Exhibit D

Research Project Requirement Template

How Effective are Marker Variables at Predicting Attitudinal Factor Scores? An Out-of-Sample Evaluation

Recipient/Grant (Contract) Number: The University of Texas at Austin; Georgia Institute of Technology / Grant # 69A3552344815 and 69A3552348320

Center Name: Center for Understanding Future Travel Behavior and Demand (TBD)

Research Priority: Improving Mobility of People and Goods

Principal Investigator(s): Patricia Mokhtarian

Project Partners: N/A

Research Project Funding: $93,544 (Federal + non-Federal funding)

Project Start and End Date: 10/1/2023 - 5/31/2024

Project Description: Despite the fact that our existing models are not up to the job of predicting travel behavior in today's rapidly changing landscape, and despite considerable evidence that attitudes help us explain behavior more completely and more meaningfully, attitudes are nowhere to be found in practice-oriented travel demand forecasting models. Two main objections have been raised to their inclusion: they are too cumbersome to measure, and difficult-if-not-impossible to forecast. This project would continue a line of research that focuses on overcoming the first objection. Specifically, the plan is to use machine learning methods to train a prediction function on one survey dataset (the "donor sample", and then apply that function to impute attitudes into another dataset (the "recipient sample"). This keeps the recipient survey less burdensome on the respondent, while allowing the dataset to receive attitudinal information that would otherwise be absent.

US DOT Priorities:

Equity (e.g. p. 36, "Data and data analysis methodologies are available to assist transportation planners in assessing equity, job quality, and accessibility issues when making decisions."): Objective variables (socio-economic traits, land use and transportation network characteristics) do not tell the whole story when it comes to predicting travel behavior. Attitude measurement can reveal time pressure, technological savviness, subjective well-being, and numerous other indicators that can identify inequities. Making it practical to include attitudes in regional planning models will improve their contribution to equitable transportation planning.

Climate and sustainability (e.g. p. 46): Understanding attitudes toward alternatives to internal combustion engine automobile travel is essential to our ability to predict the demand for those alternatives, and to design products that will be successful in the marketplace. Making it easier and less burdensome on the respondent to incorporate attitudes into transportation surveys will improve that understanding.

Transformation research (e.g. p. 50, "**Data Science:** Harness advanced data collection and data processing capabilities to create timely, accurate, credible, and accessible information to support transportation operations and decision-making"): The proposed research focuses precisely on this objective! It relies on the "Artificial intelligence (AI) and machine learning" trend described on p. 57, and is "Conduct[ing] exploratory research on transformational mobility data analytics" in keeping with the Data Science research priority on p. 59.

The proposed research clearly supports "U.S. DOT['s] encourage[ment of] UTCs to engage in research, education, and work-force development" (p. 68). The project is expected to generate one or more conference presentations, and ultimately a peer-reviewed journal article.

Outputs: The proposed project will produce new results illuminating the efficacy of using machine learning to impute missing attitudinal measures into a dataset and then using the imputed measures to help improve the prediction of travel behavior based on that dataset. The methods used and their results will be appropriately documented for replicability in future studies. However, although this line of inquiry has the potential to be transformative, it is still in exploratory stages, and thus it is probably premature to consider "codifying" this study's processes as definitive.

In view of the abbreviated duration of this grant period, we do not want to overpromise on outputs. At a minimum, we will produce a Power Point presentation that summarizes key findings. Ideally, we will produce a paper ready for conference presentation and/or submission to a peer-reviewed journal. The PI has a 33-year track record of extremely productive and impactful scholarship, and be counted on to produce the maximum quantity that can be achieved without sacrificing quality.

Outcomes/Impacts: The ambitious longer-term goal of this line of research is to influence regional planning agencies to incorporate attitudes into their (a) household travel survey instruments, and (b) travel demand forecasting models. If successful in so doing, the outcomes will be an increased understanding of travel behavior, and an improved ability to predict behavioral responses to societal trends, new technologies, infrastructure changes, and proposed or implemented policies.

A nearer-term goal is to train young transportation professionals through offering them caring professional mentorship; engaging them in rigorous and meaningful research; providing them opportunities for, and coaching them on, technical written and verbal communication; and helping them develop a broad and deep professional network.

In the long run, this line of inquiry has the potential to substantially change the practice of regional travel demand forecasting, by showing how attitudinal information can be incorporated into regional models. The resulting model improvements can be expected to lead to more effective transportation planning and decision-making. There will certainly be an increase in our knowledge with respect to attitudinal measurement and the use of machine learning to inform causal models.

Final Research Report: A URL link to the final report will be provided upon completion of the project.