Center for Teaching Old Models New Tricks (TOMNET)

A USDOT Tier 1 University Transportation Center

PROJECT PROPOSAL 2017-2018

Title: An Integrated Model of Activity-Travel Behavior and Subjective Well-being

Principal Investigator: Ram Pendyala, Professor, School of Sustainable Engineering and the Built Environment, Arizona State University

Co-Principal Investigator: Sara Khoeini, Assistant Research Professor, School of Sustainable Engineering and the Built Environment, Arizona State University

1. Introduction/Problem Statement

Transportation plays a critical role in shaping the quality of life in communities around the world by making it possible for people to engage in activities, participate in societal functions, and interact with various agents and entities that make up a region's ecosystem. Additionally, transportation enables mobility, thus providing people and businesses access to goods, services and opportunities. By enabling these functions, transportation and logistics systems directly impact the economic vitality of a region, along with the state of the environment, energy consumption, public health, and safety and security.

Because of the tight connection between transportation and quality of life, considerable attention has been paid to understanding the linkage between mobility and subjective well-being (Ziems et al., 2010; Bergstad et al., 2011; Lee and Sener, 2016; Friman et al., 2017). Measures of subjective well-being capture the emotions that people feel as they go about their daily lives, undertake activities, and travel. While the quality of life may be viewed as a notion that captures the broader and longer-term outlook that people have on their lives, the notion of subjective well-being may be viewed as capturing the emotions experienced in a specific context or situation (National Research Council, 2013). Although important distinctions can and should be drawn between the broader quality of life measures and measures of subjective well-being, it can be said that a healthy accumulation of positive feelings of well-being will contribute (over time) to a higher quality of life. To the extent that transportation can engender such positive feelings of well-being (through access to opportunities and destinations, enabling participation in activities and society at large, and provision of pleasant mobility experiences and options), it would be of value to be able to measure and quantify well-being that people derive from their daily activity-travel and time use patterns. Armed with knowledge about the well-being implications of the activity-travel ecosystem, transportation professionals will be able to plan built environments, design mobility systems, and implement policies that enhance well-being – and consequently, quality of life.

However, transportation demand forecasting models do not output measures of well-being, and household travel surveys never collect information about feelings of well-being associated with various activity-travel episodes reported in a travel diary. In the absence of any knowledge or data about actual subjective feelings of well-being that are derived from activities and trips, inferences about well-being are often drawn based on the time use pattern. There is a rich body of literature that is devoted to the notions of time poverty (Williams et al., 2016) and social exclusion (Lucas, 2012; Schwanen et al., 2015). This body of literature has generally posited that individuals who do not travel (report zero trips) may be experiencing social exclusion (Lucas, 2012), i.e., they are not participating in society and engaging in activities outside the home. In the absence of interactions with the outside world, they may suffer from loneliness, depression, and other mental health issues. In the time poverty literature, individuals who do not engage in leisure time activities for a duration that exceeds a certain threshold are considered to be "time poor" (Williams et al., 2016). The time poverty criterion is often pegged to the median (or some fraction of the median) leisure activity time depicted by the population under consideration. Those who experience time poverty are assumed to have lower well-being and overall quality of life.

While a time-based definition of well-being (and quality of life) certainly has merit, there remains some uncertainty as to the extent to which time use based measures truly represent the feelings of well-being experienced by individuals. Some may find staying at home to be pleasurable (especially if the in-home activities are of a discretionary and social nature), while others may find work very rewarding and satisfying (even though they spend little to no time on discretionary leisure activities). In other words, there is a need to develop a measure of well-being that can be computed based on standard outputs of an activity-based transportation demand forecasting model. Activity-based travel models, which simulate activity-travel patterns at the level of the individual agent, are increasingly being adopted in metropolitan areas for transportation planning and forecasting purposes. These models are able to provide rich information about individual activity-travel patterns under a wide range of conditions, essentially providing an output that mimics data collected in a travel diary survey. For each and every individual in a representative synthetic population of agents, the activity-based model furnishes activity-travel records at fine-grained spatial and temporal resolution. It would be of considerable value if the activity-travel and time use measures implied by an individual's pattern can be translated into a measure of well-being, thus enabling planners to assess the well-being implications of the transportation system and alternative actions.

This project proposes estimating an integrated model of activity-travel behavior and subjective well-being that can essentially serve as a well-being scoring tool for activity-travel patterns. The model, when interfaced with an activity-based travel demand model that outputs activity-travel records at the level of the individual agent, can be used to compute well-being scores that are based on the predicted activity-travel and time use patterns. A couple of challenges need to be addressed, however, in the development of such a model, and this project proposes the application of a data fusion approach to help overcome the challenges. The first challenge is that travel surveys do not contain any information about subjective well-being, and hence the calibration of a model of well-being is difficult in the absence of data. To overcome this issue, well-being data from 2010, 2012, and 2013 editions of the American Time Use Survey (ATUS) data collected in the United States will be used to estimate well-being scores as a function of activity engagement and time use allocation patterns. The second challenge is that activity-based travel models (and the surveys upon which they are estimated and calibrated) provide no information about in-home activity engagement patterns. However, activity engagement inside the home is likely to contribute substantially to feelings of well-being (or lack thereof). Hence, in-home time use allocation patterns need to be estimated so that appropriate well-being measures (that account for both in-home and out-of-home activity engagement and time use) can be developed and computed. To overcome this challenge, a multiple discrete-continuous extreme value (MDCEV) model of in-home activity participation and time use allocations will be estimated on the American Time Use Survey (ATUS) data. This model can be applied to the output of the activity-travel record by any activity-based travel model to infer in-home activity engagement and time use patterns for each agent in the synthetic population. This information can, in turn, be used to compute a holistic well-being score that accounts for the entire slate of activities pursued by an individual inside and outside the home. The project will demonstrate the efficacy of the model by presenting an application of the model to a small sample of 2017 National Household Travel Survey (NHTS) records (which represent the output of an activity-based travel model for purposes of the demonstration).

The remainder of this report is organized as follows. The project objective is presented in the next section. The third section presents the modeling methodology and conceptual framework with data. The fourth section offers a description of the work plan. The fifth section presents the project schedule, while the sixth section presents the relevance to the center theme. Anticipated outcomes are offered in the seventh section following by research team, technology transfer plan, workforce development, and outreach plan.

2. Project Objectives

The notion that people's activity-travel patterns influence well-being and overall quality of life is well recognized. Nonetheless, activity-travel demand model outputs do not provide explicit measures of well-being that can be used to assess the impacts of alternative policies, investments, and technologies. Since activity-travel demand models lack information about in-home activity time allocation, it is virtually impossible to derive measures of well-being that account for in-home activity engagement. This study proposes developing a modeling framework for well-being score estimation that overcomes these challenges and serves as a tool to assess the quality of life implications of activity-travel patterns for diverse groups of the population.

3. Proposed Methodology and Data

This section presents the conceptual framework for the personal well-being score estimation and analysis tool proposed in this project. Figure 1 presents the framework with a view to identifying the components and steps that are involved in developing a well-being score for each individual in a synthetic population of agents. The fundamental premise underlying the conceptual framework is that well-being is determined by how people feel spending time traveling and engaging in different types of activities inside and outside the home.

Any output of an activity-based model includes information about out-of-home activities and travel episodes but includes no information about specific activities pursued inside the home. These activities do, however, contribute to well-being of an individual. Therefore, to compute a person well-being score, it is necessary to post-process the output of an activity-based model so that the time allocated to various activities inside the home can be determined. Once a full-fledged daily activity profile (in-home and out-of-home) is constructed for an individual, then a person-day level well-being score can be computed.

The process starts with the estimation of a multiple discrete continuous extreme value (MDCEV) model of in-home time allocation to various activity purposes. The MDCEV model (Bhat, 2008) essentially allocates a budget of resources (in this case, time at home) to various goods that are consumed (in this case, activities inside the home). The budget of resources is the total time spent at home. This can be easily computed from the output of an activity-based model for each synthetic agent by simply subtracting total out-of-home activity time and travel time from 1440 minutes. The MDCEV model of in-home activity participation and time allocation can be applied to the output of an activity-based travel model to construct the full daily activity and time use profile for each individual in the synthetic population.

The 2010, 2012, and 2013 editions of the American Time Use Survey (ATUS) data included a well-being module. All survey respondents were asked to rate three randomly identified activities that they reported in their time use diary on six emotional measures – happiness, meaningfulness, sadness, painfulness, stress, and tiredness. The respondents rated each emotion on a scale of 0 through 6, with higher scores indicating a greater intensity of the emotion. While happiness and meaningfulness can be characterized as positive emotions, the other four constitute negative emotions. In order to consolidate these emotions into positive and negative scores, a factor analysis will be conducted to identify two subjective well-being scores for each activity episode. The two positive emotions will be combined into a positive well-being score while the four negative emotions will be combined into a negative well-being score. The factor analysis essentially yields latent constructs that serve as indicators of positive and negative emotions; the factor scores (positive and negative) constitute linear combinations of the numeric ratings assigned by individuals to the various individual emotions. In order to obtain a "net" emotional score for each activity episode, the difference between the two scores (positive score – negative score) may be computed. This difference is termed the Activity Well-being Composite Score (AWCS).

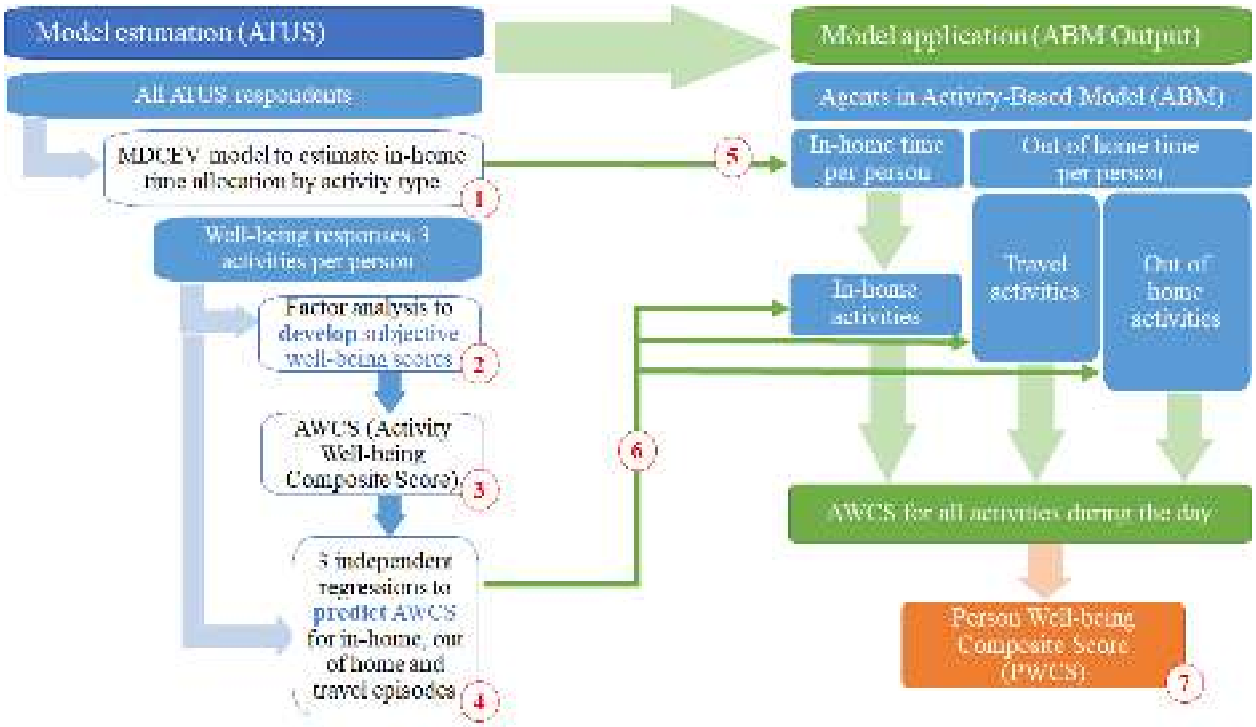

FIGURE 1 Summary of the Study Approach to Compute Daily Well-being Composite Score

Next, a set of linear regression equations of AWCS will be estimated for three activity episode types, namely, out-of-home activities, in-home activities, and travel. The regression equations include a number of socio-economic and demographic variables as well as activity episode attributes as explanatory variables. The AWCS served as the dependent variable in each regression equation. The regression equations can be applied to all of the activities and travel episodes that constitute an individual's daily activity engagement profile. In this way, an AWCS can be computed and attached to every activity undertaken by an individual in a synthetic population. In the end, the model system is intended to provide a single day-level Person Well-being Composite Score (PWCS) for each individual agent in the synthetic population of an activity-based travel demand model. The PWCS will be computed as a simple summation of all AWCS scores associated with various activities in the day. The summation operation implies that the scores associated with various activities are additive and that well-being is derived from an accumulation of emotions experienced over the course of pursuing various activities and travel episodes in a day.

The right-hand side of Figure 1 depicts how the model system may be applied to activity-travel records (such as those obtained as output from an activity-based travel demand model) to compute PWCS for synthetic agents. The efficacy of the model will be demonstrated in this paper by applying it to a random sample of records from the 2017 National Household Travel Survey (NHTS) data set (the activity-travel records in the NHTS data set are very similar to a typical activity-travel model output).

4. Work Plan (Project Tasks)

Task 1: Literature Review, and Data Assembly

During this task, a comprehensive review of the literature at the intersection of travel and wellbeing will be conducted. Furthermore, all the datasets from ATUS and NHTS which are needed to be analyzed will be assembled with the right sample size and list of variables in SPSS.

Task 2: Factor Analysis and Regression Estimation for Activity Wellbeing Score

The factor analysis on the positive and negative emotions reported in the wellbeing module of ATUS dataset will be conducted to estimate activity wellbeing scores for each activity. Once, each activity is assigned with a wellbeing score, regression models will be estimated to relate activity attributes and socioeconomic characteristics to activity wellbeing score for in-home, out-of-home, and travel activities separately.

Task 3: MDCEV Model Estimation for In-home Time Use

Using a random sample of ATUS data, the MDCEV model will be estimated for in-home time use activity participation to allocate in-home time to different activities conducted at home.

Task 4: Model Application for Personal Wellbeing Score Estimation

This step first utilizes the MDCEV estimated in the previous step to assign the time individuals (in NHTS model application sample) spend at home to different activities. Once each individual has a list of activities and travel episodes throughout the 24-hour, the regression models estimated in the previous steps will be applied to calculate wellbeing scores for all the activities for each person. Lastly, the activities wellbeing scores will be added to estimate a personal wellbeing score.

Task 5: Analyzing the Personal Wellbeing Score in relation to Socioeconomic Attributes

Using descriptive analysis and illustration explores the personal wellbeing score across various socioeconomic groups of the population to find out people with significant low and significant high scores and discuss potential reasons and how policy and decisionmaking can improve wellbeing scores for various groups of the population.

Task 6: Project Deliverables

The project deliverables including the research report and a research paper will be prepared in this step. Building an actual tool that practitioners can easily apply to estimate the wellbeing score is planned for the next phase of this project.

5. Project Schedule

Table 1 illustrates a table of timeline for all the tasks explained in the previous section.

TABLE 1 Project Schedule

Aug-17	Sep-17	Oct-17	Nov-17	Dec-17	Jan-18	Feb-18	Mar-18	Apr-18	May-18	Jun-18	Jul-18
Task 1											
		Task 2									
				Task 3							
						Task 4					
								Task 5			
										Task 6	

6. Relevance to the Center Theme/Mission

Transportation and well-being are inextricably connected with one another due to the activities and experiences that mobility enables. Transportation planners and policymakers strive to implement policies and direct investments in ways that would enable mobility for all, enhance access to destinations and opportunities for all, and increase quality of life. Despite the widespread recognition of the connection between well-being and activity-travel patterns, little progress has been made in translating measures of activity-travel behavior into measures of well-being. As a result, the time use patterns themselves are often viewed as indicators of well-being and quality of life. Those who do not travel are viewed as experiencing isolation and social exclusion; those who do not engage in discretionary activities are viewed as experiencing time poverty. While these notions are useful, the lack of a model that explicitly delivers measures of well-being as a function of socio-economic attributes, built environment attributes, and activity-travel pattern attributes renders it challenging to truly assess the quality of life (well-being) impacts of alternative investments, technologies, and policies. By considering wellbeing implications of transport policies and decisions, this project builds upon the mission of TOMNET to improve travel demand models and guide them toward wellbeing considerations.

7. Anticipated Outcomes and Deliverables

The proposed project will result in the development of a rich modeling framework on the interaction of activity time-use patterns and subjective wellbeing. The project will also result in the delivery of harmonized models that can estimate in-home time use activity pattern as a function of socioeconomic attributes. The project will also result in the publication of a final report and the preparation of presentations that document the entire study. It is anticipated that the modeling framework developed in this research effort can be used by any jurisdiction in the country interested in incorporating wellbeing measures in their travel demand model practices.

In a follow-up step, TOMNET researchers will develope the Wellbeing Estimator for Activities and Travel (WBEAT) using the modeling framework developed in this project. This special model is intended to serve as an add-on module for any activity-based travel demand model system. The methodology embedded in the module calculates a wellbeing index for each person in the simulation based on the activities (predicted to be) undertaken by that individual (including "travel" episodes) over the course of a day. Given the critical role that transportation plays in shaping wellbeing of communities, this tool will prove valuable in assessing and comparing the potential impacts of alternative transportation investments, policies, and mobility options on societal wellbeing. It is expected that WBEAT will be developed in consecutive years after the first year of the project that this proposal is intended for.

8. Research Team and Management Plan

The research team is led by Dr. Ram Pendyala, who will serve as the Principal Investigator for the project at ASU. Sara Khoeini will serve as the co-principal investigator for the project and will be in charge of working with graduate students to accomplish the analytical work of the project. The project will support one highly qualified Ph.D. student completely, and a few graduate research assistants (who will assist with different data assembly and model estimation practices) partially.

Ram M. Pendyala is a Professor of Transportation Systems in the School of Sustainable Engineering and the Built Environment at Arizona State University. He serves as the Director of TOMNET. Pendyala is an expert in activity-travel behavior modeling and has led the development of a number of large scale behaviorally robust microsimulation model systems. He has published extensively in the literature and serves as the Chair of the Transportation Research Board's Planning and Environment Group (2015-2018). He previously served as Chair of the Travel Analysis Methods Section (2009-2015) as well as the Traveler Behavior and Values Committee (2003-2009). He has also served as the Chair of the International Association for Travel Behaviour Research (IATBR). He is currently an Associate Editor for Transportation Research Part D. He has his Ph.D. and MS degrees in Civil and Environmental Engineering with a specialization in transportation from the University of California at Davis, and his Bachelor's degree in Civil Engineering from the Indian Institute of Technology-Madras in India.

Sara Khoeini is an Assistant Research Professor of Transportation Systems in the School of Sustainable Engineering and the Built Environment at Arizona State University. She is the Assistant Director of TOMNET. Sara has extensive experience in the study of traveler behavior and attitudes, particularly in the context of managed lane operations. She has deep expertise in statistical analysis of transportation data and travel behavior modeling. She has conducted special-purpose surveys to collect information about changes in travel behavior in response to changes in transportation system conditions. She has published her work in a variety of journals and has been active in several professional organizations. Sara has her Ph.D. from the Georgia Institute of Technology, MS from Clemson University, and her undergraduate degree from K.N.T. The University of Technology in Iran.

Sara Khoeini will be the primary point of contact for all aspects related to this research and will manage all aspects of the project. She will work closely with graduate students to accomplish the project tasks. Ram Pendyala will assist with various project tasks and provide significant input on the analytical and modeling work of the project.

9. Technology Transfer Plan

The project team believes in executing an effective technology transfer plan by disseminating project information and results widely to the professional community. During the one-year duration of this particular project, each milestone will be disseminated using one of the TOMNET communication mechanisms (e.g., website, webinar, seminar, teleconference). Project team members will prepare articles for publication in refereed journals and conference proceedings. Project team members will participate in conferences and deliver presentations about this work and the outcomes of the effort. The project will also result in the preparation of Wellbeing Estimator for Activities and Travel (WBEAT) which is a modeling tool that can be shared with the broader professional community so that other jurisdictions can mimic the study without any difficulty. The project team will conduct webinars and seminars and post all interim reports and technical memoranda online at the TOMNET website.

10.Workforce Development and Outreach Plan

The project incorporates a strong workforce development and outreach plan. The project will employ a full-time Ph.D. graduate student as a graduate research associate. The doctoral student will be involved in all aspects of the project including literature review, data assembly, and model estimation and application. At ASU, project team members will engage with the National Summer Transportation Institute, a three-week residential summer program for high school students that aims to expose them to transportation-related careers. Finally, the project will also welcome high school students who may be interested in serving as volunteer researchers under the TOMNET Scholar Initiative. Findings from the project will be integrated into graduate-level courses taught at various institutions in the consortium so that the research and workforce development activities of the center are seamlessly blended together.

11. References

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Bhat, C.R. (2008). The multiple discrete-continuous extreme value (mdcev) model: role of utility function parameters, identification considerations, and model extensions. *Transportation Research Part B, 42*(3), 274–303.

Friman, M., Gärling, T., Ettema, D., & Olsson, L.E. (2017). How does travel affect emotional wellbeing and life satisfaction? *Transportation Research Part A*, *106*, 170-180.

Lee, R.J., & Sener, I.N. (2016). Transportation planning and quality of life: Where do they intersect? *Transport Policy*, *48*, 146-155.

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Williams, J.R., Masuda, Y.J., & H. Tallis, H. (2016) A measure whose time has come: Formalizing time poverty. *Social Indicators Research*, *128*(1), 265–283.

Ziems, S.E., Konduri, K.C., Sana, B. & Pendyala, R.M. (2010). Exploration of time use utility derived by older individuals from daily activity-travel patterns. *Transportation Research Record*, *Journal of the Transportation Research Board*, *2156*, 111-119.

12. Qualifications of Investigators

RAM M. PENDYALA

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Arizona State University (ASU), Tempe, AZ 85287-3005 Email: pendyala@asu.edu

Education

Ph.D., Civil Engineering (Transportation), University of California-Davis, December 1992.
M.S., Civil Engineering (Transportation), University of California-Davis, June 1990.
B.Tech., Civil Engineering, Indian Institute of Technology-Madras, June 1988

Employment and Professional Experience (last 25 years)

Professor, Sustainable Engineering and the Built Environment, ASU, 2006-2014 & 2016-present.
Frederick R. Dickerson Chair Professor, School of Civil and Environmental Engineering, Georgia Institute of Technology, 2014-2016
Senior Sustainability Scientist - Global Institute of Sustainability, ASU, 2011-Present.
Asst/Assoc/Professor, Civil & Environmental Engineering, Univ of South Florida, 1994-2006.
Assistant Professor, Civil Engineering, University of Louisiana at Lafayette, 1992-1994.

Fields of Interest and Expertise

(1) Multimodal transportation systems planning; (2) Activity-travel behavior analysis; (3) Transportation demand modeling and forecasting; (4) Mobility analytics and visualization; (5) Statistical and econometric analysis of transportation data; (6) Dynamic mobility management; (7) Travel survey methods and data collection; (8) Built environment – transportation – energy

5 Recent Relevant Publications (from over 200)

1. Garikapati, V. M., Pendyala, R. M., Morris, E. A., Mokhtarian, P. L., and McDonald, N. (2016). Activity Patterns, Time Use, And Travel of Millennials: A Generation in Transition? *Transport Reviews*, 36(5), pp. 558-584.
2. Pinjari, A. R., Augustin, B., Sivaraman, V., Imani, A. F., Eluru, N., and Pendyala, R. M. (2016). Stochastic Frontier Estimation of Budgets for Kuhn–Tucker Demand Systems: Application to Activity Time-Use Analysis. *Transportation Research Part A*, 88, pp. 117-133.
3. Shin, J., Bhat, C. R., You, D., Garikapati, V. M., and Pendyala, R. M. (2015). Consumer Preferences and Willingness to Pay for Advanced Vehicle Technology Options and Fuel Types. *Transportation Research Part C*, 60, pp. 511-524.
4. Garikapati, V. M., You, D., Pendyala, R. M., Jeon, K., Livshits, V., and Vovsha, P. S. (2015). Tour Characterization Framework Incorporating Activity Stop–Sequencing Model System. *Transportation Research Record: Journal of the Transportation Research Board*, 2494, pp. 77-86.
5. Archer, M., Paleti, R., Konduri, K., Pendyala, R., & Bhat, C. (2013). Modeling the connection between activity-travel patterns and subjective well-being. *Transportation Research Record: Journal of the Transportation Research Board*, 2382, pp. 102-111.

Graduate Student Supervision/Advising

Graduated: 10 PhDs (includes 2 women), 50 Masters; **Current Supervision**: 4 PhDs

Recent Honors and Awards

Pyke Johnson Award for Best Paper in Planning and Environment, Transportation Research Board of the National Academies, 2011 and 2013
Invited Speaker, Distinguished Lecture Series, Department of Civil and Environmental Engineering, Florida International University, 2015

Invited Keynote Speaker at 5 International/National Conferences, 2014-2016

SARA KHOEINI

Assistant Research Professor, Sustainable Engineering and the Built Environment
Arizona State University (ASU), Tempe, AZ 85287-3005 Email: Sara. Khoeini@asu.edu

Education

Ph.D., Civil Engineering (Transportation), Georgia Institute of Technology, May 2014.
M.Sc., Civil Engineering (Transportation), Clemson University, Dec 2009.
B. Sc., Civil Engineering, K.N. Toosi University of Technology, Aug 2007.

Employment and Professional Experience (last 25 years)

Assistant Research Professor, Sustainable Engineering and the Built Environment, ASU, March 2017 – present
Research Affiliate, School of Civil and Environmental Engineering, Georgia Institute of Technology, April 2015 – Feb 2017
Research Scientist I, School of Civil and Environmental Engineering, Georgia Institute of Technology, March 2014 – March 2015

Fields of Interest and Expertise

(1) Urban transportation systems planning; (2) Travel behavior analysis; (3) Transportation demand modeling and forecasting; (4) Geographic Information Systems; (5) Statistical analysis of transportation data; (6) Travel survey methods and data collection; (7) Sustainability and energy

5 Recent Relevant Publications

1. **S. Khoeini**, and R. Guensler. "Socioeconomic Assessment: Conversion of I-85 High-Occupancy Vehicle to High-Occupancy Toll in Atlanta, Georgia"; Transportation Research Record: Journal of the Transportation Research Board, National Academy of Sciences; No. 2450.1, pp. 52-61, 2014.
2. **S. Khoeini**, R. Guensler. "Using Vehicle Value In place of income For Pricing Economic Analysis: A case study on Atlanta I-85 HOT lane"; Research in Transportation Economics, Special issue on "road pricing in US", Vol. 44, pp. 33-42, 2014.
3. F. Castrillon, M. Roell, **S. Khoeini**, R. Guensler. "The I-85 HOT Lane's Impact on Atlanta's Commuter Bus and Vanpool Occupancy"; Transportation Research Record Journal of the Transportation Research Board, National Academy of Sciences; No. 2470, pp. 169-177, 2014.
4. V. Elango, **S. Khoeini**, Y. Xu, R. Guensler. "Longitudinal GPS Travel Data and Breach of Privacy via Enhanced Spatial and Demographic Analysis"; Transportation Research Record: Journal of the Transportation Research Board, National Academy of Sciences; No. 2345, pp. 86-98, 2013.
5. **S. Khoeini**, R. Guensler, M. Rodgers, V. Elango. "Sensitivity of commuters' demographic characteristics to license plate data collection specifications: A case study for HOV-to-HOT project in I-85 corridor, Atlanta, GA"; Transportation Research Record: Journal of the Transportation Research Board, National Academy of Sciences; No. 2308, pp. 37-46, 2012.

Honors and Awards

Student of The Year, Georgia Tech National Center for Sustainable Transportation, 2013
WTS Helene M. Overly Memorial Scholarship, 2013
Best Student Paper Award, Freeway & Managed Lane Operations Meeting and Conference, Atlanta, GA, 2013
Ranked 2nd, Nationwide Graduate School Entrance Examination, Civil Engineering-Surveying, Iran, 2007

13. Budget Including Non-Federal Matching Funds

Institution: Arizona State University

Project Title: An Integrated Model of Activity-Travel Behavior and Subjective Well-being

Principal Investigator: Ram Pendyala

Budget Period: 8/1/2017 to 7/31/2018

CATEGORY	Budgeted Amount from Federal Share	Budgeted Amount from Matching Funds	Explanatory Notes; Identify Source of Matching Funds
Faculty Salaries			
Other Staff Salaries			
Student Salaries			
Fringe Benefits			
Total Salaries & Benefits			
Student Tuition Remission			
Operating Services and Supplies			
Domestic Travel			
Other Direct Costs (specify)			
Other Direct Costs (specify)			
Total Direct Costs			
F&A (Indirect) Costs			
TOTAL COSTS			

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

UTC Project Information	
Project Title	An Integrated Model of Activity-Travel Behavior and Subjective Well-being
University	Arizona State University
Principal Investigator	Ram Pendyala
PI Contact Information	Address: 660 S College Ave, CAVC Email: Ram.Pendyala@asu.edu
Funding Source(s) and Amounts Provided (by each agency or organization)	
Total Project Cost	
Agency ID or Contract Number	
Start and End Dates	8/1/2017 - 07/31/2018
Brief Description of Research Project	The notion that people's activity-travel patterns influence well-being and overall quality of life is well recognized. Nonetheless, activity-travel demand model outputs do not provide explicit measures of well-being that can be used to assess the impacts of alternative policies, investments, and technologies. Since activity-travel demand models lack information about in-home activity time allocation, it is virtually impossible to derive measures of well-being that account for in-home activity engagement. This study presents a model of well-being that overcomes this challenge. The model serves as a tool to assess the quality of life implications of activity-travel patterns for diverse groups of the population.
Describe Implementation of Research Outcomes (or why not implemented) Place Any Photos Here	TOMNET is developing the Wellbeing Estimator for Activities and Travel (WBEAT). This special model is intended to serve as an add-on module for any activity-based travel demand model system. The methodology embedded in the module calculates a wellbeing index for each person in the simulation based on the activities (predicted to be) undertaken by that individual (including "travel" episodes) over the course of a day. However, due to the time-insentiveness of accomplishing all the models proposed in this project, the actual development of the tool may be postponed to the next phase of the project.
Impacts/Benefits of Implementation (actual, not anticipated)	Given the critical role that transportation plays in shaping wellbeing of communities, this tool will prove valuable in assessing and comparing the potential impacts of alternative transportation investments, policies, and mobility options on societal wellbeing. WBEAT utilizes the models that will be estimated under the proposed project.
Web Links • Reports • Project Website	