PROJECT PROPOSAL

Title: Investigation of the Role of Attitudinal Factors on Adoption of Emerging Automated Vehicle and Vehicle Safety Technologies

Principal Investigator: Fred Mannering, Professor and Associate Dean, Department of Civil & Environmental Engineering, University of South Florida

Co-Principal Investigator: Abdul R. Pinjari, Associate Professor, Department of Civil & Environmental Engineering, University of South Florida

Co-Principal Investigator: Michael Maness, Postdoctoral Research Associate, Department of Civil & Environmental Engineering, University of South Florida

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1. Introduction/Problem Statement

Emerging automotive and transportation technologies have created revolutionary possibilities in the way we might travel and drive in the future. These technologies include: (1) advanced vehicle safety technologies that are aimed at keeping the vehicle occupants safe while riding, such as collision warning systems and lane departure warning systems, and (2) automated vehicles that can drive by themselves with little to no need for a human driver. Among these, several vehicle safety technologies are already available in the market and are touted to reduce collision risks and increase highway safety. The National Highway Traffic Safety Administration (NHTSA) has mandated several vehicle safety technologies to be available on all new cars to be manufactured in the near future. Likewise, technology giants, car manufacturers, and ridesharing companies have announced aggressive schedules to make automated vehicles available for the market and several U.S. states and cities have passed laws permitting the testing of automated vehicles.

There is considerable interest among transportation planners in forecasting the ownership, market penetration, and travel behavior impacts of automated vehicles. Similarly, transportation engineers are interested in predicting the safety and driving behavior impacts of vehicle safety technologies. From a transportation systems planning standpoint, it is important to forecast potential future scenarios with automated vehicles, including the market penetration of these technologies, the different forms of ownership and usage (such as owning automated vehicles for personal use versus using automated vehicles as a shared mobility service), and the impact of these technologies on travel demand.

Despite the rapid evolution of automated-vehicle technology and the interest among transportation planning agencies in forecasting the future of transport systems with automated vehicles, there is considerable uncertainty in the consumer perception and adoption patterns of these technologies. The uncertainty is partly due to a limited understanding of consumers' attitudes (or opinions or perceptions[1]) toward the potential benefits and concerns of automated vehicles. Additionally, there is also limited understanding of how these perceptions change over time as automated-vehicle technology becomes more prevalent and individuals learn more about the technology from others. Currently, there is much speculation about potential benefits and concerns of these technologies. Some speculate that

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[1] In this proposal, we use the terms "attitudes", "opinions" and "perceptions" interchangeably in the context of people's opinions about the potential benefits and concerns of automated-vehicle technologies.

benefits, such as the potential for reduction in traffic crashes, reduction in traffic congestion, and improvement in mobility for otherwise less mobile population (elderly, physically disabled, and children) outweigh potential concerns. On the other hand, some are concerned about issues such as poor performance of automated vehicles in inclement weather, potential for system failures and hacking, insurance liability issues, and unwillingness to give up control over the steering wheel.

A first step toward a thorough understanding of consumers' attitudes and their influence on consumer preferences for automated vehicles is the collection of relevant data. Most previous survey efforts and studies (e.g., Kyriakidis et al. 2015) on public opinions regarding automated vehicles focus on simplistic descriptive analyses (such as bivariate correlations) on the relationship between consumers' sociodemographic characteristics and their attitudes toward automated vehicles (see Menon et al., 2016 for a review). Such analyses do not offer deeper insights on the distinct market segments consumers might belong to in the context of their attitudes toward automated vehicles. Besides, barring a few exceptions (Lavieri et al., 2017), most studies utilize simplistic modeling methods for analyzing the influence of attitudes and sociodemographic factors on consumers' likelihood of adopting automated vehicles, the forms of automated-vehicle ownership/usage consumers prefer, and the types of advanced safety technologies they prefer. There is a need for advanced consumer choice modeling methods that can provide insights into the influence of both sociodemographic factors and attitudinal factors on consumers' preference for automated vehicles, while also recognizing that sociodemographic differences might exist in consumers' attitudes toward automated vehicles. There is also a need to understand how these perceptions are impacted by social factors involving social learning and social influence processes.

Finally, in addition to the development of advanced choice modeling methods, it is necessary to examine the practical benefits of incorporating attitudinal variables in models of automated-vehicle adoption and usage. Specifically, it is fruitful to examine the extent to which including attitudinal factors can help improve spatial transferability of automated-vehicle adoption models. Spatial transferability of automated-vehicle adoption models is of considerable interest because the assessment of a model's performance in different spatial contexts can provide insight into the models' forecast accuracy (Sikder et al., 2013). Therefore, establishing that automated-vehicle adoption models with attitudinal factors are more transferable than those without attitudinal factors can highlight the importance of incorporating attitudinal factors for modeling and analysis of automated-vehicle adoption.

2. Project Objectives

In view of the above background, the overarching goals of this project are to:

1. Collect new data as well as utilize existing data to understand consumers' attitudes toward the potential benefits and concerns on automated vehicles and their likelihood of adopting automated vehicles as well as the impacts of social networks on shifting consumers' attitudes and perceptions.
2. Investigate the role of consumers' attitudes toward the potential benefits and concerns of the automated vehicle (automated-vehicle) technology on their intended adoption of the technologies when they become available. In doing so, the specific objectives are to:
    a. Assess the influence of perception variables vis-à-vis the role of sociodemographic variables on consumers' intended adoption of automated-vehicle technology.
    b. Identify distinct market segments based on consumer perceptions toward potential benefits and concerns of automated-vehicle technology and understand the differences in automated-vehicle adoption behavior of these market segments.
    c. Develop advanced modeling methods, such as the integrated choice and latent variable (ICLV) models, that enable the examination of the role of consumers' perceptions on their intended adoption of automated-vehicle technology. Specifically, develop modeling methods that recognize and address: (1) the multidimensional nature of attitudinal variables (as opposed to the typically used approach of treating attitudinal variables as unidimensional, ordered response variables), and (2) statistical issues such as endogeneity

bias in the assessment of the role of attitudinal variables on automated-vehicle adoption behavior.

3. Examine the practical benefits of incorporating attitudinal variables in models of automated-vehicle adoption behavior by assessing the spatial transferability of automated-vehicle adoption models with attitudinal variables vis-à-vis automated-vehicle adoption models without attitudinal variables.

4. Examine the literature on the general relationship between attitudes and behavior (including literature from psychology, cognitive science, neuroscience, and economics), and review the role that changing attitudes (and other factors) may have on the temporal stability of estimated model parameters. Write and publish a paper on this topic.

5. Explore the role that unobserved heterogeneity plays when attitudes are considered in estimated models. Write a discussion paper on this topic to help guide future TOMNET research.

3. Proposed Methodology and Data

To address some of the analysis objectives, this project will utilize recently collected survey data on consumers' perceptions, intended adoption, and anticipated travel behavior impacts of automated-vehicle technologies. The survey was conducted in 2015 for two different target populations: (1) the students, faculty, and staff of a large university (University of South Florida), and (2) the membership of the AAA foundation for traffic safety in the Unites States. The research team possesses data of about 3000 individuals from these target populations. This survey was broken up into three parts including: (1) respondent and household characteristics, (2) perceptions of advanced safety features and autonomous vehicles, and (3) anticipated impacts of autonomous vehicles (Menon et al., 2016). This simultaneous collection of perceptions and anticipated impacts allows for the estimation of models that can link demographics and perceptions in models of travel choice. Hybrid choice models – and integrated latent variable and choice models, in particular – are growing as a prominent tool for this type of analysis. We propose to use such a model (or a similar one) to aid in analyzing causal relationships between perceptions and behavior.

The dataset provides Likert scale measurements of respondents' familiarity and level of comfort with automated-vehicle technology as well as their perceived benefits and expectations for the technology. But these measurements relate to constructs that are not easily measured, such as tech-savviness and environmentally friendliness, thus our model must relate these measurements as "indicators" of these constructs.

In addition to the above data, the USF research team will collaborate with the TOMNET team members from Arizona State University (ASU) and Georgia Tech on developing a new survey questionnaire and administering it for the general population of the Tampa Bay Region.

4. Work Plan (Project Tasks)

The objectives of the project will be achieved in the following three major tasks:

(1) Analysis of the existing survey data on attitudes toward automated vehicles,

(2) Review/position papers on 1) potential temporal instability of model estimates and the role that attitudes may play in this and 2) the role of unobserved heterogeneity in estimating models with attitudinal variables., and

(3) Collection and preliminary analysis of new data to understand the influence of social learning on automated vehicle perceptions.

Task 1: Analysis of existing (USF) survey data on attitudes toward automated vehicles

As discussed earlier, the research team has already collected data on perceptions, intended adoption, and anticipated travel behavior impacts of automated vehicle technologies from the students, faculty, and staff of USF and the members of the AAA foundation for traffic safety. This data will be analyzed to understand the individuals' attitudes toward the potential benefits and concerns of the automated vehicle

technology on their intended adoption of the technologies when they become available. Specifically, the following subtasks will be undertaken:

1.1 *Descriptive analysis of USF survey data*: A through descriptive analysis of the survey responses will be undertaken to analyze respondents' demographic characteristics, their perceptions about automated vehicles, their intended adoption of automated vehicles, and their anticipated changes in travel behavior in the presence of automated vehicles.

1.2 *Identification of consumer market segments in perceptions toward automated vehicles*: A cluster analysis will be conducted to identify distinct market segments (if any) based on consumer perceptions toward potential benefits and concerns of automated vehicle technology. Such analysis will be useful later in the development econometric models for understanding the influence of perceptions on automated vehicle adoption.

1.3 *Develop and implement models of automated vehicle adoption that incorporate attitudinal variables*: Advanced choice models, such as integrated choice and latent variable (ICLV) models will be developed to examine the role of consumers' perceptions on their intended adoption of automated-vehicle technology. In doing so, modeling methods will be developed to recognize and address: (1) the multidimensional nature of attitudinal variables (as opposed to the typically used approach of treating attitudinal variables as unidimensional, ordered response variables), and (2) statistical issues such as endogeneity bias in the assessment of the role of attitudinal variables on automated-vehicle adoption behavior.

1.4 *Analyze transferability of behavioral models with attitudinal variables*: An empirical assessment will be conducted to assess the transferability of automated vehicle adoption models with and without attitudinal variables to understand the practical benefits of incorporating attitudinal variables in travel behavior models. Based on data availability, the transferability assessments will be either between geographic contexts (i.e., spatial transferability) or between demographic contexts (i.e., between university population and non-university population).

Task 2: Review/position papers on the temporal instability of model estimates, unobserved heterogeneity, and attitudes.
An abundance of research in transportation safety and travel behavior has provided empirical evidence that estimated model parameters may vary over time. Attitudes may provide insights as to why this may be the case, and can be potentially used to track temporal shifts. However, from an estimation perspective, unobserved heterogeneity and how it is handled could also influence the apparent effect of attitudes and their effect over time. Two sub-task review/position papers will be undertaken to provide a benchmark for future TOMNET work:

2.1 Review/position paper on relationship between attitudes and behavior: Undertake a review/position paper that examines the literature on the general relationship between attitudes and behavior (including literature from psychology, cognitive science, neuroscience, and economics), and review the role that changing attitudes (and other factors) may have on the temporal stability of estimated model parameters.

2.2 Review/position paper on the role of unobserved heterogeneity in estimating influence of attitudinal variables: Undertake a review/position paper that examines methods of handling unobserved heterogeneity and the effect that attitudinal variables may have on model estimation results. Provide empirical evidence using model estimation from existing databases.

Task 3: Data collection on social learning processes in automated vehicle attitudes

In the new data collection effort to understand the impacts of social networks on automated-vehicle perceptions, the work tasks will focus on survey design and administration. Specifically, the following subtasks will be undertaken:

3.1 *Design of survey and sampling plan*: In this task, the project team will first identify the research questions of interest and behavioral, attitudinal, and social variables that are needed to address the research questions and inform behavioral model specifications. The survey instrument and sampling plan will be designed so that the data needs are met. An analysis of respondent's response habits and metadata from the former automated-vehicle survey will be performed. From this effort, recommendations for improving question quality and reducing respondent burden and questionnaire length will be determined. The survey design and sampling plan will be harmonized across projects being undertaken by other TOMNET members to ensure that data and findings can be compared across regions.

3.2 *Survey pretest and revision*: The survey will go through a period of refinement using tools from cognitive interviewing and trial tests. This will primarily be performed with university employees and students. This process will result in a revised survey questionnaire that will be ready for the main data collection task.

3.3 *Survey administration and data collection*: This task involves the administration of the survey questionnaire to travelers in the Tampa Bay metro area. A survey vendor will be selected to perform the recruitment of respondents. The vendor may also be responsible for hosting the survey server. Respondents will be recruited and collection of survey responses will occur. An early short trial will be performed to ensure the survey is being displayed and administered as expected.

3.4 *Data compilation and documentation*: After completion of the data collection effort, the team will compile the electronic databases and thoroughly document the data. Data validity will be checked and documented. A detailed data dictionary and description of the data collection methodology will be prepared to support permanent data archival.

5. Project Schedule

The proposed project schedule is shown in the table below. It is expected that milestones will be accomplished after each subtask (at the end of that subtask's final month). These are denoted in parentheses below the task labels.

Subtasks	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
1.1 Descriptive analysis of USF survey data (Technical report draft chapter completed)	▨	▨										
1.2 Identification of consumer market segments (Technical report draft chapter completed)				▨	▨							
1.3 Develop and implement models with attitudes (Working paper on methods & case study completed)						▨	▨	▨	▨	▨		
1.4 Analyze transferability of models with attitudes (Working paper on transferability completed)											▨	▨
2.1 Attitudes, behavior and temporal instability (Literature review completed)	▨	▨	▨	▨	▨	▨	▨					
2.2 Modelling unobserved heterogeniety and attitudes (Discussion paper completed)	▨	▨	▨	▨	▨	▨	▨					
3.1 Design of survey and sampling plan (Sampling plan completed)	▨	▨	▨	▨	▨							
3.2 Survey pretest and revision			▨	▨	▨							

(Final survey instrument ready)				▨	▨	▨	▨							
3.3 Survey administration and data collection (Survey dataset collected)								▨	▨	▨				
3.4 Data compilation and documentation (Final datasets ready and technical report completed)												▨	▨	▨

6. Relevance to the Center Theme/Mission

This project's application area in autonomous vehicles and vehicle safety features directly addresses FAST Act Research Priorities in (1) improving mobility of people and goods, (2) reducing congestions, and (3) promoting safety. This project will contribute to TOMNET's mission to address barriers related to inclusion of attitudes in travel models. This will be done through data collection and analysis of attitudinal data. Additionally, the project seeks to develop code to estimate models with attitudinal data as well as to produce research addressing whether collecting attitudinal data can improve model transferability. In collecting new data on social networks for social learning, this project will attempt to develop data collection procedures to understand and forecast changes in perceptions and attitudes. Addressing social effects in attitude formation will contribute to TOMNET's other mission to address barriers related to forecasting attitudes similarly to socioeconomics.

7. Anticipated Outcomes and Deliverables

The proposed project will result in the review and development of modeling methods that incorporate information about people's attitudes and perceptions with socioeconomic data and unobserved heterogeneity. These modeling efforts will provide researchers and practitioners with documents to help familiarize them with the incorporation of attitudes and perceptions. The models developed and their accompanying software will be available for use by the public to help disseminate these methods into the larger transportation modeling community. Additionally, the project will collect data that will enable future analysis and development of models to forecast changes in perceptions due to social learning and social influence processes. The data collection effort will aid in providing guidance on how respondents are handling the task of relaying perceptions and travel choices. This will be important in understanding possible sources of survey error related to biases due to question structure and question ordering. This will be important for improving the efficiency and accuracy of TOMNET's year 3 collective survey effort.

The project will result in the following deliverables:
1. Two working papers prepared for future submission to peer-reviewed journals
2. A technical report detailing the autonomous vehicle data collection analysis
3. A discussion paper on the role that unobserved heterogeneity plays when attitudes are considered in travel behavior models
4. Publicly available versions of autonomous vehicle perceptions datasets
5. Publicly available software to estimate choice model incorporating perceptions data

8. Research Team and Management Plan

Fred Mannering is currently the Associate Dean for Research in the College of Engineering and a Professor of Civil and Environmental Engineering (with a courtesy appointment in Economics) at the University of South Florida. His research interests are in the application of econometric and statistical methods to a variety of engineering problems, highway safety, transportation economics, automobile demand, and travel behavior. He has published extensively in these fields with over 130 journal articles and has coauthored two books: Principles of Highway Engineering and Traffic Analysis and Statistical and Econometric Methods for Transportation Data Analysis. He is also Editor-in-Chief of the journal Analytic Methods in Accident Research and previous Editor-in-Chief (2003-2012) and current Associate Editor for Transportation Research Part B.

Abdul Pinjari is an Associate Professor in the Department of Civil and Environmental Engineering at the University of South Florida (USF). He is an expert in both the development of advanced statistical/econometric methods for modeling travel behavior as well as the implementation of modeling methods in large-scale travel forecasting models. Dr. Pinjari has made significant contributions to the state of the art in econometric choice modeling and statistical modeling of disparate transportation data sources, several of which have now made way into regional transportation modeling practice. More recently, he is involved in the development of statistical methods to incorporate the influence of attitudinal factors into such models. He has published numerous articles in top transportation journals and written book chapters on travel demand modeling and advanced choice modeling. Pinjari is a member of Transportation Research Board (TRB) committee on Travel Demand Forecasting and co-chair of the TRB subcommittee on Integrated Transport Modeling. He serves in the editorial boards of Transportation Research Part B, Transportation, Journal of Choice Modelling, and Transportation in Developing Economies.

Michael Maness is a Postdoctoral Research Associate in the Department of Civil and Environmental Engineering at the University of South Florida. His research interests are in the methodology and application of behavioral modeling in urban and regional systems. His dissertation, which was awarded the 2015 Eric Pas Dissertation Prize, involved incorporating social interactions into activity and travel behavior models. Maness is experienced in advanced choice models with applications to car ownership, electric vehicles, managed lanes, cycling, activity behavior, and communication behavior. His professional experience has included a postdoc at Oak Ridge National Laboratory and a graduate research fellowship at Turner-Fairbank Highway Research Center. He has published articles in top transportation journals including Transportation Research Part B, Transportation Research Part A, and Journal of Transport Geography.

The team will be led by Fred Mannering. Primary research responsibilities for (1) analyzing existing data will fall on Abdul Pinjari, (2) understanding the role of unobserved heterogeneity will fall on Fred Mannering, and (3) collection of new data will fall on Michael Maness. The team is expected to have internal communications biweekly and communication with the greater TOMNET team monthly. The PI and Co-PIs will supervise the student researchers with the student directly reporting to them weekly.

9. Technology Transfer Plan

The technology transfer component of the project involves: (1) dissemination of project findings and outcomes in the form of conference presentations (such as the Transportation Research Board Annual Meeting) and peer-reviewed journal publications, presentation at a weekly seminar series that attracts a number of students, faculty, and practitioners at the University of South Florida, and a webinar that will be announced out to a large number of students, researchers, and practitioners outside University of South Florida, and (2) making the model estimation software codes available for public use through TOMNET website.

10. Workforce Development and Outreach Plan

The project will directly provide career development opportunities for a postdoctoral research associate. The research effort will allow the postdoc to expand his technical skills into new areas of discrete choice modeling and transferability analysis. The project will also provide opportunities for the postdoctoral research associate to gain teaching experience as an instructor of record for an undergraduate and graduate course. The postdoctoral scholar is expected to gain experience in managing a research project and supervising and mentoring of student researchers.

The project will include an educational component where data and information from the project will be provided to students to aid in their development. One of the co-PIs will teach a graduate-level course on travel demand modeling. The course will likely include homework assignments and a project component involving the analysis of travel behavior data. The past data collection effort on automated vehicles will be used in these efforts to expose students to real-world travel data. Additionally, the class will have a

component on data collection in travel demand modeling. Students will be exposed to the process that respondents partake of in providing travel data. This will allow for partial testing of the new survey instrument that will provide debugging assistance and valuable feedback on question wording, respondent burden, and survey layout.

11. References

Kyriakidis, M., R. Happee, and J.C.F. De Winter. Public Opinion on Automated Driving: Results of an International Questionnaire among 5000 Respondents. *Transportation Research Part F*, Vol. 32, 2015, pp. 127-140.

Lavieri, P., V.M. Garikapati, C.R. Bhat, R.M. Pendyala, S. Astroza, and F. Dias (2017). Modeling Individual Preferences for Ownership and Sharing of Autonomous Vehicle Technologies. Forthcoming, *Transportation Research Record.*

Menon, N, A.R. Pinjari, Y. Zhang, and L. Zhou (2016). Consumer Perception and Intended Adoption of Autonomous-Vehicle Technology: Findings from a University Population Survey. Presented at the Transportation Research Board's 95th Annual Meeting, Washington D.C.

Sikder, S., A.R. Pinjari, S. Srinivasan, and R. Nowrouzian (2013). Spatial Transferability of Travel Forecasting Models: A Review and Synthesis. *International Journal of Advances in Engineering and Applied Mathematics,* Vol. 5(2-3), pp. 104-128.

12. Qualifications of Investigators

FRED L. MANNERING
Professor of Civil and Environmental Engineering
University of South Florida, 4202 E Fowler Avenue, ENC 3506, Tampa, FL 33620

Education

Ph.D.	Massachusetts Institute of Technology	1983
M.S.C.E.	Purdue University	1979
B.S.C.E.(with Distinction)	University of Saskatchewan	1976

Research expertise

Application of advanced statistical and econometric methods to engineering problems, transportation safety analysis, transportation economics, automobile demand, and travel behavior.

Professional History

Professor, Department of Civil Engineering (courtesy appointment, Department of Economics) at the University of South Florida (2015-present). Charles Pankow Professor of Civil Engineering (2009-2015), Professor of Civil Engineering (2001-2009), Head of the School of Civil Engineering (2001-2005) at Purdue University. Assistant, associate, and full professor during 14-year tenure at the University of Washington (1987-2001), Chair of the Department of Civil and Environmental Engineering at Washington (1997-2001). Assistant Professor, Department of Civil Engineering at the Pennsylvania State University (1983-1986).

Publications/Presentations

Published 134 refereed journal articles, 2 text books, 73 other publications (conference proceedings, project reports, book reviews and commentaries), and 103 presentations at professional conferences, 9 keynote speeches and distinguished lectures; and 37 invited talks.

Citations

Published work has been cited over 5,000 times in the *Institute for Scientific Information* databases, over 6,000 times in Scopus, and over 14,000 times in Google Scholar.

Funded Research

Principal investigator on 44 research projects with total funding of over 4 million dollars.

Graduate Student Supervision

Supervised 22 PhD students (14 currently in academic positions) and 44 MS students.

Professional Activities and Awards

Founding Editor and Editor-in-Chief of Elsevier Science's Analytic Methods in Accident Research (2012-present), previously Editor-in-Chief of Elsevier Science's Transportation Research Part B: Methodological (2003-2012). Awards include: inclusion in the Eno Foundation's Top 10 Transportation Thought Leaders in Academia (2016); inducted into Purdue University's "Book of Great Teachers" (2013); Fellow, Purdue University Teaching Academy (2013-2015); Charles B. Murphy Outstanding Undergraduate Teaching Award, Purdue University's highest undergraduate teaching honor (2013); Arthur M. Wellington Prize; American Society of Civil Engineers, for the best paper in the Journal of Transportation Engineering (2010); James Laurie Prize, American Society of Civil Engineers (2009) "For his outstanding contribution to the advancement of transportation engineering through his influential research and publication in the area of highway safety"; Wilbur S. Smith Award, American Society of Civil Engineers (2005) "For outstanding contributions to the enhancement of the role of the civil engineer in highway engineering through excellence in teaching and research"; and the National Highway Safety Award (2001) for "A new method for prioritizing intersection improvements"

ABDUL R. PINJARI

Associate Professor, Department of Civil & Environmental Engineering
University of South Florida (USF), Tampa, FL 33620 Email: apinjari@usf.edu

Education

Ph.D., Civil Engineering (Transportation), University of Texas at Austin, August 2008.
M.S., Civil Engineering (Transportation), University of South Florida, May 2004.
B.Tech., Civil Engineering, Indian Institute of Technology-Madras, June 2002.

Employment and Professional Experience

- Department of Civil & Environmental Engineering, University of South Florida (USF), Tampa
  - ° Associate Professor, Transportation Systems, 2014-Present
  - ° Assistant Professor, Transportation Systems, 2008-2014
  - ° Faculty Affiliate, Center for Urban Transportation Research (CUTR), 2011 – Present
- Center for Transportation Research, University of Texas at Austin, Texas
  - ° Research Fellow, May 2015-August 2015 (sabbatical visit)
- Indian Institute of Science, India
  - ° Visiting Professor, October 2015-April 2016 (sabbatical visit)

Fields of Interest and Expertise

(1) Transportation Planning; (2) Statistical and econometric analysis of transportation data; (3) Choice modeling; (4) Activity-travel behavior analysis; (5) Transportation demand modeling and forecasting; (6) Freight transportation modeling

5 Recent Relevant Publications

1. Enam, A., K. Konduri, A. Pinjari, and N. Eluru (2017). A Hybrid Multiple Discrete Continuous (HMDC) for Examining the Role of Moods on Daily Activity Engagement Choices. In review (minor revisions), *Journal of Choice Modelling*.
2. Pinjari, A.R., B, Augstin, A. Faghih Imani, V. Sivaraman, N. Eluru, and R.M. Pendyala. Stochastic Frontier Estimation of Budgets for Kuhn-Tucker Demand Systems: Application to Activity Time-Use Analysis. *Transportation Research Part A*, Vol. 88, 117-133.
3. Bhat, C.R., A.R. Pinjari, S.K. Dubey, and A. Hamdi (2016). On Accommodating Spatial Interactions in a Generalized Heterogeneous Data Model (GHDM) of Mixed Types of Dependent Variables. *Transportation Research Part B*, Vol. 94, pp. 240-263.
4. Menon, N., A.R. Pinjari, Y. Zhang, and L. Zou (2016). Consumer Perception and Intended Adoption of Autonomous-Vehicle Technology: Findings from a University Population Survey. Proceedings of the 95th Transportation Research Record (TRB) Annual Meeting, Washington D.C., January 2016.
5. Sikder, S., A.R. Pinjari, S. Srinivasan, and R. Nowrouzian (2013). Spatial Transferability of Travel Forecasting Models: A Review and Synthesis. *International Journal of Advances in Engineering and Applied Mathematics,* Vol. 5(2-3), 104-128.

Graduate Student Supervision/Advising

Graduated: 3 PhDs, 11 Masters;   **Current Supervision**: 2 PhDs

Recent Honors and Awards

Honorable mention for the 2008 Eric Pas Dissertation Prize in Travel Behavior Research; given by the International Association of Travel Behavior Research (IATBR).
Invited Expert Speaker at the International Choice Modelling Conference (ICMC) Workshop on Recent Advances in Multiple Discrete-Continuous Choice Modelling, Leeds, UK, July 2011.

MICHAEL MANESS
Postdoctoral Scholar, Department of Civil and Environmental Engineering
University of South Florida (USF), Tampa, FL 33620 Email: mmaness.research@gmail.com

Education

Ph.D.,Civil Engineering, University of Maryland, May 2015.

M.S., Civil Engineering, University of Maryland, December 2010.

B.S., Civil Engineering, University of Maryland, May 2009

B.S., Computer Science, University of Maryland, May 2009

Selected Employment and Professional Experience

Postdoctoral Scholar, Department of Civil and Environmental Engineering, USF, 2017-present.

Postdoctoral Research Associate, Center for Transportation Analysis, Oak Ridge National Laboratory, 2015-2016.

Graduate Research Fellow, Office of Operations Research and Development, Federal Highway Administration, 2013-2014.

Fields of Interest and Expertise

(1) Advanced discrete choice modeling; (2) agent-based modeling of people and freight; (3) The role of social networks and social interactions in decision making; (4) Forecasting emerging technologies in transportation; (5) Data collection and experimentation in transportation

Recent Relevant Publications

1. M. Maness (forthcoming). A Theory of Strong Ties, Weak Ties, and Activity Behavior: Leisure Activity Variety and Frequency. *Transportation Research Record: Journal of the Transportation Research Board*.

2. C. Cirillo, Y. Liu, and M. Maness (2017). A Time-dependent Stated Preference Approach to Measuring Vehicle Type Preferences and Market Elasticity of Conventional and Green Vehicles. *Transportation Research Part A: Policy and Practice*, 100, 294-310.

3. C. Calastri, S. Hess, A. Daly, M. Maness, M. Kowald, and K. Axhausen (2017). Modelling Contact Mode and Frequency of Interactions with Social Network Members Using the Multiple Discrete-continuous Extreme Value Model. *Transportation Research Part C: Emerging Technologies,* 76, 16-34.

4. M. Maness and C. Cirillo (2016). An Indirect Informational Conformity Social Influence Choice Model: Formulation and Case Study. *Transportation Research Part B: Methodological*, 93, 75-101.

5. M. Maness, C. Cirillo, and E. Dugundji (2015). Generalized Behavioral Framework for Choice Models of Social Influence: Behavioral and Data Concerns in Travel Behavior. *Journal of Transport Geograph*y, 46, 137-150.

6. M. Maness and C. Cirillo (2012). Measuring Future Vehicle Preferences: Stated Preference Survey Approach with Dynamic Attributes and Multiyear Time Frame. *Transportation Research Record: Journal of the Transportation Research Board*, 2285, 100-109.

Recent Honors and Awards

Appointed as a Member of the Traveler Behavior and Values Committee (ADB10), Transportation Research Board, 2017-Present

2015 Eric Pas Dissertation Prize, International Association for Travel Behaviour Research, 2017

Outstanding Student of the Year, University Transportation Centers Program, 2015

Eisenhower Transportation Fellowship, Federal Highway Administration, 2010-2012, 2013-2014

13. Budget Including Non-Federal Matching Funds

Institution: University of South Florida

Project Title: Investigation of the role of attitudinal factors on adoption of emerging automated vehicle and vehicle safety technologies

Principal Investigator: Fred Mannering

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			
Other Staff Salaries			To include Postdoc salary for cost match
Student Salaries			
Fringe Benefits			
Total Salaries & Benefits	$130,727	63,178	
Student Tuition Remission	$7,759	$15,549	Tuition waiver for 3 students for cost match
Operating Services and Supplies	$1,240		$1,240 research materials
Domestic Travel	$6,000		For team members to attend TOMNET meetings and conferences to disseminate research results
Other Direct Costs (specify): Survey Related Costs (address database, URL, printing and mailing)			
Other Direct Costs (specify): Software license	$4,000		Software
Total Direct Costs	$149,726	78,727	
F&A (Indirect) Costs	$70,274	0	
TOTAL COSTS	220,000	78,727	

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

Exhibit F

UTC Project Information	
Project Title	Investigation of the role of attitudinal factors on adoption of emerging automated vehicle and vehicle safety technologies
University	University of South Florida
Principal Investigator	Fred Mannering
PI Contact Information	Address: 4202 E. Fowler Ave. ENB 118 Tampa, FL, 33620 Email: flm@usf.edu
Funding Source(s) and Amounts Provided (by each agency or organization)	US Department of Transportation (Federal UTC): $220,000 University of South Florida (Cost Share): $78,727
Total Project Cost	$298,727
Agency ID or Contract Number	
Start and End Dates	8/1/2017 - 07/31/2018
Brief Description of Research Project	Emerging automotive and transportation technologies have created revolutionary possibilities in the way we might travel and drive in the future. These technologies include advanced vehicle safety technologies that are aimed at keeping the vehicle occupants safe and automated vehicles that can drive by themselves with little to no need for a human driver, and have the potential to revolutionize travel behavior. However, it is important to understand the effect that consumers' attitudes will have on the adoption of these technologies and their ultimate impact on travel. The proposed project will result in the review and development of modeling methods that incorporate information about people's attitudes and perceptions with socioeconomic data and unobserved heterogeneity. These modeling efforts will provide researchers and practitioners with documents to help familiarize them with the incorporation of attitudes and perceptions in the adoption of new technologies and their impact on travel behavior. The models developed and their accompanying software will be available for use by the public to help disseminate these methods into the larger transportation modeling community. Additionally, the project will collect data that will enable future analysis and development of models to forecast changes in perceptions due to social learning and social influence processes. The data collection effort will aid in providing guidance on how respondents are handling the task of relaying perceptions and travel choices. This will be important in understanding possible sources of survey error related to biases due to question structure and question ordering. This will be important for improving the efficiency and accuracy of TOMNET's year 3 collective survey effort.

Describe Implementation of Research Outcomes (or why not implemented)	The project will provide review documents and empirical estimations that will form the basis for subsequent TOMNET work on the incorporation of attitudes in travel and transportation safety models.
Impacts/Benefits of Implementation (actual, not anticipated)	The eventual impact of this research will be to improve the accuracy of travel and highway safety forecasting models.
Web Links • Reports • Project Website	Reports will be made available on the TOMNET website.