# Center for Teaching Old Models New Tricks (TOMNET)

## A USDOT Tier 1 University Transportation Center

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**2017-2018 PROJECT PROPOSAL**

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**Title:** An Investigation of the Contribution of Targeted Marketing Data to the Prediction of Attitudes

**Principal Investigator:** Patricia L. Mokhtarian, Susan G. and Christopher D. Pappas Professor, School of Civil and Environmental Engineering, Georgia Institute of Technology

**Co-Principal Investigator:** Kari Watkins, Frederick Law Olmsted Associate Professor, School of Civil and Environmental Engineering, Georgia Institute of Technology

**Co-Principal Investigator:** Giovanni Circella, Senior Research Engineer, School of Civil and Environmental Engineering, Georgia Institute of Technology

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## 1. Introduction/Problem Statement

We are living in a time of unprecedented change in the transportation "landscape". Information and communication technologies (ICTs) have facilitated the emergence of ***numerous new services*** (such as real-time traveler information, on-demand ridesharing, carsharing, bikesharing, accommodation-sharing) ***and technologies*** (including drones, connected and autonomous vehicles, 3-D printing, alternative energy sources and propulsion methods, and virtual reality). ***Societal trends*** include delayed or deferred marriage and childbearing; greater education coupled with widespread underemployment; increasing ethnic diversity; and shifting values (with respect to subjects such as the environment, physical activity, and technology). In response, ***policy and planning instruments*** are evolving as well, to include favoring denser and more diverse land uses that will promote more sustainable transportation patterns; changing the transportation tax revenue base away from petroleum-based taxes; and tentative steps toward the introduction of automated vehicles.

In view of this extraordinary upheaval, it has never been more vital for national, state, and regional planners to understand and predict the transportation-related behavioral impacts of change. The ability to do so, however, is severely hampered by the absence of attitudinal vari-ables from large-scale in-practice travel demand forecasting models. Numerous academic stu-dies have demonstrated the increased explanatory power provided by the inclusion of attitudes in small-scale travel behavior models (e.g. Mokhtarian and Salomon 1997; Kuppam, et al. 1999; Domarchi, et al. 2008), and their absence from in-practice models is manifested in low goodness of fit and predictive ability, as well as the need to judgmentally "assert" many parameters in order to achieve consistency with theoretical expectation or to better replicate existing condi-tions. Further, a common lament with respect to such models is their lack of sensitivity to social and personal values – it is clear, as just one example, that it will be difficult to predict the adop-tion of on-demand ridesharing services without knowledge of the individual's attitudes toward vehicle ownership, riding with strangers, and technology.

There are reasons why attitudes have been neglected in large-scale regional models: they can be burdensome to measure and analyze, and difficult to forecast. Nevertheless, it is the mission of the TOMNET center to find practical ways to incorporate attitudinal information into such models. The present proposal will make an important contribution to that mission.

In previous research, we have successfully used a small-scale attitudinally-rich dataset collected in California in 2011 to train a machine learning process for imputing attitudes into the 2009 National Household Travel Survey (NHTS) database (Malokin et al., 2017). We demonstrated the added value of those attitudes by developing a vehicle ownership model and evaluating the goodness of the model without and with the attitudinal variables (and also comparing the models estimated on NHTS data to their counterparts estimated on the training sample).

However, the previous study identified a number of potentially fruitful avenues for improving the results. The proposed study would have two key aims: (1) to implement the previous suc-cessful imputation methods using (a) a source or training sample that is newer (collected in 2017) and more representative of a large geography (the urban and small-town population of the state of Georgia) and (b) a recipient sample that is equally up-to-date (the Georgia subsample1 of the 2016-17 NHTS); and (2) to extend and improve the methods developed in the previous study.

We will particularly focus on the potential of targeted marketing data for improving the predic-tion of attitudes. "Targeted marketing" (TM) refers to a strategy of tailoring marketing messages to specific categories of people who are expected to be more receptive to the message than ave-rage. This expectation is based on (presumed) knowledge about an extensive set of individual and household characteristics. TM firms make a business of collecting information on numerous traits of every possible household, based on credit card purchases, credit reporting, and public records such as tax assessor data. They then analyze the information to create various lifestyle markers (generally assigning the household to one of a sizable number of lifestyle-defined clus-ters), and sell the information to entities (including businesses, non-profits, and researchers) who wish to target an appeal of some kind, or simply to learn more about a particular population seg-ment and/or geographic area.

Previous studies have used TM data to enable new or improved analyses of travel-related choices (Binder et al. 2014; Macfarlane et al. 2015), and have found that incorporating such data directly into travel demand models improved those models (e.g. Kressner and Garrow 2012). However, to our knowledge no one has used such data to predict attitudes, and then incorporated the pre-dicted attitudes into travel models, which is the approach of the proposed study. The advantage of the proposed approach is that the attitudes may have a stronger and more direct conceptual re-lationship to the outcome variable of interest, resulting in models that are more meaningful and interpretable than if more loosely associated lifestyle indicators were used. However, given the considerable information about attitudes that is implicitly embedded into the variables available in TM databases, there is good reason to expect that such variables could substantially improve our ability to predict those attitudes in the first place. If TM variables are confirmed to be useful for that purpose, it would be an extremely valuable development, since such data are commerci-ally available at very economical prices (10 cents per household or less).

## 2. Project Objectives

The objectives of this project are (1) to impute attitudes into the Georgia subsample of the 2016-17 NHTS, training the imputation functions using attitudinally-rich data collected in Fall 2017 from a sample that is (reasonably) representative of the urban and small-town population of the state of Georgia; and (2) to augment the set of "common variables" available for training the im-putation process with information from targeted marketing databases. Achievement of both ob-jectives will involve testing the efficacy of the imputed attitudes for predicting travel-related choices of interest, using a variety of comparisons.

1 Note that the previous study used a Northern California source sample from which we imputed attitudes to the entire NHTS dataset, and the same could easily be done with the Georgia source sample to be used in this study. We found, however, that regional differences in attitudes and values made it preferable, at least at this stage in the development of these methods, to keep the same geographic span for both the source and the recipient samples.

# 3. Proposed Methodology and Data

*3.1 Description of primary data sources*

The proposed project will capitalize on two independent data collection efforts that are, respectively, recently completed and underway, resulting in an extremely efficient and effective leverage of resources. The first is the 2016-17 wave of the National Household Travel Survey (http://nhts.ornl.gov/). The year-long data collection concluded in April 2017, with more than 129,000 households responding. The Georgia Department of Transportation (GDOT) has pur-chased an "add-on" sample to the NHTS, to obtain more observations than would be the case if its subsample size were proportional to Georgia's share of the US population (1.2%). The exact size of the Georgia subsample is not known at the time of this writing, but should exceed 2,000 households.

The second data collection effort is separately funded by GDOT (henceforth, "GDOT survey"), and directed by the same Georgia Tech Principal Investigator as the project proposed here. The purpose of this second effort is to understand the impacts of emerging technologies and trends on travel behavior in Georgia. To that end, the project team has been developing a survey designed to measure an extensive set of attitudes, behaviors, socio-economic/demographic (SED) traits, and other variables. Survey design is nearing completion, and deployment is scheduled for Sep-tember 2017. A paper version of the survey will be mailed to randomly-selected addresses in the urban and small-town areas of Georgia; an online version of the survey will also be available for those preferring that format. The invitation will be mailed to about 30,000 households, so conservatively assuming a 10% response rate yields around 3,000 responses[2].

*3.2 Background to the methodology*

Figure 1 schematically illustrates the inputs and outputs of the attitude imputation process. The colored shapes represent data matrices, where the height of a given rectangle represents the number of rows or cases (in this project the donor and recipient datasets are likely to have about the same number of cases, but ordinarily the recipient dataset would be much "taller" than the donor), and the width represents the number of columns or variables. In the types of applications envisioned here, the donor dataset is rich in attitudes (ATT) but poor in (travel) behavioral

(BEH) variables (e.g. it typically will not include a detailed travel diary), while for the recipient dataset the converse is true. The logic of the process is that the "observed" attitudes in the donor dataset are modeled, or predicted, as functions of a set of variables that will be present in both the donor (D) and the recipient (R) dataset ("common variables", CVs). Once those functions have been calibrated on the donor data, the same functions are applied to the counterpart CVs in the recipient dataset to produce the predicted, or imputed, attitudes for that sample.

2 In addition, later this month (June 2017) we expect to be provided with the contact information of the Georgia respondents to the NHTS who were willing to be surveyed again. The GDOT contact handling the Georgia add-on to the NHTS sample, Mr. Habte Kassa, is the project liaison for the GDOT survey project, and is facilitating this

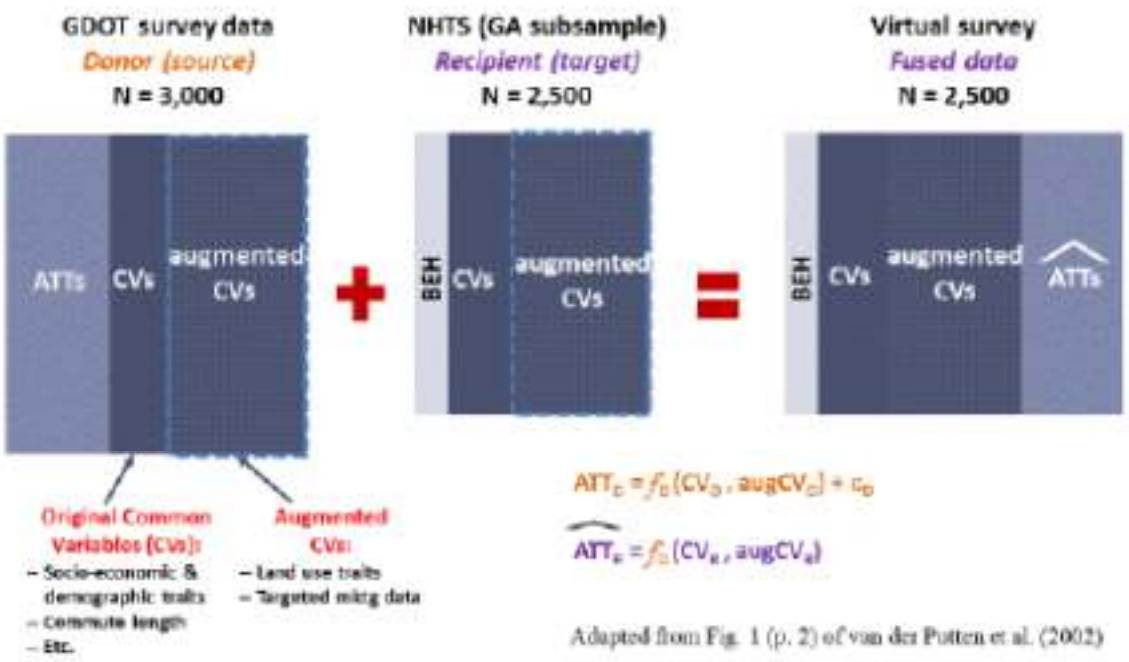


**Figure 1: Schematic representation of the attitude imputation process**

Initially, the CVs consist of variables that appear in both the NHTS and the GDOT survey – primarily SED traits, but including a few others such as commute distance (henceforth, "SED+"). However, in our previous study (Malokin, et al. 2017), we augmented those variables with a large number of measures related to the respondent's residential neighborhood (henceforth, "LU", for "land use"), obtained from the Decennial Census 2010 (US Census Bureau 2011), American Community Survey (ACS) 2013 (US Census Bureau 2014), and Smart Location Database 2013 (US Environmental Protection Agency 2014). We plan to do the same in the study proposed here, and also to further augment the CVs with data obtained from a TM firm.

With this background in mind, the proposed project would proceed as described in Section 4.

## 4. Work Plan (Project Tasks)

***Task 1:*** *Literature review.* On a continuous basis throughout the project, we will monitor the rapidly-evolving literature on machine learning/data fusion methods and their transportation-related applications. We anticipate that this literature review task will result in a journal article or book chapter as an early results dissemination component.

***Task 2:*** *Obtain land-use-related and targeted marketing variables*, spatially matched to the observations in both the Georgia subsample of the NHTS and the GDOT survey sample. We have investigated several TM firms and are currently in discussion with a reputable one (Infogroup, http://www.infogroup.com/) to lay the groundwork for this task. As part of this task, we will compare the distributions of selected SED, LU, and TM variables across the two samples of interest and the population; for selected variables we will

process. Accordingly, we will augment the invitations to randomly-selected households, as described above, with invitations to the willing subset of the Georgia NHTS sample. In this way, we expect to measure several hundred respondents who will have completed *both* the richly attitudinal GDOT survey *and* the richly behavioral NHTS. An in-depth analysis of this exceptional subsample will be the subject of a later TOMNET proposal; to represent a more typical situation and in view of the uncertainty about the number of cases involved, the present proposal does not strongly rely on this intersection of the two samples.

also conduct a pairwise comparison of the self-reported versus TM version of the same variable (Kressner, et al. 2014). Substantial variations will be noted as potential limitations on the generalizability of the samples.

***Task 3:*** Using the best available machine learning methods, *predict the attitudinal variables in the GDOT survey sample* as a function of the original (SED+) and augmented (LU and TM) CVs. Evaluate the quality of those predictions, e.g. through reductions in the mean-squared error of a naïve benchmark prediction (such as the mean), and correlations of the observed and predicted attitudes. Repeat the analysis but dropping the TM variables from the set of CVs, and compare the results to ascertain the improvement in predictive ability that is conferred by the TM variables. If time permits, repeat by including TM but dropping LU, and then by dropping both LU and TM, to reflect a situation in which no augmented variables are available, just the variables originally common to both surveys. Tasks 2 and 3 are likely to result in a peer-reviewed journal article, documenting the amount of value added by TM variables to the prediction of attitudes – a first-ever analysis to the best of our knowledge.

***Task 4:*** Using the best machine learning function/algorithms calibrated on the donor (GDOT survey) sample in Task 3, *predict attitudes for the recipient (NHTS) sample,* with and without the TM variables. Distributions of the recipient sample's predicted attitudes will be compared to those of the donor sample's observed attitudes; substantial variations will be noted and evaluated in the context of the variations in CV distributions identified in Task 2.

***Task 5:*** *Validate the imputed attitudes by developing parallel travel behavior models on both the donor and recipient samples, without and with attitudes, and comparing the results.* Prospective travel behavior variables include vehicle ownership, transit ridership, and usage of shared mobility services, among others. Conduct the analysis first using the predicted attitudes obtained with the TM variables, and then the predicted attitudes obtained when the TM variables are excluded from the set of CVs. Compare the results to ascertain the value added by the TM variables. We anticipate at least one peer-reviewed journal article arising from Tasks 4 and 5.

***Task 6:*** *Document and disseminate the study methods and findings.* For further details, see Section 9.

## 5. Project Schedule

***Schedule notes:*** This project must be carefully choreographed around the collection and analyses of the NHTS and GDOT survey samples, which is why some tasks overlap much more and extend over a longer period of calendar time than would ordinarily be needed. We expect that some tasks will initially be conducted on relatively raw versions of the data, and scripts will be carefully saved and documented so that they can be quickly redeployed on cleaner versions of the data once those are available.
Specific fixed points are that the GDOT survey deployment will be completed in October, and is under the control of the PI of the proposed project. NHTS data collection is complete, but public release of the data (which is outside our control) is not expected until "early 2018". However, through our GDOT liaison, we expect to have access to the locations of the Georgia respondents to the NHTS soon after the proposed project would begin. Accordingly, assembly and analysis of the LU and TM variables for those respondents (Task 2) can begin promptly.

| Task | Condensed title | Dates | Milestones |
|---|---|---|---|
| **1** | Literature review | Continuous | Review paper |
| **2** | Obtain LU and TM variables | Aug. – Nov. 2017 | Augmented source & target datasets |

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| **3** | Predict attitudinal variables in GDOT survey sample | Nov. 2017 – Feb. 2018 | Internal memo and journal article documen-ting process and results for Tasks 2 and 3 |
| **4** | Predict attitudes for target (NHTS) sample | Feb. – Apr. 2018 | Augmented target dataset |
| **5** | Validate imputed attitudes via travel behavior models | Feb. – June 2018 | Internal memo and journal article documen-ting process and results for Tasks 4 and 5 |
| **6** | Document, disseminate study methods & findings | Oct. 2017 – July 2018 | Papers, presentations, technical briefs |

## 6. Relevance to the Center Theme/Mission

The relevance of the proposed project to the TOMNET mission is patently clear and need not be belabored. The project is exploring specific ways in which attitudes can be imputed into a travel dataset that does not initially possess them, and evaluating the effectiveness of those imputed attitudes at explaining behavior. The success of such methods will allow metropolitan planning organizations (MPOs) to begin including attitudes into their regional travel demand forecasting models.

## 7. Anticipated Outcomes and Deliverables

In terms of ***research outcomes/benefits*** of this study, it will expand our still quite limited knowledge about the application of machine learning methods to the imputation of attitudinal data. In particular, it will provide important information about whether readily and economically available targeted marketing data are helpful in predicting various attitudes of interest to travel behavior studies. The findings of this study could potentially be applicable well beyond travel be-havior, extending to the general challenge of imputing attitude-oriented data into large-scale databases focusing on a variety of behaviors such as time use, physical activity, energy consumption, and monetary expenditures.

With respect to ***transportation planning and practice, the outcomes/benefits*** include taking us another step closer to making it practical to incorporate attitudinal information into regional travel demand models. The value of doing so was stressed in Section 1 of this proposal. Finally, ***tangible outcomes/deliverables*** include at least three papers (as described in Sections 4 and 5), a similar number of conference or seminar presentations, and the Georgia subsample of the NHTS dataset augmented with LU and TM common variables collected and purchased by the project, together with the imputed attitudes created by the project.

## 8. Research Team and Management Plan

The research team assembled for this project is not only well-qualified to conduct it, but has extensively and harmoniously worked together in the past, on projects involving many of the same skills as the proposed study. Principal Investigator (co-PI) ***Patricia Mokhtarian*** is an internationally-known travel behavior scholar, who has specialized in measuring and modeling attitudes and incorporating them into models of travel-related behaviors. She will be responsible for the overall direction of the project, and will be directly engaged with its ongoing progress. Co-PI ***Kari Watkins*** is a rising star in travel behavior research, specializing in transit planning and operations, traveler information, mode choice, and complete streets design. She will coordinate the collection and analysis of the targeted marketing data, and be heavily involved with the validation modeling. She will also facilitate engagement with MPO staff. Co-PI ***Giovanni Circella*** is a seasoned, thoughtful, and rigorous travel behavior scholar; he will provide substantive input and coordination at all stages of the project. One-page CVs for these project leaders appear after the budget.

The project is budgeted to include ***two graduate students*** and ***an undergraduate student*** (or two undergraduate students for shorter periods). The graduate students will be responsible for the day-to-day

execution of substantive project tasks, while the undergraduate student(s) will assist with more routine tasks such as literature assembly, graphics preparation, and analysis of des-criptive statistics. More advanced tasks will be assigned commensurate with student aptitude and availability, and project needs. In addition, a ***PhD candidate who is funded by a National Science Foundation fellowship*** will be part of the team at no cost to the project, thereby leveraging project funds to offer a whole that will be greater than the (budgeted) sum of its parts.

The project team will meet weekly for in-depth reports on progress and tactical planning. All members are local, so communication will be straightforward, of course supplemented by e-mail during inevitable absences. A project website will be set up at Georgia Tech as a working repository for literature, presentations prepared by the project, data, and analyses. Milestone products, including papers, presentations, reports, and data, will be provided to the central TOMNET site.

## 9. Technology Transfer Plan

The project management team has a proven track record of scholarly productivity and research dissemination. In July 2018, just before the project concludes, we will prepare at least one, but possibly two papers to be submitted for presentation at the Annual Meeting of the Transportation Research Board in January 2019 and submitted to *Transportation Research Record*. Other journal publications will be sought and conferences that do not conflict with our ability to publish in these journals will be used to disseminate the results. Based on past history, we expect multiple opportunities to present project findings throughout the life of the study and beyond, and we will seek out and volunteer for such opportunities as appropriate.

In addition, to disseminate the work among practitioners, we will present the study at one of the national MPO conferences, one or more meetings of MPOs in Georgia, and in other locations as opportunities are made available. Finally, the project team will seek out an opportunity to do a webinar regarding the research results to disseminate to practitioners who may be unable to travel to conferences at which we present the work.

## 10.Workforce Development and Outreach Plan

Regarding the future of our workforce, the proposed project (two of whose leaders are women) will contribute heavily to the professional development of at least three graduate students and an undergraduate. At least two of these will be women. The PIs have a particular passion for the careful mentoring of female graduate students, including with respect to career-life balance, a major reason why female PhD students do not choose academia (Mason, et al. 2009). Research has shown that mentoring and positive role models can make a big difference in the attraction of women to STEM fields (Hill et al. 2010).

Regarding the development of the current workforce, as described in Section 9, we will present the work at meetings of MPOs in Georgia. These presentations will include introductory material about attitudinal variables and their importance in understanding travel behavior, as a means of educating beyond these latest research results.

## 11.References


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Hill, C., Corbett, C., & St. Rose, A. (2010). Why So Few? Women in Science, Technology Engineering and Mathematics. American Association of University Women. http://www.aauw.org/files/2013/02/Why-So-Few-Women-in-Science-Technology-Engineering-and-Mathematics.pdf.

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Kressner, J.D. & Garrow, L.A. (2012). Lifestyle segmentation variables as pre-dictors of home-based trips for Atlanta, Georgia airport. *Transportation Research Record, 2266*, 20-30.
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Kuppam, A.R., Pendyala, R.M., & Rahman, S. (1999). Analysis of the role of traveler attitudes and perceptions in explaining mode-choice behavior. *Transportation Research Record, 1676*, 68-76.
Malokin, A., Mokhtarian, P.L., & Circella, G. (2017). An Investigation of Methods for Imputing Attitudes from One Sample to Another. Final report prepared under Oak Ridge National Laboratory Subcontract 4000145803, June. School of Civil and Environmental Engineering, Georgia Institute of Technology.
Mason, M.A., Goulden, M., & Frasch, K. (2009). Why graduate students reject the fast track. *Academe, 95*(1), 11-16.
Mokhtarian, P.L. & Salomon, I.. (1997). Modeling the desire to telecommute: The im-portance of attitudinal factors in behavioral models. *Transportation Research A, 31*(1), 35-50.
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van der Putten, P., Kok, J.N., & Gupta, A. (2002) Data fusion through statistical matching. Paper 185, ebusiness.mit.edu, Sloan School of Management, Massachusetts Institute of Technology, January.

## 12.Qualifications of Investigators

**PATRICIA L. MOKHTARIAN, PhD**
**Susan G and Christopher D Pappas Professor**, School of Civil & Environmental Engineering Georgia Institute of Technology, Atlanta, GA 30332-0355 Email: patmokh@gatech.edu

**Education**
PhD, Industrial Engineering/Management Sciences, Northwestern University, 1981
MS, Industrial Engineering/Management Sciences, Northwestern University, 1977
BA (summa cum laude), Mathematics, Florida State University, 1975

**Employment and Professional Experience (last 25 years)**
Susan G and Christopher D Pappas Professor (2016-present) / Professor (2013-2016), School of Civil & Environmental Engineering, Georgia Institute of Technology
Full (1999-2013)/Associate (1996-1999)/Assistant (1990-1996) Professor, Department of Civil & Environmental Engineering, University of California, Davis
Chair and Graduate Adviser (1997-2013), Interdisciplinary Graduate Group in Transportation Technology and Policy, University of California, Davis

Acting Director (1999-2000) / Associate Director for Education (2001-2013), Institute of Transportation Studies, University of California, Davis

**Fields of Interest and Expertise**

(1) Attitude measurement and survey design; (2) Statistical/econometric analysis of transportation data; (3) Impacts of information/communications technology on travel; (4) Attitudes toward travel;(5) Activities conducted while traveling; (6) Impacts of the built environment on travel behavior

**5 Recent Relevant Publications (not already cited in the proposal)**

1. Lee, Richard J., Ipek N. Sener, Patricia L. Mokhtarian, and Susan L. Handy (2017) Relationships between the online and in-store shopping frequency of Davis, California residents. *Transportation Research A, 100*, 40-52.
2. Garikapati, Venu M., Ram M. Pendyala, Eric A. Morris, Patricia L. Mokhtarian, and Noreen McDonald (2016) Activity patterns, time use, and travel of millennials: A generation in transition? *Transport Reviews, 36*(5), 558-584.
3. Mokhtarian, Patricia L. and David van Herick (2016) Quantifying residential self-selection effects: A review of methods and findings from applications of propensity score and sample selection approaches. *Journal of Transport and Land Use, 9*(1), 7-26.
4. Mishra, Gouri Shankar, Regina Ruby Lee Clewlow, Patricia L. Mokhtarian, and Keith F. Widaman (2015) The effect of carsharing on vehicle holdings and travel behavior: A propensity score and causal mediation analysis of the San Francisco Bay Area. *Research in Transportation Economics (Special Issue on Sustainable Transportation), 52*, 46-55.
5. Mokhtarian, Patricia L., Francis Papon, Matthieu Goulard, and Marco Diana (2015) What makes travel pleasant and/or tiring? An investigation based on the French National Travel Survey. *Transportation, 42*(6), 1103-1128.

**Graduate Student Supervision/Advising**

**Graduated:** 10 PhDs (including 2 women), 23 MSs (6); **Current Supervision:** 4 PhDs (1)

**Recent Honors and Awards**

Invited speaker, endowed or distinguished/eminent lecture series, 5 occasions (2013-2016) Invited keynote speaker at 5 international conferences (2014-2017)
Sustained Research Award, School of Civil and Environ. Engineering, Georgia Tech (2015)

**KARI EDISON WATKINS, PH.D., P.E.**

**Frederick Law Olmsted Associate Professor**, Civil and Environmental Engineering Georgia Institute of Technology, Atlanta, GA 30332-0355, kari.watkins@ce.gatech.edu

**Education**

Ph.D., Civil and Environmental Engineering, University of Washington, 2011
M.S., Civil and Environmental Engineering, University of Connecticut, 2003.
B.C.E., Civil and Environmental Engineering, Georgia Institute of Technology, 1997

**Employment and Professional Experience (last 25 years)**

Georgia Institute of Technology, Atlanta, GA
Associate Professor, Civil & Environmental Engineering, Georgia Tech, 2017-present Frederick Law Olmsted Junior Professor, Civil & Environmental Engineering, 2016-present Assistant Professor, Civil & Environmental Engineering, Georgia Tech, 2011-2017
Research Assistant, Civil & Environmental Engineering, University of Washington, 2007-2011 Senior Transportation Engineer, Wilbur Smith Associates, 1998-2007

**Fields of Interest and Expertise**

(1) Transportation planning; (2) Transit planning and operations; (3) Traveler information; (4) Mode choice decision making; (5) Complete streets design

**5 Recent Relevant Publications**

1. Brakewood, C. and K. Watkins, "A Method for Conducting Before-After Analyses of Transit Use by Linking Smart Card Data and Survey Responses" in Public Transport Planning with Smart Card Data, edited by F. Kurauchi and J. Schmocker, CRC Press, 2016
2. Kressner, J., M. Carragher, and K. Watkins "A Household-Level Comparison of Targeted Marketing Data and Self-Reported Survey Data" Transportation Research Board 2014 Annual Meeting.
3. Watkins, K., B. Ferris, A. Borning, G.S. Rutherford and D. Layton. "Where Is My Bus?Impact of mobile real-time information on the perceived and actual wait time of transit riders." Transportation Research Part A, 45(8), pp.839-848, 2011.
4. Brakewood, C., G. Macfarlane and K. Watkins, "The Impact of Real-time Information on Bus Ridership in New York City", Transportation Research Part C, 53, pp.59-75, 2015.
5. Berrebi, S., K. Watkins, and J. Laval, "A Real-Time Bus Dispatching Policy to Minimize Headway Variance", Transportation Research Part B, Vol 81, pp. 377-389, 2015.

**Graduate Student Supervision/Advising**

**Graduated:** 3 PhDs (includes 2 women), 24 Masters; **Current Supervision:** 3 PhDs

**Recent Honors and Awards**

Council of University Transportation Centers New Faculty Award (2017) and Wootan Award for Best Dissertation in Transportation Policy and Planning (2012)
Three time National Academy of Engineers Frontiers of Engineering invitee: Attendee at Indo-American (2012); Speaker at Euro-American (2013); Co-Chair at Japan-America (2016) Top 40 under 40, Mass Transit Magazine (2013)

## GIOVANNI CIRCELLA, PhD

**Senior Research Engineer,** Civil and Environmental Engineering
Georgia Institute of Technology, Atlanta, GA 30332-0355 Email: gcircella@gatech.edu

**Education**

Ph.D., Infrastructure Engineering and Transportation Planning, Politecnico di Bari, Jul 2008. M.Sc., Agricultural and Resource Economics, University of California, Davis, Sep 2009.
M.Sc. + B. Sc. (Italian Laurea, summa cum laude), Civil Engineering (Transportation), Politecnico di Bari, Apr 2004.

**Employment and Professional Experience (last 25 years)**

Senior Research Engineer, School of Civil and Environmental Engineering, Georgia Institute of Technology, Nov 2016 – present (75% appointment).
Assistant Professional Researcher, Institute of Transportation Studies, University of California, Davis, Oct 2015 – present (25% appointment).
Research Engineer, School of Civil and Environmental Engineering, Georgia Institute of Technology, Nov 2013 – Nov 2016 (75% appointment).
Post-Doc Researcher, Institute of Transportation Studies, UC Davis, Oct 2009 – Sep 2015.

**Fields of Interest and Expertise**

(1) Personal attitudes and travel behavior analysis; (2) Discrete choice modeling; (3) Travel survey methods and data collection; (4) Transportation planning; (5) Transportation demand modeling and

forecasting; (6) Statistical analysis of transportation data; (7) Sustainability and energy; (8) Shared mobility; (9) Information communication technologies and transportation

**5 Recent Relevant Publications**

1. Dong, Z., P. L. Mokhtarian, **G. Circella** and J. Allison (2015) "Estimation of Changes in Rail Ridership Through an Onboard Survey: Did Free Wi-Fi Make a Difference to Amtrak's Capitol Corridor Service?", Transportation, 42 (1), 123-142.
2. Guzman, L. A., D. De La Hoz and **G. Circella** (2015), "Evaluation of Synergies from Transportation Policy Packages Using a Social Welfare Maximization Approach: a Case Study for Madrid, Spain", Case Studies on Transport Policy, 3 (1), 99–110.
3. McFadden, A. J., **G. Circella**, B. Haydu and N. J. Linesch (2014) "Impact of Proposed Land Use and Transportation Investments on Future Travel Patterns in California", Transportation Research Record, Journal of the Transportation Research Board, 2430, 207-215.
4. **Circella G.,** P. L. Mokhtarian and L. K. Poff (2012) "A Conceptual Typology of Multitasking Behavior and Polychronicity Preferences", electronic International Journal of Time Use Research, 9 (1), 59-107.
5. Ye, L., P. L. Mokhtarian and **G. Circella** (2012) "Commuter Impacts and Behavior Changes during a Temporary Freeway Closure: The Fix I-5 Project in Sacramento, California", Transportation Planning and Technology, 35 (3), 341 – 371.

**Graduate Student Supervision/Advising**

**Graduated:** 1 MS; **Current Supervision:** 5 PhDs (including 2 women)

**Honors and Awards**

Keynote Speaker, Trailways 80th Annual Meeting and Conference, Fort Myers, FL, Feb 2016. Fulbright Fellowship, University of California, Davis, 2006-2007.
Erasmus Scholarship, Universidad Politecnica de Valencia, Spain, 2013.
Research Award, City of Bari, Italy, for the Best Research Thesis, 2006.

## 13.Budget Including Non-Federal Matching Funds

[Provide itemized budget showing federal and non-federal matching funds. Please use the tabular format shown below. Projects should be of one-year duration. Multi-year projects should be proposed each year as a separate phase.]

**Institution:**

**Project Title:**

**Principal Investigator:**

**Budget Period: 8/1/20XX - 07/31/20YY**

| CATEGORY | Budgeted Amount from Federal Share | Budgeted Amount from Matching Funds | Explanatory Notes; Identify Source of Matching Funds |
|---|---|---|---|
| Faculty Salaries | $21,174 | $27,965 | Regular salary |
| Other Staff Salaries | $42,500 | $12,500 | GDOT-funded project: GSTDM |

| | | | |
|---|---|---|---|
| Student Salaries | $53,000 | $24,000 | GDOT-funded project: Emerging technologies & trends |
| Fringe Benefits | $20,594 | $12,782 | Regular salary fringe + the two GDOT projects above |
| **Total Salaries & Benefits** | $137,268 | $77,247 | |
| Student Tuition Remission | $35,736 | $17,868 | GDOT-funded project: Emerging technologies & trends |
| Operating Services and Supplies | $4,000 | $2,905 | GDOT-funded project: Emerging technologies & trends;<br>Mokhtarian start-up funds;<br>Mokhtarian Pappas Chair funds |
| Domestic Travel | $3,500 | $2,500 | Mokhtarian start-up & Pappas Chair funds |
| Other Direct Costs (specify) | | | |
| Other Direct Costs (specify) | | | |
| **Total Direct Costs** | $180,504 | $100,520 | |
| F&A (Indirect) Costs | $83,676 | $31,574 | same as above |
| **TOTAL COSTS** | $264,180 | $132,094 | $396,274 |

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

| **UTC Project Information** | |
|---|---|
| Project Title | An Investigation of the Contribution of Targeted Marketing Data to the Prediction of Attitudes |
| University | Georgia Institute of Technology |
| Principal Investigator | Patricia L. Mokhtarian |
| PI Contact Information | patmokh@gatech.edu, 404-385-1443 |
| Funding Source(s) and Amounts Provided (by each agency or organization) | TOMNET, $264,180<br>Georgia Tech and GDOT, $132,094 |
| Total Project Cost | $396,274 |
| Agency ID or Contract Number | |
| Start and End Dates | Aug. 1, 2017 - July 31, 2018 |

| | |
|---|---|
| Brief Description of Research Project | Use machine learning methods to impute attitudes into the Georgia subsample of the 2016-17 National Household Travel Survey, training the methods on the responses to a 2017 attitudinal survey administered to a separate statewide sample in Georgia. The "common variables" needed to train the learning function will include socio-economic/ demographic and other variables found in both samples, but will be augmented by (1) land use-related variables (obtained from multiple external sources) associated with respondents' residential neighbor-hoods, and (2) (for the first time) lifestyle-oriented targeted marketing variables associated with the household/respondent that are purchased from a commercial provider. The project will evaluate the effective-ness of targeted marketing variables for this purpose. |
| Describe Implementation of Research Outcomes (or why not implemented)<br><br>Place Any Photos Here | TBD |
| Impacts/Benefits of Implementation (actual, not anticipated) | TBD |
| Web Links<br>• Reports<br>• Project Website | TBD |