

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

---

**PROJECT PROPOSAL**

---

**Title: How Important Are Attitudes in Travel Behavior Models? A Comprehensive Review**

**Principal Investigator:** Deborah Salon, Assistant Professor, School of Geographical Sciences and Urban Planning, Arizona State University

---

**1. Introduction/Problem Statement**

Attitudes, past experiences, habits, and norms have a large influence on the choices we make in our daily lives. Beginning in the 1970's, researchers studying transportation choices began to include these psychological factors in their analyses (e.g., Tardiff, 1977). Nearly 50 years later, the relevant literature is vast. Results have been applied to more effectively market neighborhoods (e.g., WalkScore) and alternative modes (e.g., free bus pass for a limited time). Results have not been used, however, to improve the prediction of travel choices in formal metropolitan planning processes. The goal of the TOMNET University Transportation Center is to devise methodologies to facilitate either the direct incorporation of attitudinal data or the findings from the literature on the effect of attitudes on travel choices into the models that inform transport plans.

Surprisingly, a comprehensive review of prior findings in this arena does not exist. An important step toward TOMNET's goal, then, is to conduct a comprehensive review of the literature on the inclusion of attitudes in models of travel-related choices.

**2. Project Objectives**

The objective of this project is straightforward: we will produce a high-quality comprehensive review of the existing evidence on the impact of attitudes on travel-related choices. Attitudes will be broadly conceived to encompass attitudes, preferences, intentions, norms, and personality traits. All of these variables are usually captured using Likert-scale survey statements with agree-disagree or unimportant-important measurement scales, and then combined into attitudinal factors such as "safety", "convenience", or "environmental". This review will be submitted for publication in a top transportation journal (possibly *Transport Reviews*), and will serve as an invaluable reference for all research on the topic of attitudes and travel behavior going forward.

In addition to this review paper, we will also create a public database of studies that have been conducted on the impact of attitudes on travel behavior. This database will contain links to the original research, as well as a directory of the attitudinal questions that were asked by the studies, and the results of the models in each paper. It will be available as an interactive web site with search functionality, as well as a machine-readable, downloadable database file to allow ourselves or others to conduct meta-analyses of the results of these studies. The interactive web site will greatly assist researchers developing new studies of attitudes and travel behavior, as they will be able to easily identify questions that were predictive in past studies. Draft versions of this database have already been used in the development of two transport-related surveys.

Another objective of this project is to provide training in interpreting travel models to a new generation of scholars. We will recruit a group of undergraduate students to assist with reviewing the literature, and will train them in interpreting travel behavior models.

### **3. Proposed Methodology and Data**

This research will begin by identifying relevant articles investigating the relationship between attitudes and travel behavior. To do this, we will perform a number of searches in the Scopus research database to find papers that met our inclusion criteria. We will include papers with a sample size of at least 300. We will only include papers that used factor analysis to identify underlying latent attitudes from attitudinal questions, as factor-analyzing many attitudinal questions to find a smaller number of latent factors reduces the influence of measurement error. We will only include papers with a multivariate model controlling for at least two sociodemographic characteristics, so that results can be compared with existing non-attitudinal models of travel behavior. We will exclude papers primarily about long distance travel, evacuation travel, autonomous vehicles, and children's' travel.

We will structure our review process as an undergraduate seminar in the Fall semester of 2019. We will recruit 3–5 undergraduates for this effort, and will pay them for their time as well as providing them class credit. In the first part of the semester, we will focus on teaching the students how to interpret a variety of models used in travel behavior research, including linear regression, multinomial logistic regression, and structural equation models. In the middle part of the semester, students will read papers identified from our literature search each week, and give short lightning talks about each. They will also record the attitudinal statements, factor analysis results, and models in each paper into our database.

The final part of the seminar will be a group project between all of the class participants—students and instructors—to create a draft of the literature review paper mentioned in the above section. This draft will be the basis for the final, published paper, which will be co-authored by all seminar participants.

The paper will be structured to be useful for transportation modeling practitioners. First, it will give a **brief review of the theoretical basis for the relationship between attitudes and behavior**. At least three major theoretical constructs from social psychology have been applied to travel behavior modeling: Cognitive Dissonance Theory (Festinger, 1962), the Theory of Planned Behavior (Ajzen, 1991), and Social Cognitive Theory (Bandura, 1989). In some cases, these theories offer competing causal explanations for observed behavior. In others, they simply explain different behavioral outcomes. This section will discuss each and provide examples of applications in the travel behavior literature.

Second, it will review the overall findings of **whether and how much attitudes influence travel behavior**. In this section, we will quantify how many studies found significant links between attitudes and travel behavior.

Thirdly, it will review **which travel outcomes are most affected by attitudes**. This section will be both theoretical and empirical, first considering which travel outcomes have the most theoretical basis for being affected by attitudes, and second whether the empirical data we have collected from the studies we reviewed supports these theoretical outcomes. This section will be useful to practitioners who are trying to decide where attitudes might improve their travel demand models.

Fourth will be a **review of what attitudinal questions have been used** in the multitude of surveys treating attitudes and travel behavior. One challenge in the generalization of attitude-travel behavior research is that most surveys, and papers based on them, use sets of questions with very little overlap. This section will present broad categories of attitudinal questions that have been asked in the studies in this literature, and identify which categories of questions are most predictive of travel behavior outcomes.

A final section of the paper will **detail any gaps found in the literature on attitudes and travel behavior, and provide suggestions for future research.** It will also detail any common methodological concerns we uncover during our review.

In addition to the paper, this project will produce a public, interactive database that catalogs the questions and models used in the reviewed research. This database will index the attitudinal questions asked by previous studies, in order to promote re-use of questions between surveys. This re-use of questions promotes comparability between studies, something sorely lacking in the existing literature. Each paper reviewed will have a page in the database displaying the questions used as well as results of the factor analyses and the models in the paper, as well as a link to the original article. Each question will have a page listing the studies it appeared in, as well as related questions. There will be a search function to locate papers or questions related to particular query. In addition to the interactive database, the data will be released as a machine-readable dataset to support additional meta-analyses by other researchers.

An ideal outcome of this project would be to identify a succinct set of questions that could be included in travel surveys. This is likely not possible given the heterogeneity in the questions and factors identified by the existing literature; in order to truly answer this question, more surveys will likely be needed in order to assess the relevance and consistency of many of these questions. However, the project will inform future research, by identifying and categorizing survey questions that have been used previously, allowing researchers to make educated guesses about questions that may work well and measure the same attitudinal constructs.

#### **4. Work Plan (Project Tasks)**

##### **Task 1: Conduct systematic literature search using Scopus academic literature database.**

We will conduct a systematic search using a variety of travel-behavior related keywords in the Elsevier Scopus database, which we have access to through ASU Library. This database is the gold-standard research database and indexes most high-quality journals, including those not published by Elsevier, as well as a number of conference proceedings. We will then evaluate the results from the searches to identify which articles meet our inclusion criteria.

##### **Task 2: Prepare teaching materials to teach model interpretation to student research assistants.**

A significant portion of this project will involve training undergraduate research assistants to interpret the varied types of regression models encountered in this literature. These models range from simple linear regression models to complex structural equation and discrete choice models. Given the advanced models used within this literature, it is not reasonable to expect to find undergraduate research assistants who already have experience with them. Thus, we will teach them specifically how to *interpret* them, rather than how to estimate them. This education component is necessary for the project, but also addresses the workforce development goal of the TOMNET center.

This will require developing new teaching materials that provide a broad overview of the econometric methods used in this literature, including graphical representations of the model forms used, to provide an overview that will allow students to understand the interpretation of the models without needing to understand the full mathematics behind them. These teaching materials will be made available under a Creative Commons Attribution license.

##### **Task 3: Recruit and interview student candidates for research assistantships**

This project requires significant input from the undergraduate research assistants who will participate in the seminar by reading articles, summarizing them, and entering them into the database. Thus, we need to attract and select highly-qualified students for the team. We will advertise to students of the School of Geographical Sciences and Urban Planning and the Honors College at ASU, as well as on the general student employment listing site.

**Task 4: Read all articles identified in Task 1, and enter their bibliographic information, abstracts, and model results into database. Also note methods used and any concerns that might put their findings into question.**

We will read each of the papers that was identified in Task 1. For each paper, we will enter all factor analyses, models, coefficients, etc. into the interactive database detailed in the next task.

**Task 5: Create interactive database**

We will create an interactive, web-based database that allows researchers to discover previous studies on the relationships between attitudes and travel behavior. This will require developing a custom Javascript-based web application that will provide search and indexing functionality for the reviewed literature. It will also allow users to download the raw data for their own meta-analyses.

**Task 6: Write a summary paper of the literature identified in Task 1**

Once we have reviewed the papers identified in Task 1, we will synthesize their findings into a literature review paper that details our methodology and common themes identified throughout the search process. This paper will be geared towards practitioners looking to include attitudinal information in their travel demand models.

**Task 7: Publish and disseminate the summary paper and database**

In order for the results of this project to be broadly useful, they need to be disseminated to the practitioner community. We will publish our literature review paper in a peer-reviewed journal. Additionally, we will post an open access preprint of the paper in the ASU Institutional Repository, and share it widely through mailing lists such as the Travel Model Improvement Program and the Zephyr Foundation. We will make the interactive online database publicly available, reference it in the paper, and promote it using mailing lists as well.

## 5. Project Schedule

	2018					2019						
Task	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July
1												>>
2												>>
3												
4												>>

*Note that this project is expected to continue into 2019-2020, and thus not all tasks are portrayed above.*

## 6. Relevance to the Center Theme/Mission

As the University Transportation Center charged with evaluating the usefulness of including attitudinal variables in all manner of models of travel behavior, it is imperative that there be a clear, concise, comprehensive literature review on the research done in this arena so far. No such review, to our knowledge, currently exists. This project will fill the gap.

## **7. Anticipated Outcomes and Deliverables**

This project will produce multiple deliverables: (1) a searchable database of the literature that we review, including abstracts as well as details about factor analyses and estimated models of travel-related outcomes, (2) a review manuscript, (3) slidedeck used for the entire training course, and (4) a recommended set of attitudinal statements for travel behavior researchers to consider utilizing in future research.

The paper produced by this project will be published in a peer-reviewed academic outlet and the preprint will be deposited to the Arizona State University Digital Repository (<https://repository.asu.edu>) to promote open access by practitioners, academics, and others with an interest in the intersection of travel behavior and attitudes.

## **8. Research Team and Management Plan**

The research team for this project will include Matthew Wigginton Conway and Deborah Salon. Conway is in his second year of his PhD studies in the School of Geographical Sciences and Urban Planning at ASU, and Salon is both a faculty member in the School and Associate Director of TOMNET. Conway will take the lead on this project, with direction and support from Salon.

Conway has experience in transportation planning and accessibility modeling, but travel demand modeling is a new field for him. Conducting this comprehensive review of the literature will provide an excellent foundation for both Conway's personal growth as a scholar in this field and for the TOMNET Center's research overall. Salon has experience conducting comprehensive literature reviews (Salon et al., 2012; Sultana et al., 2017).

In addition to Salon and Conway, we will hire 3–5 undergraduate and/or graduate students to assist with reading papers, inputting them into the database, and preparing the manuscript. We will train these students in interpreting statistical models, and they will be an integral part of the team.

The research team will meet regularly during the project to ensure timely delivery of the final manuscript.

## **9. Technology Transfer Plan**

Both of the deliverables identified in section 7 above will allow practitioners to better use attitudinal information in their travel models. The paper will give an overview of the state of the practice, allowing practitioners to understand how attitudes have been incorporated into models in the past, and what types of analyses have been successful. The database will allow practitioners to make specific decisions about what variables to include in their surveys and how to incorporate them into their travel demand models, on the basis of past research. We will make both of these resources publicly and freely available to all.

The database will be presented both as an interactive Web site and as a raw data download. The raw data download will allow other researchers and practitioners to present the data in new ways and perform meta-analyses. This raw dataset will be publicly available and referenced from the interactive database to promote its use.

In addition to these deliverables, the research team will present the work at conferences as well as through webinars. This will increase the profile of the research and make it accessible to more practitioners.

## **10. Workforce Development and Outreach Plan**

This project will have a substantial workforce development component. Matthew Wigginton Conway and Deborah Salon will co-teach a course open to both graduate and undergraduate students at ASU, the output of which will be this literature review. We have budgeted \$12,000 to pay hourly student researchers who have been trained in this course to conduct this research. In this way, Matthew

Wigginton Conway will be trained in teaching and the students in the course will be trained in reading and interpreting complex statistical models of travel behavior.

## 11. References

- Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50, 179–211.
- Bandura, A. (1989). Human agency in social cognitive theory. *American Psychologist*, 44(9), 1175–1184. <http://dx.doi.org.ezproxy1.lib.asu.edu/10.1037/0003-066X.44.9.1175>
- Dunlap, R. E. (2008). The New Environmental Paradigm Scale: From Marginality to Worldwide Use. *The Journal of Environmental Education*, 40(1), 3–18. <https://doi.org/10.3200/joe.40.1.3-18>
- Festinger, L. (1962). *A Theory of Cognitive Dissonance*. Stanford University Press.
- Salon, D., Boarnet, M. G., Handy, S., Spears, S., & Tal, G. (2012). How do local actions affect VMT? A critical review of the empirical evidence. *Transportation Research Part D: Transport and Environment*, 17(7), 495–508. <https://doi.org/10.1016/j.trd.2012.05.006>
- Sultana, S., Salon, D., & Kuby, M. (2017). Transportation sustainability in the urban context: A comprehensive review. *Urban Geography*, 00(00), 1–30. <https://doi.org/10.1080/02723638.2017.1395635>
- Tardiff, T. J. (1977). Causal inferences involving transportation attitudes and behavior. *Transportation Research*, 11(6), 397–404. [https://doi.org/10.1016/0041-1647\(77\)90004-1](https://doi.org/10.1016/0041-1647(77)90004-1)

## 12. Budget Including Non-Federal Matching Funds

Institution: ASU

Project Title: The Role of Attitudes, Experiences, Habits, and Norms in Travel-Related Choices: A Comprehensive Review

Principal Investigator: Deborah Salon

Budget Period: 8/1/2018 - 07/31/2019

CATEGORY	Budgeted Amount from Federal Share	Budgeted Amount from Matching Funds	Explanatory Notes; Identify Source of Matching Funds
Faculty Salaries	\$8,934.18	\$8,485.89	Salon 5% AY salary + 0.5 summer months
Other Staff Salaries	\$-	\$-	
Student Salaries	\$37,000.00	\$-	
Fringe Benefits	\$4,067.23	\$2,291.19	
<b>Total Salaries &amp; Benefits</b>	\$50,001.41	\$10,777.08	
Student Tuition Remission	\$17,000.00	\$-	
Operating Services and Supplies	\$-	\$-	
Domestic Travel	\$1,500.00	\$-	
Open Access publishing charges	\$-	\$-	
	\$-	\$-	
<b>Total Direct Costs</b>	\$68,501.41	\$10,777.08	
F&A (Indirect) Costs	\$29,355.80	\$6,142.94	
<b>TOTAL COSTS</b>	\$97,857.21	\$16,920.02	

**DEBORAH SALON, Ph.D.**

**Assistant Professor, School of Geographical Sciences and Urban Planning,  
Arizona State University, Tempe, AZ 85287-3005. Ph: (480) 965-7475; Email:  
deborah.salon@asu.edu**

---

**EDUCATION**

- University of California at Davis, Davis, CA, USA
  - Ph.D., Agricultural and Resource Economics, May 2006
- Carleton College, Northfield, MN
  - B.A., Physics, June 1994

**PROFESSIONAL EXPERIENCE**

- Arizona State University
  - Assistant Professor, School of Geographical Sciences and Urban Planning, 2014-present
  - Graduate Faculty, School of Sustainability, 2016-present
  - Senior Sustainability Scientist, Global Institute of Sustainability, 2014- present
- University of California, Davis, Institute of Transportation Studies
  - Professional Researcher, 2008-2014
- The Earth Institute at Columbia University
  - Post-Doctoral Fellow, 2006-2008

**RELEVANT REFEREED PUBLICATIONS (Total: 21 Refereed Publications)**

1. Salon, Deborah. (2015) Heterogeneity in the relationship between the built environment and driving: Focus on neighborhood type and travel purpose. *Research in Transportation Economics*, 52, 34-45.
2. Cook, Jonathan, James Sanchirico, Deborah Salon, and Jeffrey Williams. (2015) Empirical distributions of vehicle use and fuel efficiency across space: Implications of asymmetry for policy analysis. *Transportation Research Part A: Policy and Practice*, 78, 187-199.
3. Salon, Deborah, Marlon Boarnet, Susan Handy, Steven Spears, and Gil Tal. (2012) How do local actions affect VMT? A critical review of the empirical evidence. *Transportation Research Part D* 17(7): 495-508.
4. Salon, Deborah. (2009) Neighborhoods, cars, and commuting in New York City: A discrete choice approach. *Transportation Research Part A: Policy and Practice* 43(2): 180-196.

**RELEVANT RESEARCH PROJECTS (Total Sponsored Research: ~ \$700,000)**

- *A Spatial Analysis of Housing and Transportation Affordability in Los Angeles County*, University of California Transportation Center, 2012-2015
- *Quantifying the effect of local government actions on VMT*, California Air Resources Board, 2010-2014

**JOURNAL EDITORIAL ACTIVITIES**

- Co-EDITOR OF SPECIAL ISSUE, *RESEARCH IN TRANSPORTATION ECONOMICS* (ELSEVIER), 2015
- EDITORIAL BOARD, *JOURNAL OF TRANSPORTATION GEOGRAPHY* (ELSEVIER), 2016-present
- EDITORIAL BOARD, *TRANSPORTATION RESEARCH PART D* (ELSEVIER), 2017-present

**EDUCATION AND STUDENT ADVISING**

- Thesis/Dissertation Major Advisor/Chair: 1 PhD student in progress; 4 MS (Thesis) students completed
- Thesis/Dissertation Committee Member: 3 PhD students completed, 2 PhD students in progress; 5 MS (Thesis) students completed