

**Center for Teaching Old Models New Tricks (TOMNET)
A USDOT Tier 1 University Transportation Center**

PROJECT PROPOSAL: 2018-2019

Title: Attitudes Towards Emerging Mobility Options and Technologies – Phase 2: Data Collection in Atlanta, GA

Principal Investigator: Giovanni Circella, PhD, School of Civil and Environmental Engineering, Senior Research Engineer

Co-Principal Investigator: Yongsung Lee, PhD, School of Civil and Environmental Engineering, Postdoctoral Researcher, and Patricia L. Mokhtarian, PhD, School of Civil and Environmental Engineering, Professor

1. Introduction/Problem Statement

Emerging mobility options and technologies including autonomous vehicles and mobility-on-demand services are bringing transformative changes in the transportation landscape. To enhance transportation forecasting models considering the increasing penetration of disruptive forces, people's attitudes towards and perceptions of these technologies and services need to be measured and understood. Armed with such an understanding, it will be possible to specify and develop behavioral models that account for attitudes and perceptions, adoption cycles, and adaptation patterns. This project proposes the survey design, recruitment and administration via two channels, data analysis and modeling for a sample of more than one thousand individuals across the Atlanta region, GA.

Autonomous vehicles (AV) (also referred to as driverless cars or self-driving cars) are capable of navigating without human input using an array of technologies such as radar, lidar, GPS, odometry, and computer vision. Most industry experts suggest that autonomous vehicles will be on the road within a few years (1). The Secretary of Transportation in the US stated at the 2015 Frankfurt Auto show that he expects driverless cars to be in use all over the world by 2025 (2). Google plans to have its driverless cars on the market no later than 2018 (3). The Institute of Electrical and Electronics Engineers (IEEE) is predicting that up to 75% of all vehicles will be autonomous by 2040 (4). Transportation Network Companies (TNCs) such as Uber and Lyft are beginning to change the transportation landscape in significant ways as they provide door-to-door mobility-on-demand through the use of mobile apps. In general, information technology is making rideshare and transit travel options more convenient using location-based services and real-time data analytics.

With the emergence of new transportation technologies and services, it is critical for transportation forecasting models to be enhanced to account for market dynamics that will result from increased penetration of disruptive forces in the transportation domain. To enhance transportation forecasting models, people's attitudes towards and perceptions of these technologies and services need to be measured and understood. Armed with such an understanding, it will be possible to specify and develop behavioral models that account for attitudes and perceptions, adoption cycles, and adaptation patterns. It is envisioned that such models will help decision-makers better plan transportation infrastructure systems and design marketing and policy strategies that maximize the benefits of these disruptive technologies. Attitudes and perceptions are likely to vary by socioeconomic characteristics, existing travel patterns and mobility experiences, and land use and built environment attributes.

Phase 1 of this project started in August 2017 and lasted for a year. A comprehensive literature review with respect to survey design and methodology was performed. A complete list of survey goals, objectives and detailed research questions was compiled. Accordingly, survey questionnaire has been designed with the following main sections: A) Attitudes and Preferences; B) Residential Choice and Vehicle Ownership; C) Current Travel Patterns; D) Mobility on Demand and Shared Mobility Services; E) Autonomous Vehicles, and F) Household and Individual Attributes.

During the second phase of the project, data collection will take place in two steps, with the administration of a pilot survey and a follow-up full-scale survey. The leading institution of the TOMNET center, Arizona State University, will lead the group efforts for the pilot data collection in September 2018, as part of a related TOMNET research grant, with the goal to have a sample size of 250 from residents of the Phoenix metropolitan area. During the pilot data collection, the paper survey questionnaires will be mailed out to 2,500 randomly selected household addresses obtained from marketing companies. In the meantime, the link to an online version of the survey will be sent out to 3,500 random email addresses. The goals of the pilot survey are to evaluate response rates across two survey methods and test the survey content and sampling plan.

As part of the activities included in this research proposal, the full-scale data collection efforts will commence in fall 2018 in the Atlanta region (as well as Phoenix, AZ, Tampa, FL, and Austin, TX, as part of related research efforts led by the research teams at partner institutions). During the full deployment, the research team will finalize the survey instrument, data collection method, content and sampling plan based on the results from the pilot deployment. Consequently, during summer 2019 we will collect survey data with the goal sample size of 1,000 residents in the Atlanta region to understand how the market may perceive, adopt, and adapt to transformative transportation technologies, mainly autonomous vehicles and mobility-on-demand services.

During phase 3, the research team will compile and clean the data, conduct systematic analyses on them via advanced statistical and econometric models, and produce the required reports and documentation. It is envisioned that such outputs will help decision-makers better plan transportation infrastructure systems and design marketing and policy strategies that maximize the benefits of these disruptive technologies. This project will provide a data collection protocol and methodology that can be widely adopted.

With the same questionnaire, the same data collection will take place concurrently in three other regions in the US. As part of a coordinated effort among TOMNET partners, Arizona State University will collect the data for a similar sample size from the Phoenix region, AZ, while and the University of South Florida will apply the survey in the Tampa region, FL. Moreover, the University of Texas at Austin, who has been our close collaborator for many years, will also deploy the same data collection. The data collected across multiple regions will eventually be aggregated to produce a single dataset with a sample size of more than four thousand cases. With the pilot survey administered in the Phoenix region and full deployment taking place concurrently in the three regions, we expect the final sample size around 4,250. This dataset will be unique in terms of large sample size, contents, and spatial expansion across multiple southern metro areas.

2. Project Objectives

The overall goal of this project is to collect a rich set of data that includes information about people's travel behavior and their attitudes towards and perceptions of advanced transportation technologies and mobility options with a view to inform the development of robust behavioral models of technology adoption capable of reflecting impacts of these disruptive forces on traveler behavior and values. This project will provide a data collection protocol and methodology that can be widely adopted.

3. Proposed Methodology and Data

During phase 1 of the project, a complete review of previous studies on attitudes towards and behavioral impacts of autonomous transportation technologies and innovative mobility services have been conducted. A comprehensive review of previous studies helped identify data needs and behavioral dimensions of

interest to focus in this study. According to these findings, the survey goals and objectives have been defined clearly.

The goal of the this survey is to understand people's perceptions towards new transportation technologies, as well as to measure how general attitudes (e.g., technology savviness, environment friendliness, etc.) influence attitudes towards new transportation technologies. Furthermore, the study aims at understanding the role of current travel behavior and current use of mobility-on-demand services on perceptions of automated mobility, and willingness to adopt autonomous vehicles. The questionnaire was designed to identify how people's travel patterns, residential choices, vehicle ownership, and mode choice decisions will change in response to transformative changes in transportation. The goal is to obtain a database able to enlighten the study of long-term impacts on people's lifestyle and well-being, as well as the general impacts on energy consumption, emissions, congestion, and urban planning, and thus revise future demand models and activities forecasting models accounting for adaptation of these new transportation technologies. Based on the defined goals and objectives, the survey instrument has been designed during the first phase of the project.

The survey design and review team, consisting of junior and senior members of the field across different TOMNET core institutions, met regularly every week during the first phase of the project and discussed all details of the survey questionnaire with full consideration. After many rounds of survey design and review processes, the paper and online survey questionnaires became ready. The paper version of the survey consists of a 16-page booklet in the letter size with the cover letter printed on the first page. The online version of the survey has been designed on the Qualtrics platform. The survey outline is summarized in the following. More details on literature review and survey design procedures can be found in the project report of Year 1 of this study (5).

Survey Outline

- Section A: Attitudes and Preferences
 - A series of general attitudinal statements with Likert scale agree/disagree response options
- Section B: Residential Choice and Vehicle Ownership
 - Current home address, type, and tenure, and choice process
 - Number and types of vehicles owned at the household
 - Vehicles driving assistant options
 - Respondent's and household members' driving status
- Section C: Current Travel Patterns
 - Commuting status, destination type, and address
 - Commuting frequency, duration, distance, and parking status
 - Frequency of different commuting travel mode
 - Frequency of different leisure/shopping/social trips travel mode
 - Physical or mental conditions
 - Total miles drives weekly
 - Long-distance trips frequency, modes, and distance
- Section D: Mobility on Demand and Shared Mobility Services
 - Ridehailing services use frequency
 - Details about the respondent's last trip with ridehailing services
 - Total amount spent on ridehailing monthly
 - Impact of ridehailing on the usage of other travel modes
 - A series of attitudinal statements with Likert scale agree/disagree response options
 - Stated preference choice question
- Section E: Autonomous Vehicles
 - Familiarity with AVs
 - Potential reaction to AVs whenever they become available in the market

- Impact of AV usage on residential choice and commuting duration
- Impact of AV on vehicle ownership and renting
- Perception of the time remaining to publicly availability of AVs
- A series of attitudinal statements with Likert scale agree/disagree response options
- Stated preference choice question
- Section F: Background Information
 - Age, Gender, Race, Place of birth, Education, Household structure, and Income

In the pilot deployment carried out by ASU, the survey instrument takes both forms of online and paper-based mail-out/mail-back survey. After pilot phase data collection, response rate and data quality will be used to decide between the two forms, and the full deployment will be conducted based on the best approach. The unique aspects of this survey are the combination of AV and ridehailing services in a single survey; inclusion of general attitudinal questions/statements (in addition to specific attitudinal statements on AV and ride-hailing services); random address-based sample (not convenient sample); consideration of residential location (long term), vehicle ownership (medium-term), and activity-travel (short term) impacts; and stated preference choice scenarios with 9 designed blocks.

The target sample size for the full deployment in the Atlanta region is one thousand valid responses. For the deployment, the survey team will purchase marketing data which includes names, mail addresses, and email addresses of a random sample of people in the core counties in the Atlanta region. We assume a 2.5 percent response rate for mail surveys and a 1 percent response rate for online surveys. The response rate, accuracy, and survey cost in the pilot deployment will determine the survey method (online vs. mail) and sampling plan for the full deployment. After data collection, data extraction and data cleaning process will be conducted. Once a clean sample is prepared for each of the four participating regions (Atlanta, GA, Phoenix, AZ, Tampa, FL, and Austin, TX), the datasets will be aggregated and a unique full dataset will be prepared for various research analyses and modeling. The comprehensive analysis of the data including developments of econometric models to understand people's perceptions and potential behavior toward new transport technologies will be conducted during the third phase (Year 3) of the project.

4. Work Plan (Project Tasks)

The following tasks will be undertaken in this project.

Task 1 - Survey Pilot Deployment in Phoenix: Prior to undertaking the full-fledged data collection effort, the research team at the partner institution ASU will conduct a small scale pilot survey using a random sample of households, purchased from a marketing company, in both paper and online formats. Participants in the pilot survey will be given the opportunity to offer feedback about the survey and identify areas for improvement. The pilot data, collected from about 250 respondents, will be analyzed in detail with a view to enhance the design of the survey and ensure that there is no ambiguity in survey questions. Moreover, if the response rate of the online version found out to be reasonably good, considering the significantly lower cost and faster data processing, the full deployment will happen in an online format. Otherwise, the full deployment will happen in the mail format or combination of mail and email survey methods. The pilot data will be analyzed initially at the descriptive level to understand if there is any shortcoming in the survey questionnaire design. Moreover, the cost, accuracy, and response rate of the pilot data will be evaluated to come up with the best plan for conducting the full deployment. Pilot data will be analyzed beyond the descriptive level as well in conjunction with the full data. One of the very important research areas the data collection effort will contribute to is survey methods by comparison between online and paper survey platforms in terms of the respondents' socioeconomic and attitudinal profiles in addition to survey logistics aspects.

Task 2 - Survey Full Deployment: In this task, a full-fledged data collection will take place. The survey will be administered in accordance with the survey design plan developed in Task 2. If it was decided to conduct a mailing survey, an address database will be purchased from a vendor to send out invitation letters

and reminder postcards; households will be able to complete the survey online or by requesting and mailing back a paper version of the survey. If it was decided to conduct an online-only survey, an email list will be purchased from a marketing company and invitation emails will be sent out to the potential respondents. If the survey design calls for an incentive, then a token of appreciation will be included in the package.

Task 3 - Data compilation and documentation: Upon completion of the data collection effort, the project team will compile the electronic databases and thoroughly document the data. A number of data validity checks will be performed so that the final data sets assembled in this project are clean and free of obvious logic errors. For the final cleaned data set, multi-dimensional raking procedures (e.g., iterative proportional fitting or IPF) will be used to weight the sample households so that the weighted sample is representative of the population over age 18 in the region. Data documentation, including a detailed data dictionary and description of the data collection methodology, will be prepared to support permanent data archival according to established data documentation standards.

Task 4 - Submission of final deliverables: The final deliverables of the project will include a comprehensive report documenting the sampling plan, data collection details, and data documentation. The project will also result in the delivery of a fully documented and weighted data set that can be used to study attitudes towards and behavioral impacts of autonomous vehicles and emerging mobility services. The final datasets will be saved and archived in CSV format to facilitate ease of use in any software platform.

5. Project Schedule

The project schedule is shown in Figure 1 below.

Aug-18	Sep-18	Oct-18	Nov-18	Dec-18	Jan-19	Feb-19	Mar-19	Apr-19	May-19	Jun-19	Jul-19
Task 1											
					Task 2						
								Task 3			
								Task 4			

Figure 1 Project Schedule

As per the schedule, the pilot deployment will be undertaken between August and October 2018, the first three months of the project. The full data collection in the Atlanta region will be carried out during the spring and summer of 2019. It is anticipated that this task will take three months. The remaining time will be assigned to data cleaning, weighting, geocoding and preparing final deliverables, which will be submitted in July 2019.

6. Relevance to the Center Theme/Mission

This research project involves the collection of attitudinal data to better understand how people perceive and value autonomous vehicles, mobility-as-a-service options, and other disruptive and transformative transportation technologies. Transportation planning agencies are increasingly seeking to forecast travel demand and mobility patterns/choices under alternative future states; however, they are limited in their ability to do so due to a severe paucity of data and behavioral insights on how individuals may adopt and adapt to various disruptive transportation services and technologies. Many studies to date have not gathered data about attitudinal variables, which are likely to play a very important role in shaping the behavioral responses to alternative technologies and services. This project directly addresses the theme of the center by collecting attitudinal data together with behavioral and socio-economic information. The resulting data set can be used to develop new behavioral forecasting models that explicitly account for attitudes, perceptions, and values. Therefore, the attitudinal data collection effort contemplated in this project directly

addresses the mission of TOMNET, namely, to advance data and methods to explicitly reflect the role of attitudes, perceptions, values, and preferences in activity-travel behavior and mobility choice models.

7. Anticipated Outcomes and Deliverables

The proposed project will result in the development of a rich dataset incorporating information about people's socioeconomic attributes, current travel behavior, attitudes toward and perception of new mobility choices and advanced technologies in transportation, and expected impact of advanced mobility options on traveler behavior and values. The project will result in the delivery of harmonized data sets that can be pooled or analyzed separately in subsequent phases (years) of the overall research enterprise. Furthermore, this project includes the estimation of models to model users' perceptions and predict the impacts of new mobility services and technologies on different choices (residential/work location, vehicle ownership, and activity-travel patterns). The latter outcome is expected for the next phase of the project while the main dataset will be produced during this phase of the project.

The project will result in the publication of a final report that documents the entire study including sampling plan and data collection plan. The data sets and documentation will be made available to all members of the TOMNET team to facilitate collaborative data analysis and modeling efforts. It is anticipated that the survey design and sampling plan developed in this research effort can be used by any jurisdiction in the country interested in collecting similar data within its metropolitan region or context. Moreover, the application of different survey methods in the pilot phase of data collections produces complementary insights about the advantages and disadvantages of different survey methods and how the respondents' profiles are different across different survey methods.

8. Research Team and Management Plan

The research team is led by Dr. Giovanni Circella, who will serve as the Principal Investigator for the project at Georgia Tech. Dr. Yongsung Lee and Professor Patricia L. Mokhtarian will serve as the co-principal investigators for the project and will assist in each and every project task. Dr. Lee will take the leadership for the execution of Tasks 2-4. Work Plan.

Giovanni Circella is a Senior Research Engineer in the School of Civil and Environmental Engineering at Georgia Tech, and the Director of the 3 Revolutions Future Mobility Program at the University of California, Davis. His interests include travel behavior, travel demand modeling, survey design, the mobility of millennials, the impact of personal attitudes and preferences, the adoption of shared mobility services and information and communication technologies, the adoption of autonomous vehicles, and the estimation of quantitative models of travel behavior, vehicle ownership and energy use. Dr. Circella has extensive experience designing large data collection using mobility surveys and other methodologies, he has authored many scientific journal papers and has advised multiple graduate students working on related grants and previous research connected to this project. Dr. Circella will lead the development of the present study, provide guidance on survey design, provide guidance and lead the data cleaning, data integration and handling, model estimation and the interpretation of the results. He will write portions of – and edit all – the project reports and scientific papers, and maintain regular communications with interested agencies and provide presentations to report and disseminate the results of the research.

Yongsung Lee is a postdoctoral researcher in the School of Civil and Environmental Engineering at Georgia Tech, with strong skills in survey design, data collection, advanced discrete choice modelling, and planning implications. His research focuses on emerging transportation services and technology, with a focus on their implications to environmental sustainability and mobility of the disadvantaged population. He will take part in the execution of all tasks specified 4. Work Plan, and also work closely with graduate students working on this project at various stages.

Patricia Mokhtarian, is a professor in the School of Civil and Environmental Engineering at Georgia Tech, who has more than 35 years of experience in travel behavior research, transportation planning, and discrete choice modeling. Her specialties include the measurement of attitudes and lifestyles and their incorporation into behavioral models, and the analysis of the impacts of ICT on travel behavior.

Giovanni Circella will be the primary point of contact for all aspects related to this research and will manage all aspects of the project. He will work closely with Dr. Lee and a graduate student to accomplish the project tasks. He will also coordinate efforts with other research groups conducting the same survey in other US metropolitan areas to ensure consistency in the survey data and products. Patricia L. Mokhtarian will assist in various project tasks and provide significant input on the design of the survey and sampling plan.

9. Technology Transfer Plan

The project team believes in executing an effective technology transfer plan by disseminating project information and results widely to the professional community. During the one-year duration of this particular project, each milestone will be disseminated using one of the TOMNET communication mechanisms (e.g., website, webinar, seminar, and teleconference). Project team members will prepare articles about the survey, data set, and modeling results for publication in refereed journals and conference proceedings. Project team members will participate in conferences and deliver presentations about this work and the outcomes of the effort. The project will also result in the preparation of data and survey products that can be shared with the broader professional community so that other jurisdictions can mimic the study without any difficulty. The project team will conduct webinars and seminars and post all interim reports and technical memoranda online at the TOMNET website. It should be noted that the main project outcomes that are based on the survey results analysis and modeling will be generated during the next phase of this project (Year 3) and the main output of this phase is the collected dataset that will be distributed among the TOMNET researchers. The survey questionnaire and the data collection protocol will be distributed to the entire community to transfer the team knowledge and efforts in designing one of the longest and in-depth surveys with respect to new transport technologies.

10. Workforce Development and Outreach Plan

The project incorporates a strong workforce development and outreach plan. The project will support a full-time postdoc as main research staff for day-to-day execution of various tasks. The postdoc will be involved in all aspects of the project including survey design, sampling plan, data collection, and data analysis. Graduate students will also be recruited to participate in the research endeavor; they will be expected to help with data entry, data checks, and data documentation. In addition, findings from the project will be integrated into graduate-level courses taught at various institutions in the consortium so that the research and workforce development activities of the center are seamlessly blended together.

11. References

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http://www.driverless-future.com/?page_id=384

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http://www.ieee.org/about/news/2012/5september_2_2012.html

Attitudes towards Emerging Mobility Options and Technologies – Phase 1: Survey Design. Center for Teaching Old Models New Tricks (TOMNET) Tier 1 University Transportation Center, 2018.

12. Qualifications of Investigators (One-page CV per Investigator)

GIOVANNI CIRCELLA, Ph.D.

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Director, 3 Revolutions Future Mobility Program and Assistant Professional Researcher
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EDUCATION

Politecnico di Bari (Technical Univ. of Bari, Italy), Ph.D. in Transportation Planning (2008)

Specializations: land use transportation modeling, transportation planning, environmental economics, policies for sustainable transportation

Dissertation: *Integrated Land Use and Transportation Planning for Sustainable Transport Solutions*
University of California, Davis, M.S. in Agricultural and Resource Economics (2009)

Politecnico di Bari (Technical Univ. of Bari, Italy), Italian Laurea (B.A.+M.S.) Degree (summa cum laude) in Civil Engineering (2004)

SELECTED PROFESSIONAL SERVICE AND AWARDS

Director, 3 Revolutions Future Mobility Program, Institute of Transportation Studies, National Center for Sustainable Transportation, UC Davis (2017 – present).

Honda Distinguished Scholar on New Mobility Studies: Endowment from American Honda Co., UC Davis (2018 - present).

Assistant Professional Researcher, Institute of Transportation Studies, National Center for Sustainable Transportation, UC Davis, 2015 - present.

Senior Research Engineer, School of Civil and Environmental Engineering, Georgia Institute of Technology, 2016 – present (Research Engineer, 2013 - 2016).

Post-Doc Researcher, Institute of Transportation Studies, University of California, Davis, 2009 - 2015.

Research Faculty Senate, Georgia Institute of Technology: Representative of Research Faculty of the School of Civil and Environmental Engineering, 2014 - 2017.

Licensed Professional Engineer (P.E.): Italy, #7374 – Bari.

Chair, Standing Committee on Transportation and Information Communication Technologies (ADB20) Committee, Transportation Research Board (2018 - present).

Member, Standing the Committees on Transportation and Sustainability (ADD40) and Travel Behavior and Values (ADB10), Transportation Research Board.

Keynote Speaker: Trailways Annual Conference, Fort Myers, FL, February 2016.

Fulbright Fellowship: Research Scholar at UC Davis (2006 –2007).

Visiting Researcher Fellowship: University of Leeds (UK), 2016.

Research Scholarship: Technische Universität Wien (Austria), 2008.

Award for the Best Research Thesis, City of Bari, Italy, 2006.

Socrates-Erasmus Fellowship: Universidad Politécnica de Valencia, Spain, 2003.

PROFESSIONAL EXPERIENCE

Giovanni Circella is the Honda Distinguished Scholar for New Mobility Studies and the Director of the 3 Revolutions Future Mobility Program at the University of California, Davis, and a Senior Research Engineer in the School of Civil and Environmental Engineering of the Georgia Institute of Technology. Dr. Circella's interests include travel behavior and emerging transportation services, sustainable transportation, travel demand modeling, travel survey methods, and policy analysis. His recent research has focused on the impacts of information and communication technology (ICT), new mobility (including shared mobility,

micromobility and ridehailing) and vehicle automation on travel behavior and auto ownership, the evolving lifestyles and mobility patterns of specific population segments (e.g. “millennials”) and in various regions of the U.S., Europe, South America and the Middle East. Dr. Circella is the Chair of the TRB Committee on ICT and Transportation (ADB20), and a member of the Transportation and Sustainability (ADD40) and the Travel Behavior and Values (ADB10) committees. He also serves in the NCHRP 20-102, 20-102(01), 20-102(09) and 20-102(19) and TCRP B-47 project panels on the impacts of connected and automated vehicles and other emerging transportation technologies. Dr. Circella regularly cooperates with metropolitan planning organizations (MPOs), other agencies and non-profit organizations in the U.S., Europe and South America.

SELECTED RECENT PUBLICATIONS

- “Will Autonomous Vehicles Change Residential Location and Vehicle Ownership? Glimpses from Georgia”, by S. H. Kim, P. L. Mokhtarian and G. Circella, *Transp. Research Part D (forthcoming)*.
- “How, and for Whom, Will Activity Patterns Be Modified by Self-driving Cars? Expectations from the State of Georgia”, by S. H. Kim, P. L. Mokhtarian and G. Circella, *Transp. Research Part F (forthcoming)*.
- “What Drives the Gap? Applying the Blinder–Oaxaca Decomposition Method to Examine Generational Differences in Transportation-related Attitudes”, by A. Etezady, A. Shaw, P. L. Mokhtarian and G. Circella, *Transportation (forthcoming)*.
- “Who Doesn’t Mind Waiting? Examining the Relationships between Waiting Attitudes and Person- and Travel-Related Attributes”, by A. Shaw, A. Malokin, P. L. Mokhtarian and G. Circella, *Transportation (forthcoming)*.
- “What Drives the Use of Ridehailing in California? Ordered Probit Models of the Usage Frequency of Uber and Lyft”, by F. Alemi, G. Circella, P. L. Mokhtarian and S. L. Handy *Transp. Research Part C*, 102, 2019, 233-248.
- “Heterogeneous Residential Preferences among Millennials and Members of Generation X in California: A Latent-class Approach”, by Y. Lee, G. Circella, P. L. Mokhtarian and S. Guhathakurta, *Transp. Research Part D*, 76, 2019, 289-304.
- “Are Millennials More Multimodal? A Latent Class Analysis with Attitudes and Preferences”, by Y. Lee, G. Circella, P. L. Mokhtarian and S. Guhathakurta, *Transportation*, 2019, <https://doi.org/10.1007/s11116-019-10026-6>.
- “It’s Not All Fun and Games: An Investigation of the Reported Benefits and Disadvantages of Conducting Activities while Commuting”, by A. Shaw, A. Malokin, G. Circella and P. L. Mokhtarian, *Travel Behaviour and Society*, 17, 2019, 8-25.
- “User Preferences for Bicycle Infrastructure in Communities with Emerging Cycling Cultures”, by Clark, C., P. L. Mokhtarian, G. Circella and K. Watkins, *Transp. Research Record*, 2673(12), 2019, 89-102.
- “Identifying Latent Mode-use Propensity Segments in an All-AV Era”, by S. H. Kim, G. Circella and P. L. Mokhtarian, *Transp. Research Part A*, 130, 2019, 192-207.
- “How Do Activities Conducted while Commuting Influence Mode Choice? Using Revealed Preference Models to Inform Public Transportation Advantage and Autonomous Vehicle Scenarios”, by A. Malokin, P. L. Mokhtarian and G. Circella, *Transp. Research Part A*, 124, 2019, 82-114.
- “Millennials in Cities”, by A. Delbosc, N. McDonald, G. Stokes, K. Lucas, G. Circella and Y. Lee, *Cities*, 90, 2019, 1-14.
- “Panel Study of Emerging Transportation Technologies and Trends in California: Phase 2 Data Collection”, by G. Circella, G. Matson, F. Alemi and S. L. Handy, Project Report, National Center for Sustainable Transportation. University of California, Davis, 2019.
- “Exploring the Latent Constructs behind the Use of Ridehailing in California”, by F. Alemi, G. Circella, S. L. Handy and P. L. Mokhtarian, *Journal of Choice Modelling*, 29, 2018, 47-62.
- “Transport Policy in the Era of Shared Mobility and Other Disruptive Transportation Technologies”, by G. Circella and F. Alemi, in *Advances in Transport Policy and Planning*, Vol. 1, eds. Y. Shiftan and M. Kamargianni, Ch. 5, 2018, 119-144, Elsevier.
- “What Influences Travelers to Use Uber? Exploring the Factors Affecting the Adoption of On-Demand Ride Services”, by F. Alemi, G. Circella, S. L. Handy and P. L. Mokhtarian, *Travel Behaviour and Society*, 13, 2018, 88-104.
- “Exploring the Self-reported Long-distance Travel Frequency of Millennials and Generation X in California”, by R. Berliner, L. Aultman-Hall and G. Circella, *Transp. Research Record*, 2672(47), 2018, 208-2018.

YONGSUNG LEE, PhD
Georgia Institute of Technology, School of Civil and Environmental Engineering
CURRICULUM VITAE

EARNED DEGREES

- Georgia Institute of Technology, Ph.D. in City and Regional Planning (2018)
- University of Illinois Urbana-Champaign, M.U.P. in Urban and Regional Planning (2012)
- Seoul National University, M.E. in Architecture (2008)
- Seoul National University, B.E. in Architecture (2003)

EMPLOYMENT

1. **2018 – present - Georgia Institute of Technology: School of Civil & Environmental Engineering, Postdoctoral Fellow**
2. **2015 – 2019 - Georgia Institute of Technology: School of City and Regional Planning, Instructor/ Graduate Teaching assistant**
3. **2012 – 2018 - Georgia Institute of Technology: School of City and Regional Planning, Graduate Research Assistant**
4. **2008– 2010 – Architecture and Urban Research Institute, South Korea, Assistant Researcher**

PEER-REVIEWED PUBLICATIONS

1. **Lee, Y.,** Circella, G., Mokhtarian, P. L., & Guhathakurta, S. (2019). Heterogeneous Residential Preferences Among Millennials and Members of Generation X in California: A Latent-Class Approach. *Transportation Research Part D: Transport and Environment*.
2. **Lee, Y.,** Circella, G., Mokhtarian, P. L., & Guhathakurta, S. (2019). Are Millennials More Multi-modal? A Latent-Class Cluster Analysis with Attitudes and Preferences among Millennial and Generation X Commuters in California. *Transportation*. <https://doi.org/10.1007/s11116-019-10026-6>
3. **Lee, Y.,** Lee, B., & Shubho, M. T. H. (2019). Urban Revival by Millennials? Intra-Urban Net Migration Patterns of Young Adults, 1980-2010. *Journal of Regional Science*. <https://doi.org/10.1111/jors.12445>
4. Delbosc, A., McDonald, N., Stokes, G., Lucas, K., Circella, G., & **Lee, Y.** (2019). Millennials in Cities: Exploring Travel Behaviour Trends in Six City Regions. *Cities*. <https://doi.org/10.1016/j.cities.2019.01.023>
5. Raymond, E., Dill, J., & **Lee, Y.** (2018). Millennials First Time Homebuyers Before and After the Housing Crisis: The Impact of Age and Credit on Location Choice. *Journal of Planning Education and Research*. <https://doi.org/10.1177/0739456X18807751>
6. Zhang, W., Wang, F., Barchers, C., & **Lee, Y.** (2018). The Impact of Transit-Oriented Development on Housing Value Resilience: Evidence from the City of Atlanta. *Journal of Planning Education and Research*. <https://doi.org/10.1177/0739456X18787011>
7. **Lee, Y.,** & Guhathakurta, S. (2018). An Analysis of the Effects of Suburban Densification on Vehicle Use for Shopping: Do Existing Residents Respond to Land-Use Changes in the Same Way as Recent Movers?. *Journal of Transport Geography* 68(April), 193–204. <https://doi.org/10.1016/j.jtrangeo.2018.03.011>
8. Lee, B., & **Lee, Y.** (2013). Complementary Pricing and Land Use Policies: Does It Lead to Higher Transit Use?. *Journal of the American Planning Association* 79(4), 314–328. <https://doi.org/10.1080/01944363.2014.915629>

BOOK CHAPTER

1. Lee, Y., & Circella, G. (2019). *ICT, Millennials' Lifestyles, and Travel Choices*. In E. Ben-Elia (Ed.), *Advances in Transport Policy and Planning: The Evolving Impact of Information and Communication Technology on Activities and Travel Behaviour Volume 3* (pp. 107-141). Oxford, UK: Elsevier. <https://doi.org/10.1016/bs.atpp.2019.08.002>

PROJECT REPORTS

1. Circella, G., Lee, Y., & Alemi, F. (2018). Exploring the Relationships among Travel Multimodality, Driving Behavior, Use of Ridehailing, and Energy Consumption. A research report from the National Center for Sustainable Transportation. Available on <https://escholarship.org/uc/item/31v7z2vf>
2. Circella, G., Alemi, F., Tiedeman, K., Berliner, R. M., Lee, Y., Fulton, L., Mokhtarian, P. L., & Handy, S. (2017). What Affects Millennials Mobility? PART II: The Impact of Residential Location, Individual Preferences and Lifestyles on Young Adults Travel Behavior in California. A research report from the National Center for Sustainable Transportation. Available on <https://escholarship.org/uc/item/5kc117kj>
3. Ross, C. L., Amekudzi, A. A., Guhathakurta, S., Welch, T. F., Kumar, A., Lee, Y., Kent, M., & Smith-Colin, J. (2015). Freight Impacts on Small Urban and Rural Areas. A research report from the National Center for Transportation Systems Productivity and Management. Available on <http://www.nctspm.gatech.edu/pi/freight-impacts-small-urban-and-rural-areas>

HONORS & AWARDS

- 2018** Invited to the Endogenous Amenities and Cities Symposium, Florida State University.
- 2017** Teaching Assistant of the Year, School of City and Regional Planning, Georgia Institute of Technology.
- 2011** Michael A. Carroll Scholarship, Department of Urban and Regional Planning, University of Illinois at Urbana-Champaign.

PROFESSIONAL SERVICE

Ad hoc referee:

Transportation Research Part A, Transportation Research Part D, Transportation Research Part F, Transport Policy, Travel Behaviour and Society, and Transportation Research Record.

University/Departmental service:

Georgia Institute of Technology

Reviewer of the President's Undergraduate Research Awards (PURA) for Spring 2020

School of City and Regional Planning, Georgia Institute of Technology

Ph.D. Committee for academic year 2016–17

Transportation Faculty Search Committee for academic year 2014–15

Professional membership:

Association of Collegiate Schools of Planning (2012–Present)

International Association of Travel Behaviour Research (2018–Present)

American Association of Geographers (2017–Present)

PATRICIA L. MOKHTARIAN, PhD
Susan G. and Christopher D. Pappas Professor
Georgia Institute of Technology, School of Civil and Environmental Engineering
CURRICULUM VITAE

EARNED DEGREES

- Northwestern University, Ph.D. in Industrial Engineering/Management Science (1981)
- Northwestern University, M.S. in Industrial Engineering/Management Science (1977)
- Florida State University, B.A. (summa cum laude) in Mathematics (1975)

EMPLOYMENT (selected)

1. **2013 – present - Georgia Institute of Technology:** *School of Civil & Environmental Engineering, Susan G. and Christopher D. Pappas Professor; Transportation Group Coordinator*
2. **1990 - 2013 - University of California, Davis**
 - a. *Department of Civil & Environmental Engineering, Assistant Professor (1990-96), Associate Professor (1996-1999), and Professor (1999-2013);*
 - b. *Graduate Group in Transportation Technology and Policy, Chair and Graduate Adviser (1997-2013);*
 - c. *Institute of Transportation Studies, Acting Director (1999-2000), Associate Director for Education (2001-2013)*
3. **1982 - 1988 - Southern California Association of Governments:** *Transportation Planner (1982-1985); Senior Planner (1985-1988)*

CURRENT/RECENT GRANTS AND CONTRACTS

1. **Teaching Old Models NEW Tricks (TOMNET), Tier 1 University Transportation Center**
U. S. Department of Transportation, subcontract to Arizona State University
\$6.25 million total (Georgia Tech share about 1/3), 2017 – 2022
(Georgia Tech) Collaborators: Prof. Kari Watkins, Dr. Giovanni Circella (senior personnel)
2. **The Impact of Emerging Technologies and Trends on Travel Demand in Georgia**
Georgia Department of Transportation, \$380,000, August 2016 - October 2019
Collaborator: Dr. Giovanni Circella (senior personnel)

PROFESSIONAL CONTRIBUTIONS

Editorial Board Memberships

1. Editorial Board, *Travel Behaviour and Society* (2013 – present).
2. Editorial Board, *Transportation* (2018 – present; Associate Editor 2008 – 2018).
3. Editorial Advisory Board, *Transportation Research A* (2004 – present).
4. Editorial Board, *Transport Policy* (2008 - present).
5. Editorial Board, *Transportation Letters: The International Journal of Transportation Research* (2008 – present).
6. Editorial Board, *International Journal of Sustainable Transportation* (2010 – present).
7. Editorial Advisory Board, *European Journal of Transport and Infrastructure Research* (2011 – present).

Society Offices, Activities, and Membership (selected)

1. Transportation Research Board:

- a. Founding chair, Effects of Information and Communication Technologies (ICT) on Travel Choices (ADB20, formerly A1C08) (1993-2000) and Subcommittee (A1C04(3)) (1988-1993); member (2000- 2006); emeritus member (2007-present)
- b. Emeritus member (2009-present), Travel Behavior and Values (ADB10)

2. Chair of International Association for Travel Behaviour Research (2016-2017)

HONORS (selected)

1. **Thomas B. Deen Distinguished Lecture**, 97th Annual Meeting of the **Transportation Research Board**, Washington, DC, January 8, 2018. “The lectureship recognizes the career contributions and achievements of an individual in one of the areas covered by the TRB’s Technical Activities Division.”
2. Opening **keynote speaker**, 17th **Swiss Transport Research Conference**, Monte Verita, Switzerland, May 17-19, 2017.
3. **Eminent Professor Lecture**, Department of Civil Engineering, **Monash University, Melbourne, Australia**, May 23, 2016.
4. **Keynote speaker**, 14th **Conference of the International Association for Travel Behaviour Research**, Windsor, UK, July 23, 2015.
5. **Keynote speaker**, 14th **International Conference on Traffic and Transportation Engineering**, Tehran, Iran, February 24, 2015.
6. Eighth Annual **Martin Wachs Distinguished Lecture in Transportation**, University of California, Los Angeles, October 9, 2014.
7. **PROFILES, TR News** (the bimonthly magazine of the Transportation Research Board), September/October 2014. “The PROFILES honor and highlight the professional achievements and contributions of select TRB leaders.”
8. **Keynote speaker, World Symposium on Transport and Land Use Research (WSTLUR)**, Delft, the Netherlands, June 24, 2014.
9. University-wide endowed lecture series: **Burack Lecture, University of Vermont**, Burlington, April 14, 2014.
10. Invited speaker, **Distinguished Transport Lecture Series. University of Hong Kong Institute of Transport Studies**, December 12, 2013.

PUBLISHED JOURNAL ARTICLES (selected)

1. “How Much Does the Method Matter? An Empirical Comparison of Ways to Quantify the Influence of Residential Self-Selection”, by David van Herick and Patricia L. Mokhtarian. *Travel Behaviour and Society* **18**, 2020, 68-82.
2. “How Do Activities Conducted while Commuting Influence Mode Choice? Using Revealed Preference Models to Inform Public Transportation Advantage and Autonomous Vehicle Scenarios”, by Aliaksandr Malokin, Giovanni Circella, and Patricia L. Mokhtarian. *Transportation Research A* **124**, 2019, 82-114.
3. “Subjective Well-Being and Travel: Retrospect and Prospect”, by Patricia L. Mokhtarian. *Transportation* **46(2)**, 2019, 493-513.
4. “Addressing the Joint Occurrence of Self-selection and Simultaneity Biases in the Estimation of Program Effects Based on Cross-sectional Observational Surveys - Case Study of Travel Behavior Effects in Carsharing”, by Gouri Shankar Mishra, Patricia L. Mokhtarian, Regina R. Clewlow, and Keith F. Widaman. *Transportation* **46**, 2019, 95-123.
5. “What Drives the Use of Ridehailing in California? Ordered Probit Models of the Usage Frequency of Uber and Lyft”, by Farzad Alemi, Giovanni Circella, Patricia Mokhtarian, and Susan Handy. *Transportation Research C* **102**, 2019, 233-248.
6. “The Times They are A-changin’: What Do the Expanding Uses of Travel Time Portend for Policy, Planning, and Life?”, by Patricia L. Mokhtarian. *Transportation Research Record* **2672(47)**, 2018, 1-11.
7. “Face to Facebook: The Relationship between Social Media and Social Travel”, by Alexa Delbosc and Patricia L. Mokhtarian. *Transport Policy* **68**, 2018, 20-27.
8. “Taste Heterogeneity as an Alternative Form of Endogeneity Bias: Investigating the Attitude-Moderated Effects of Built Environment and Socio-demographics on Vehicle Ownership using Latent Class Modeling”, by Sung Hoo Kim and Patricia L. Mokhtarian. *Transportation Research Part A* **116**, 2018, 130-150.

13. Budget Including Non-Federal Matching Funds

Institution: Georgia Institute of Technology

Project Title: Attitudes towards Emerging Mobility Options and Technologies – Phase 2: Data Collection

Principal Investigator: Dr. Giovanni Circella, Senior Research Engineer

Budget Period: 8/1/2018 to 7/31/2019

CATEGORY	Budgeted Amount from Federal Share	Budgeted Amount from Matching Funds	Explanatory Notes; Identify Source of Matching Funds
Faculty Salaries	18,000	40,000	Dr. Mokhtarian salary as match = \$40,000
Other Staff Salaries	26,000		Dr. Lee
Student Salaries (includes data entry costs)	12,600		Grad Research Assistant (6 months)
Fringe Benefits	14,528	11,520	Faculty: 28.8% of salaries Grad RA: 14.73% of salaries
Total Salaries & Benefits	71,128	51,520	
Student Tuition Remission	8,934		
Operating Services and Supplies (data storage)		500	Dr. Mokhtarian Startup Funds
Domestic Travel		1,000	Dr. Mokhtarian Startup Funds
Other Direct Costs (specify): Survey Related Costs (address database, URL, printing and mailing)	30,000		Costs for survey administration
Other Direct Costs (specify)			
Total Direct Costs	110,062	53,020	
F&A (Indirect) Costs: 57.8% of MTDC (excludes tuition)	58,452	30,646	
TOTAL COSTS	168,514	83,666	Total Project Cost: \$252,180

Grant Deliverables and Reporting Requirements for UTC Grants (November 2016)
Exhibit F

UTC Project Information	
Project Title	Attitudes towards Emerging Mobility Options and Technologies – Phase 2: Data Collection
University	Georgia Institute of Technology
Principal Investigator	Giovanni Circella
PI Contact Information	Address: 790 Atlantic Dr, Atlanta GA 30302 Email: Giovanni.Circella@ce.gatech.edu
Funding Source(s) and Amounts Provided (by each agency or organization)	US Department of Transportation (Federal UTC): \$166,519 Georgia Institute of Technology (Cost Share): \$83,666
Total Project Cost	\$250,185
Agency ID or Contract Number	
Start and End Dates	8/1/2017 - 07/31/2018
Brief Description of Research Project	Emerging transportation technologies including electric and autonomous vehicles and emerging mobility services such as ride-hailing and vehicle sharing are bringing about transformative changes in the transportation landscape. With the emergence of new transportation technologies and services, it is critical that transportation forecasting models be enhanced to account for behavioral dynamics that will result from the increasing penetration of disruptive forces in the transportation marketplace. To enhance transportation forecasting models, people’s attitudes towards and perceptions of emerging technologies and services need to be measured and understood. Armed with such an understanding, it will be possible to specify and develop behavioral models that account for attitudes and perceptions, adoption cycles, and adaptation patterns. It is envisioned that such models will help decision-makers better plan transportation infrastructure systems and design marketing and policy strategies that maximize the benefits of these disruptive technologies. This project aims to collect survey data from a sample of 1000 residents in the Atlanta region, GA to understand how the market perceives, adopts, and adapts to transformative transportation technologies. During the one-year duration of the project, the research team will review relevant behavioral studies, design the survey instrument and sampling plan, conduct a survey pre-test, perform full-fledged data collection through the administration of a comprehensive attitudinal and behavioral survey, compile and clean data, and produce reports and documentation. Thus, the focus of this phase-2 effort is to collect a rich dataset of users’ attributes and current mobility choices,

	together with attitudes, perceptions and stated preferences towards new mobility options and technologies. It is envisioned that this project will result in the development of a data collection protocol and methodology that can be widely adopted in any jurisdiction interested in replicating the study. (283 words)
Describe Implementation of Research Outcomes (or why not implemented) Place Any Photos Here	The main outcome of this project at the end of this project year is a harmonized comprehensive survey about users' attitudes and perceptions toward new transport technologies. The survey questionnaire and deployment plan can be widely adopted anywhere in the country. The collected dataset will be used to shed light on questions regarding users' responses to new transport choices.
Impacts/Benefits of Implementation (actual, not anticipated)	Eventually, the collected valuable dataset will help transport modelers to more accurately account for new transport choices in their models and will assist policy-makers to place more effective policies to maximize the positive impacts and minimize the negative impacts of these transformative forces.
Web Links <ul style="list-style-type: none"> • Reports • Project Website 	https://www.tomnet-utc.org/gt-av-survey-project.html