.youtube.com/@TBDCenter>
- The Time Use, Travel, and Telework Dashboard (T3D) is an open-source platform designed to offer insights into time use, travel, and telework trends and patterns within the United States.
- Research lab website (A. Shaw, U Michigan): <https://infrall.engin.umich.edu/>
- UW: The code and data are saved to a GitHub Repository through this link: <https://github.com/orgs/street-furniture/repositories>. This repository will contain documented python files for utility functions, as well as a synthetic GPS dataset. Currently the repositories are private and when the project is finished, we will turn them into public

Technologies or techniques:

- A TBD project at UT Austin entitled “Telemedicine Adoption Before, During, and After COVID-19: The Role of Socioeconomic and Built Environment Variables” has developed a joint econometric model system that is a first in the econometric literature, including a longitudinal multivariate binary probit model structured to discern the shifts in the effects of telemedicine adoption factors between the before- and after-COVID periods, as well as a cross-sectional multivariate probit model system that explores the reasons for using or not using telemedicine. This approach helps gain a deeper understanding of how socioeconomic and built environment variables influence telemedicine adoption before the pandemic and how the willingness of different segments of society to engage in telemedicine shifted as a result of the pandemic.

Inventions, patent applications, and/or licenses: Nothing to report.

Section 4: Outcomes

- Patricia Mokhtarian continued to mentor postdoctoral scholar Dr. Jason Soria. During the reporting period, Dr. Soria received a job offer from Cintra, a global infrastructure company, and will be starting with them in June.
- TBD projects are increasing the understanding of commonly underrepresented groups in travel surveys, as well as examining weighting-related issues in behavioral model estimation. TBD projects are also increasing the understanding of the built environment, including the influence of temporary street furniture on pedestrian movement. In particular, a UW project entitled “The Effect of Urban Infrastructure Change on Movement” is evaluating the impact of street furniture at the fine level of blocks. For example, how does pedestrian flow change if a street is blocked off or the sidewalk is converted to outdoor dining area. In addition, multiple TBD projects are examining tele-activity repercussions on land-use and transportation, providing transportation planners and policymakers insights regarding infrastructure investments and resource allocation in an evolving digital landscape. Other projects are advancing our understanding of how best to measure transportation disadvantage in a way that is actionable.

Section 5: Impacts

What is the impact on the effectiveness of the transportation system?

A sampling of the impacts of TBD research is provided below.

The program at CPP has provided exposure to transportation, science, and technology for both current CPP students and high school students, many of whom are first-generation college students from underserved communities. This initiative has made a significant impact on transportation workforce development. Additionally, CPP partnered with the Women’s Transportation Seminar’s Los Angeles Chapter to co-host Girls’ Empowerment Day, during which ninety high school girls visited CPP to explore various careers in transportation. This collaborative effort further promotes diversity and inclusion in the transportation field.

The TBD project entitled “Investigating Travel Survey Representativeness: Who’s missing and what can we do?” ensures that we can take into account all system users when planning and designing our transportation infrastructure. This ultimately ensures improved effectiveness in the form of improved accessibility and equity for all users.

Another TBD project entitled “The Effect of Urban Infrastructure Change on Movement” will provide cities with important insights to design urban infrastructure interventions in a way that supports pedestrian flow, the walkability of the street, and yet have a minimal impact on the traffic patterns, while another entitled “The Differential Accessibility Effects of Work from Home: Travel Behavior Outcomes and Transportation Equity Implications” supports the development of new demand management strategies, such as telecommuting incentives or staggered work hours, which can help reduce traffic congestion and GHG emissions. It also informs the development and implementation of transportation policies and programs that promote equitable and inclusive communities, such as investments in innovative mobility programs for underserved communities, as well as promotes social mobility by improving transportation accessibility and creating more opportunities for everyone.

What is the impact of technology transfer on industry and government entities, on the adoption of new practices, or on research outcomes which have led to initiating a start-up company?

TBD projects related to surveys, built environment effects, and tele-activity effects have the potential to inform government/industry, and drive innovative new ways of survey data collection and inform new land use-transportation policies. The many research efforts will also result in open-source codes and tools that cities and government entities can use to evaluate the effects the changes in urban infrastructure.

What is the impact on the body of scientific knowledge?

Ongoing research will contribute to the current literature on the relationship between transportation and information and communication technologies in (a) shaping the land-use and spatial economy in cities and regions, (b) improving smartphone-based mobility data collection to support personalized recommendation, (c) identifying challenges and gaps in the design of personalized recommendation systems in the context of travel behaviors, and (d) exploring nuanced questions related to travel behavior, infrastructure planning, and environmental sustainability within the context of an increasingly hybridized (from the standpoint of work place location) workforce. TBD research will also develop improved measures of transportation disadvantage that can be incorporated into national or regional travel surveys.

What is the impact on transportation workforce development?

All TBD core faculty teach courses at their respective universities. The typical teaching schedule involves anywhere from two to four courses per year, directed toward both undergraduate and graduate teaching. TBD faculty also supervise the MS and PhD theses of graduate students supported by the TBD grant, numbering over 40 graduate students across all participating institutions. In addition, TBD projects fund undergraduate research assistantships, and train students from multiple disciplines (including civil and environmental engineering, epidemiology, and computer science). The students working together tackle interdisciplinary problems that matters to transportation, safety, and economy of a local area.

Section 6: Changes/Problems

Changes in approach and reasons for change: Nothing to report.

Actual or anticipated problems or delays and actions or plans to resolve them:

The contracting process was substantially delayed, especially to UW, CCNY, Cal Poly Pomona and Georgia tech (these institutions received their funding authorization only in March/April 2024). But, in general, the time lines initially stated should still work, because of pre-planned scholarly investigations, and the end-date of many projects being well beyond even the next semi-annual reporting period.

Initial freight datasets from NYC DOT to support the “Measuring the Last-Mile: A Comprehensive Evaluation of Synthesis Approaches to Address Data Gaps for Local Freight Decision-Making (Phase 1)” project were received on April 8, 2024 and April 12, 2024. The other two CCNY TBD year one projects entitled “Measuring the Last-Mile: A Comprehensive Evaluation of Synthesis Approaches to Address Data Gaps for Local Freight Decision-Making (Phase 1)” and “Analysis of Changes in the Activity Prisms of Individuals to Predict a Shared Life Experience Metric Over Different Regions and Sociodemographic Groups” both intended to use data from the 2022 New York Citywide Mobility Survey; however, release of this dataset has been delayed several times (expected release dates were Summer 2023, October 2023, and January 2024). First quarter work on “The Effects of Changing Commutes on Home Delivery Activity” project focused on completing a comprehensive literature review while awaiting the data release. However, both project teams are now proceeding with methodological development using previous versions of the survey (2018 and 2019).

The project entitled “Consumer Preferences for Restaurant and Grocery Delivery Services in Seattle: Impacts on Travel Behavior”, PI: Amelia Regan” may have to be dissolved entirely. This is because the PhD student who was supposed to work on this project has not yet arrived in the US. It also appears that it is unlikely the student will be able to get a visa and come here. Director Bhat will write to the UTC Program Manager, Britain Bruner, soon to address this issue.

Changes that have a significant impact on expenditures: Nothing to report.

Significant changes in use or care of human subjects, vertebrate animals, and/or biohazards: Nothing to report.

Change of primary performance site location from that originally proposed: Nothing to report.