Center for Teaching Old Models New Tricks (TOMNET)

A USDOT Tier 1 University Transportation Center

PROJECT PROPOSAL 2021-2022

Title: An empirical assessment of the role of attitudes and identification in safety research

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

Co-Principal Investigator: Michael Maness, Assistant Professor, Department of Civil and Environmental Engineering, University of South Florida

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1. Introduction/Problem Statement

Research in highway safety, and specifically the statistical analysis of the frequency and injury severity of highway crashes has yet to deal adequately with two issues: the role that attitudes may play on risk perception and resulting crash and injury-severity likelihoods; and the issue of identification in safety modeling caused by self-selective sampling of safety data. Regarding the role of attitudes, there is a very high likelihood that attitudes toward travel and other factors are likely to be influential in determining the the risk profile of drivers and ultimately their likelihood of a crash and the extent of the resulting injury severity. In fact, there is an abundance of research that suggests attitudes will play a role such as Abay and Mannering (2016) were they provided empirical evidence showing that risk-taking in driving was significantly correlated with risk taking in other aspects of life. This suggests that the attitudinal data being collected in the TOMNET surveys could be directly applicable to safety, and this will be explored by adding additional safety-related questions and empirically studying the effect of attitudes on safety. This has the potential to influence safety research which currently addresses possible attitude influence as unobserved heterogeneity.

The second point, the issue of identification in safety research, is a potentially important issue that is just recently been recognized as a modelling issue (Mannering et al., 2020). The identification problem arises in safety data since crashes are only observed on a portion of the population, making drivers involved in crashes a self-selective group of riskier drivers. Thus, any change in the selectivity of people involved in crashes (changing safety features in cars etc.) could affect the interpretation and forecasting using estimated model parameters. The magnitude of this problem is not known but needs to be explored since it could affect safety-policy decisions. Currently, safety models deal with this issue by using mixing distributions, but this does not completely mitigate the potential effects of the selectivity problem (Mannering et al., 2020). The current research project intends to gain insight into the magnitude of this problem by studying travel behavior during the COVID-19 pandemic. The idea is that the pandemic should significantly affect the mix of drivers on the roads and such that the mix of risky and

safe drivers should change (as some drivers will stay at home and other will not) and this could be measured with a survey that could help guide changing parameter values in crash-injury severity models. Using self-reported safety data, a model of pandemic-influence travel will help determine if the population driving-risk profiles changed during the pandemic and the effect (if any) of that change on resulting crash-injury severities.

2. Project Objectives

Considering the above, the objectives of this project include:

1. Develop questions and conduct a survey of drivers' self-reported crash histories to go along with previously collected attitudinal data.
2. Using available self-reported crash data, estimate statistical models that consider attitudes as possible variables determining crash risk. Write and publish a paper on this.
3. Develop questions and conduct a survey of how drivers vehicle miles of travel changed during the COVID-19 pandemic.
4. Using the reported changes in vehicle miles traveled, develop a statistical model to determine factors that significantly change the vehicle miles traveled during the pandemic. Using discrete categories of pandemic-induced mileage changes, determine if the crash histories of of individuals in the discrete categories differ significantly. This will provide some empirical insight into the extent of the selectivity problem that may be causing identification issues in safety models.
5. To support the empirical analysis of objective 4, collect several months of Florida crash data and estimate injury severity models to study observed time-varying patterns in actual crash data. Write a paper based on the findings in objects 4 and 5.

3. Proposed Methodology and Data

To determine the effect of the COVID-19 pandemic on vehicle usage, as well as individuals' perception of safety issues, and driver crash/citation history, a number of questions will be added to the Leisure Activity and Social Resources Longitudinal Study. This longitudinal study will be conducted through at least two waves during 2020 and 2021. Following up on the initial cross-sectional study that took place in Fall 2019 (Luong and Maness, in review), the longitudinal survey is designed to better understand social factors influencing the leisure activity participation and the impacts of the COVID-19 pandemic on leisure activity. The survey consists of a non-probability sample using two internet panels -- Prolific and Qualtrics Panels -- as well as a convenience same from Amazon MechanicalTurk. The survey consists of sections on respondent's activity space, social capital, mobility/accessibility, individual and household characteristics. Additionally, there are sections on individuals' personality styles, subjective well-being, and attitudes about the pandemic. It is expected that a sample size of approximately 750 to 1000 respondents will be obtained.

This study seeks to add questions in the mobility/accessibility section about individuals' driving safety. These questions will include the following:

1. Are you a licensed driver? ___Yes___No
2. How many years have you had a driver's license? ___years
3. About how many miles per year do you drive? ___miles
4. Since the outbreak of the COVID-19 pandemic how has your number of miles driven changed?
___ I drive much less (drive less half of what I usually drive)

___ I drive substantially less (drive between 25% and 50% less than usual)
___ I drive less (drive between 10% and 25% less than usual)
___ I drive about the same (drive between 10% less and 10% more than usual)
___ I drive more (drive 10% or more than usual)
5. How many police reported accidents (as a driver) have you had since you started driving? ____
6. About how many moving violations (speeding tickets, etc.) have you had since you started driving? ___
7. In general, do you believe speed limits are: ___too low ___about right ___too high
8. About safe do you believe it is to drive today compared to 5 years ago?
___ much less safe ___ less safe ___ about the same ___ more safe ___ much more safe

Given these questions, the first analysis will be to develop crash-history models (based on Question 5) using traditionally collected socioeconomic variables as explanatory variables and then the attitudinal variables (in addition to socio-economic variables) to determine if attitudinal and personality variables provide a statistical improvement over traditional socio-economic-only approaches while accounting for unobserved heterogeneity with complex mixing distributions.

The second analysis will build on the findings of the first by addressing possible self-selectivity/identification issues in safety data. It is well known that the effects of COVID-19 have not been uniform across the population. This suggests that the mix of vehicle-miles travelled for drivers that are safe and unsafe may have changed as a result of the pandemic. This suggests that there could be a statistically significant shift in crash rates (crashes per mile driven) and injury-severity proportions of observed crashes. To address this possibility, a series of statistical models will be developed to determine if the mileage driven by less safe drivers in relation to the mileage driven by safe drivers (as indicated by their driving histories) changed significantly during the pandemic. If such a change is observable and statistically significant, this could have profound implications for the analysis of highway-crash data in general.

The third analysis will follow up on the first two to address the possible COVID-19 induced shifts in highway-crash injury severities. Such shifts could be induced by the pandemic causing self-selectivity (the pandemic changing the mix of safe and unsafe drivers in the driving population), or by the possibility that driver behavior is changing in a fundamental way due changing economic conditions and risk profiles (there is ample evidence in the crash-research literature to support this possibility, see Behnood and Mannering, 2016 and Mannering, 2018). To undertake this study, highway crash data from the state of Florida will be used to estimate random parameters logit models (with heterogeneity in the means and variances of random parameters) of the resulting crash occupant injury severities. The crash data will be split into months starting from January 2020 (pre-pandemic) until July 2020 (post-pandemic), in separate injury-severity models by month will be estimated and tested to determine if statistically significant shifts in driver-injury severities have occurred. Likelihood ratio tests will be performed to determine if the parameter estimates are stable from month to month. If temporal instability is found, an assessment of individual parameter estimates will be conducted to determine if any individual parameter has temporally stable marginal effects. A thorough assessment of marginal effects, which measure the effect of individual explanatory variables on resulting driver-injury outcomes, will be made to assess the potential policy implications of the findings. These Florida crash-analysis results will then be assessed in light of the survey findings undertaken in the first two analyses described above.

The three proposed analyses hope to provide valuable new insights into the effects of attitudes on safety as well as valuable new insights into the self-selectivity identification problem as it affects highway safety analysis.

4. Work Plan

Task 1: Study the role of attitudes in highway safety

Current models of highway safety generally only consider traditional socio-economic data when determining individual crash risks. We propose to collect safety information and individuals and determine if attitudes do play a statistically significant in individuals' highway crash risks. To do this, the following subtasks will be undertaken:

1.1 Develop safety survey questions and collect and code resulting data: A number of questions will be added to the Leisure Activity and Social Resources Longitudinal Study. Survey recruitment will occur across three online platforms: Prolific, MechanicalTurk, and Qualtrics Panels. It is expected that about 750 to 1000 useable surveys will be returned.

1.2 Statistical model development: A series of statistical models will be developed to compare the inclusion/exclusion of attitudinal variables in models that predict the number of crashes, crash rates (number of crashes per mile driven), and other observable safety data such as moving violations.

1.3 Assessment and implications of using attitudes to predict safety: Through extensive review of the literature and an assessment of the findings of other TOMNET studies, the model findings will be discussed and their implications for future highway-safety research will be presented.

Task 2: The effects of COVID-19 on the travel of safe and unsafe drivers

It is well known that the pandemic has affected different elements of the population to varying degrees. It is thus possible that the proportions of vehicle miles travelled by safe and unsafe drivers may have changed as a result. To study the possibility, the following subtasks will be undertaken:

2.1 Develop safety survey questions and collect and code resulting data: As a portion of Task 1.1 above, a question on how vehicle miles of travel has changed as a result of the pandemic will be asked. Again, it is expected that about 750 to 1000 useable surveys will be returned.

2.2 Assessment of factors affecting vehicle usage: Estimate random parameters logit models (or random parameters ordered probability model if warranted) to determine the likelihood of drivers changing their vehicle usage during the pandemic (see question 4 in Section 3 above). Write up appropriate findings.

2.3 Model the relationship between safety and changes and vehicle usage: Develop statistical models to determine if the differential impacts of the pandemic across the population in terms of vehicle miles traveled is also associated with safe and unsafe drivers driving more or less than pre-pandemic conditions.

Task 3: Effect of COVID-19 on crash injury severities in Florida

Changing travel patterns during the pandemic could potentially impact the proportion of injury severities occurring in crashes (reported in crash reports as no injury, possible injury, evident injury, disabling injury, fatality). To study this possibility, the following subtasks will be performed:

3.1 Collect Florida police-reported crash data: Crash data will be collected in the state of Florida from January 2020 to July 2020 to cover the period immediately before the COVID-19 lockdown as well as during and immediately after the lockdown.

3.2 Estimation of statistical models of driver-injury severities: For each month of the data collected in sub-task 3.1, estimate a random parameters logit model to assess factors significantly affecting the probability of injury severity. Conduct a series of likelihood ratio tests to determine if the effect of explanatory variables on injury-outcome probabilities has changed significantly over time.

3.3 Assessment of COVID-19 on crash-injury severity findings: Based on the model estimation results in sub-task 3.1 and the findings in Task 2 above, discuss the potential effects induced by the pandemic in terms of self-selectivity (the pandemic changing the mix of safe and unsafe drivers in the driving population) and the possibility that driver behavior is changing in a fundamental way due changing economic conditions and risk profiles.

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	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Task 1: Study the role of attitudes in highway safety												
1.1 Develop safety survey questions and collect and code resulting data (Questionnaire developed)	■	■	■	■								
1.2 Statistical model development (Modeling vignette brief developed)		■	■	■	■	■	■	■	■	■		
1.3 Assessment and implications of using attitudes to predict safety (Paper completed)					■	■	■	■	■	■	■	■
Task 2: The effects of COVID-19 on the travel of safe and unsafe drivers												
2.1 Develop safety survey questions and collect and code resulting data (Questionnaire developed)	■	■	■	■	■	■	■	■				
2.2. Assessment of factors affecting changes vehicle usage (Modeling vignette brief developed)			■	■	■	■	■					
2.3 Model the relationship between safety and changes and vehicle usage (Paper completed)		■	■	■	■	■	■	■	■	■	■	■
Task 3: Effect of COVID-19 on crash injury severities in Florida												
3.1 Collect Florida police-reported crash data (Dataset assembled)	■	■	■									

3.2 Estimation of statistical models of driver-injury severities (Modeling vignette brief developed)												
3.3 Assessment of COVID-19 on crash-injury severity findings (Paper 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 congestion, 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 and social data can aid in addressing unobserved heterogeneity. In analyzing new data on social networks for social learning and temporal instability, this project will attempt to develop data 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 project will result in the following deliverables:

1. Three working papers prepared for future submission to peer-reviewed journals
2. A technical report detailing the three phases of the project
3. Publicly available version of the self-reported safety and COVID-19 data collected.
4. A modeling vignette brief on incorporating attitudes and COVID-19 effects in highway safety modeling

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 150 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.

Michael Maness is an Assistant Professor 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.

Fred Mannering and Michael Maness will both be involved in statistical model development and interpretation of findings. 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 and (2) making the datasets available for public use through TOMNET's website.

10.Workforce Development and Outreach Plan

The project will directly provide career development opportunities for 2 doctoral students. The research effort will allow doctoral students to expand their technical skills into new areas of discrete choice modeling and transferability analysis. The supported doctoral students are expected to gain experience in managing research projects and mentoring undergraduate 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. The PI and Co-PI both will teach graduate-level courses on econometric methods and data science. These courses will likely include homework assignments and a project component involving the analysis of transportation data. Students will be exposed to the process that respondents partake of in providing safety-related data.

11.References

Abay, K., Mannering, F., 2016. An empirical analysis of risk-taking in car driving and other aspects of life. Accident Analysis and Prevention 97, 57-68.

Behnood, A., Mannering, F., 2016. An empirical assessment of the effects of economic recessions on pedestrian-injury crashes using mixed and latent-class models. Analytic Methods in Accident Research 12, 1-17.

Luong, T., Maness, M., in review. Comprehensive analysis of leisure activity variety as an instrumental outcome of social capital. Submitted for presentation at the 2021 Transportation Research Board Annual Meeting.

Mannering, F., 2018. Temporal instability and the analysis of highway accident data. Analytic Methods in Accident Research 17, 1-13.

Mannering, F., Bhat, C., Shankar, V., Abdel-Aty, M., 2020. Big data, traditional data and the tradeoffs between prediction and causality in highway-safety analysis. Analytic Methods in Accident Research 25, 100113.

12.Qualifications of Investigators

FRED L. MANNERING, Ph.D.
Professor, School of Civil and Environmental Engineering,
University of South Florida, Tampa, FL Ph: (813) 974-5817; Email: flm@usf.edu

EDUCATION

- Massachusetts Institute of Technology, Cambridge, MA, USA
  - Ph.D., Civil Engineering (Transportation Systems), May 1983
- Purdue University, West Lafayette, IN, USA
  - M.S., Civil Engineering, May 1979
- University of Saskatchewan, Saskatoon, SK, Canada
  - B.S., Civil Engineering (with Distinction), May 1976

PROFESSIONAL EXPERIENCE

- Interim Executive Director, Center for Urban Transportation Planning, University of South Florida, 2020-
- College of Engineering, University of South Florida, Tampa, FL
  - Professor, 2015-
  - Associate Dean for Research, 2016-
- School of Civil Engineering, Purdue University, West Lafayette, IN
  - Charles Pankow Professor of Civil Engineering, 2009-2015
  - Professor, 2005-2009
  - Professor and Head of Civil Engineering, 2001-2004
- Department of Civil and Environmental Engineering, University of Washington, Seattle, WA
  - Professor and Chair, 1997-2001
  - Professor, 1992-1997; Associate Professor 1989-1993; Assistant Professor, 1987-1989
- Department of Civil Engineering, The Pennsylvania State University, State College, PA
  - Assistant Professor, 1983 – 1986

REFEREED PUBLICATIONS (Total: 158 Refereed Publications)

- Published work has been cited more than 10,500 times in Clarivate Analytics Web of Science Core Collection, with h-index = 52. (https://publons.com/researcher/2601045/fred-l-mannering/)
- Published work has been cited more than 13,500 times in Scopus (Elsevier), with h-index = 56. (https://www.scopus.com/authid/detail.uri?authorId=7005423388)
- Published work has been cited more than 25,500 times in Google Scholar with h-index = 73. (https://scholar.google.com/citations?user=HJc-5WMAAAAJ&hl=en)

RESEARCH PROJECTS (Total Sponsored Research: exceeding $5 million)

JOURNAL EDITORIAL ACTIVITIES

- Editor-in-Chief, *Analytic Methods in Accident Research*, Founding Editor, 2013-present
- Editor-in-Chief, *Transportation Research Part B* (*Methodological*), 2003-2012
- Associate Editor, *Transportation Research Part B* (*Methodological*), 2003, 2013-present
- Associate Editor, *Transportation Research Part A* (*Policy and Practice*), 2001-2002

EDUCATION AND STUDENT ADVISING

- Thesis/Dissertation Major Advisor/Chair
  - 24 PhD students completed; 43 MS (Thesis) students completed

- Thesis/Dissertation Committee Member
  - 92 PhD students completed; 125 MS (Thesis) students completed
- Course Instructor
  - Graduate: *Statistical and Econometric Methods I, Statistical and Econometric Methods II*

13.Budget Including Non-Federal Matching Funds

Institution: University of South Florida
Project Title: An empirical assessment of the role of attitudes and identification in safety research
Principal Investigator: Fred Mannering

Budget Period: 8/1/2020 - 07/31/2021

CATEGORY	Budgeted Amount from Federal Share	Budgeted Amount from Matching Funds	Explanatory Notes; Identify Source of Matching Funds
Faculty Salaries	$21,111	$15,889	Salary for Fred Mannering and Michael Maness
Other Staff Salaries	$0	$0	
Student Salaries	$13,000	$0	One half-time GA
Fringe Benefits	$6,343	$3,642	Faculty and Student Benefits
Total Salaries & Benefits	$40,454	$19,531	
Student Tuition Remission	$0	$7,993	Tuition waivers for GA (24 credits)
Operating Services and Supplies	$0	$0	
Domestic Travel	$2,050	$0	Conference travel or virtual conference registration
Other Direct Costs	$7,250	$0	Survey distribution and data processing; student competition
Total Direct Costs	$49,754	$27,524	
F&A (Indirect) Costs	$24,628	$9,668	
TOTAL COSTS	$74,382	$37,192	

Grant Deliverables and Reporting Requirements for UTC Grants (November 2022)
Exhibit F

UTC Project Information	
Project Title	An empirical assessment of the role of attitudes and identification in safety research
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): $74,382 University of South Florida (Cost Share): $37,192
Total Project Cost	$111,573
Agency ID or Contract Number	
Start and End Dates	09/01/2021 – 08/31/2022
Brief Description of Research Project	
Describe Implementation of Research Outcomes (or why not implemented) Place Any Photos Here	
Impacts/Benefits of Implementation (actual, not anticipated)	The eventual impact of this research will be to improve the accuracy of highway safety forecasting models.
Web Links • Reports • Project Website	Reports will be made available on the TOMNET website.