Project Report

Attitudes towards Emerging Mobility Options and Technologies – Phase 1: Survey Design

Prepared for **Teaching Old Models New Tricks (TOMNET) Transportation Center**

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Disruptive transportation technologies such as autonomous vehicles and mobility-on-demand services are bringing transformative changes in the urban area. To enhance our understanding of various impacts of these new mobility options on travel behavior and relative consequences, people’s attitudes towards and perceptions of these technologies and services need to be measured and understood. This report summarizes the initial phase of a large-scale survey-based research study to understand people’s preferences and choices when it comes to future mobility options and technologies in the four southern US metro areas. The T4 survey (TOMNET Transformative Transportation Technologies Survey) is intended to collect very detailed and in-depth data about people’s mobility patterns, as well as attitudes towards and perceptions of emerging transportation options such as ridehailing services and autonomous vehicles. TOMNET consortium members, Arizona State University, Georgia Institute of Technology, and the University of South Florida, as well as a sister University Transportation Center (called D-STOP) led by the University of Texas at Austin, are joining forces to collect the survey data from a sample of residents in the four metropolitan regions of Tampa, Austin, and Atlanta in addition to Phoenix metro area. This report explains the first phase of the project report including the literature review, survey goals and objectives, and survey design. Moreover, the complete designed survey questionnaire is presented. The next phases of the project include the pilot survey deployment in the Phoenix metro area and the full survey deployment in all the four southern cities.</td></tr>
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EXECUTIVE SUMMARY

The Center for Teaching Old Models New Tricks (TOMNET), which is a Tier 1 University Transportation Center (UTC), aims to shed deep attitudinal and behavioral insights on the factors that affect a wide array of people's mobility choices in an era of new mobility options and technologies that will have a transformational impact on transportation. This report summarizes the initial phase of a large-scale survey-based research study to understand people's preferences and choices when it comes to future mobility options and technologies in the four southern US metro areas. The T4 survey (TOMNET Transformative Transportation Technologies Survey) is intended to collect very detailed and in-depth data about people's mobility patterns, as well as attitudes towards and perceptions of emerging transportation options such as ridehailing services and autonomous vehicles.

TOMNET consortium members, Arizona State University, Georgia Institute of Technology, and the University of South Florida, as well as a sister University Transportation Center (called D-STOP) led by the University of Texas at Austin, are joining forces to collect the survey data from a sample of residents in the four metropolitan regions of Tampa, Austin, and Atlanta in addition to Phoenix metro area. This report explains the first phase of the project report including the literature review, survey goals and objectives, and survey design. Moreover, the complete designed survey questionnaire is presented. The next phases of the project include the pilot survey deployment in the Phoenix metro area and the full survey deployment in all the four southern cities. Further work will go into an in-depth analysis of the survey results to respond to numerous research questions still unsolved about the usage pattern and perceptions around new transportation technologies. For further information on this project and accessing related project reports please visit the TOMNET UTC website at www.tomnet-utc.org or contact the project director at Sara.Khoeini@asu.edu.

INTRODUCTION

Emerging mobility options and technologies including autonomous vehicles and mobility-on-demand services are bringing transformative changes in the transportation landscape. To enhance transportation forecasting models considering the increasing penetration of disruptive forces, people's attitudes towards and perceptions of these technologies and services need to be measured and understood. Armed with such an understanding, it will be possible to specify and develop behavioral models that account for attitudes and perceptions, adoption cycles, and adaptation patterns. This project proposes the survey design, two phases of respondents' recruitment, data analysis, and modeling for a sample of more than four thousand individuals across the four southern US cities (Phoenix, Atlanta, Tampa, and Austin).

Autonomous vehicles (AV) (also referred to as driverless cars or self-driving cars) are capable of navigating without human input using an array of technologies such as radar, LIDAR, GPS, odometry, and computer vision. Most industry experts suggest that autonomous vehicles will be on the road within a few years (www.driverless-future.com). The Secretary of Transportation in the US stated at the 2015 Frankfurt Auto show that he expects driverless cars to be in use all over the world by 2025 (Frankfurter Allgemeine Zeitung). The Institute of Electrical and Electronics Engineers (IEEE) is predicting that up to 75 percent of all vehicles will be autonomous by 2040. Virtual ridehailing companies such as Uber and Lyft are beginning to change the transportation landscape in significant ways as they provide door-to-door mobility-on-demand with the use of mobile apps. In general, information technology is making rideshare and transit travel options more convenient using location-aware services and real-time data analytics.

With the emergence of new transportation technologies and services, it is critical for transportation forecasting models to be enhanced to account for market dynamics that will result from increased penetration of disruptive forces in the transportation domain. It is envisioned that the enhanced models will help decision-makers better plan for the transportation infrastructure systems and design marketing and policy strategies that maximize the benefits of these disruptive technologies. Attitudes and perceptions are likely to vary by socioeconomic characteristics, existing travel patterns and mobility experiences, and land use and built environment attributes. The overall goal of this project is to collect a rich set of data that includes information about people's travel behavior and their attitudes towards and perceptions of advanced transportation technologies and mobility options with a view to inform the development of robust behavioral models of technology adoption capable of reflecting impacts of these disruptive forces on traveler behavior and values.

The objectives of the first phase of the project include the development of a harmonized survey instrument and administration protocol that other jurisdictions can adopt to conduct similar surveys in their areas. There is significant interest in understanding how people may adapt and respond to the introduction of transformative transportation technologies, but there is considerable uncertainty in how best to design a survey and set of questions that elicit the information needed to develop well-specified behavioral models. This project proposed a survey which is called T4 (Transformative Technologies in Transportation) Survey with the objective of providing a data collection protocol and methodology that can be widely adopted.

The first phase of this project started in August 2017 and lasted for a year. Phase 1 includes the literature review, development of survey goals, objectives, detailed research questions, and survey questionnaire design. The second phase includes data collection which will happen in two phases: pilot and full deployment. The pilot phase of data collection will be conducted during fall 2018 (only in Phoenix metro area) and the full deployment is planned for summer 2019 (across all four southern metro areas). During the third phase, the research team will compile and clean the data, deeply analyze it using advanced

statistical methods, estimate econometric models, and produce the required reports and documentation. This project will provide a data collection protocol and methodology that can be widely adopted in addition to survey results and modeling products and outputs.

As part of a coordinated effort among TOMNET partners, Arizona State University will collect data from the Phoenix metro area, Arizona with a goal of 1000 responses. Similarly, Georgia Tech will collect the data for a similar sample size from the Atlanta metro area, Georgia; and the University of South Florida will apply the survey in the Tampa metro area, Florida. Moreover, the University of Texas at Austin, who has been our close collaborator for many years, will also deploy the same data collection which is supported by the D-STOP University Transportation Center at the University of Texas at Austin. The data collected across multiple jurisdictions will eventually be aggregated to produce a single dataset with a sample size of more than four thousand responses. This dataset will be unique in terms of large sample size, contents, and spatial expansion across multiple southern metro areas.

The remaining of this report will present a comprehensive description of all the steps taken to the complete survey design and is organized in the following sections: literature review, project goals and objectives, and survey design. The produced survey instrument to be deployed in the pilot phase of the project is presented in Appendix I at the end of this report.

LITERATURE REVIEW

Phase 1 of this project started in August 2017 and lasted for a year. A comprehensive review of previous studies around autonomous vehicles (AV) and ridehailing services helped identify data needs and behavioral dimensions of interest to focus on this study.

Autonomous Vehicles

Society of Automation Engineers (SAE - Society of Automation Engineers, 2018) has defined six levels of driving autonomation, going from no autonomy to a fully autonomous vehicle. To be consistent with the majority of academic and official publications, this text will use the terminology proposed by (SAE - Society of Automation Engineers, 2018) and shown in . When not specified, an autonomous vehicle refers to a vehicle with Level 5 of driving automation. The full level of autonomy (Level 5) will also be considered for the survey questionnaire and will be explained for the respondents.

Many positive outcomes are expected as a result of the widespread adoption of autonomous vehicles, such as increased traffic safety, enhanced mobility to those who cannot drive, increased capacity, the convenience of no need to drive or park the car, and more (Gkartzonikas & Gkritza, 2019). However, automated mobility also raises many concerns such as the potential increase in traffic congestion and vehicle miles traveled, reduced vehicle occupancy, liability issues, data safety issues, and more (Gkartzonikas & Gkritza, 2019). While multiple surveys have been conducted in measuring public opinions around autonomous vehicles, more research is essential to understand the perceptions and potential behaviors with respect to AVs across the time, location, and various segments of the populations with different socioeconomic characteristics, attitudes, and travel behaviors.

Efforts to understand users' attitudes and perceptions toward autonomous vehicles have been started a few years ago across the world using survey-based studies with various sample sizes and recruitment methods. Most of the previous studies have collected data about familiarity with autonomous vehicles. Based on a continental survey-based study, 67 percent in Germany, 50 percent in the U.S., 64 percent in China and, 29 percent in Japan have heard about automated vehicles and 53 percent in Germany, 41 percent in the U.S., 79 percent in China and, 61 percent in Japan believed that automated driving is a useful advancement (Continental, 2015). Based on another study conducted in the US and Canada, 75.9 percent of AAA members are slightly/moderately familiar with AVs (Menon et al., 2015). According to another study in the US, 54 percent are worried and 40 percent are enthusiastic about the development of driverless vehicles; 44 percent would and 54 percent would not ride in a driverless vehicle; 35 percent have heard a lot, 59 percent a little, and 6 percent have heard nothing at all about the effort to develop driverless vehicles (Smith and Anderson, 2017). These results highlight the fact that although the technology is under testing in the public streets, still there is a long way toward widespread awareness and motivation to use across the board. Therefore, it is important to understand the attributes of people that are familiar vs. not familiar with the technology when trying to improve public awareness. This goal needs a large sample across time, various segments of the population, and geographies to track its changes over time and plan the future accordingly.

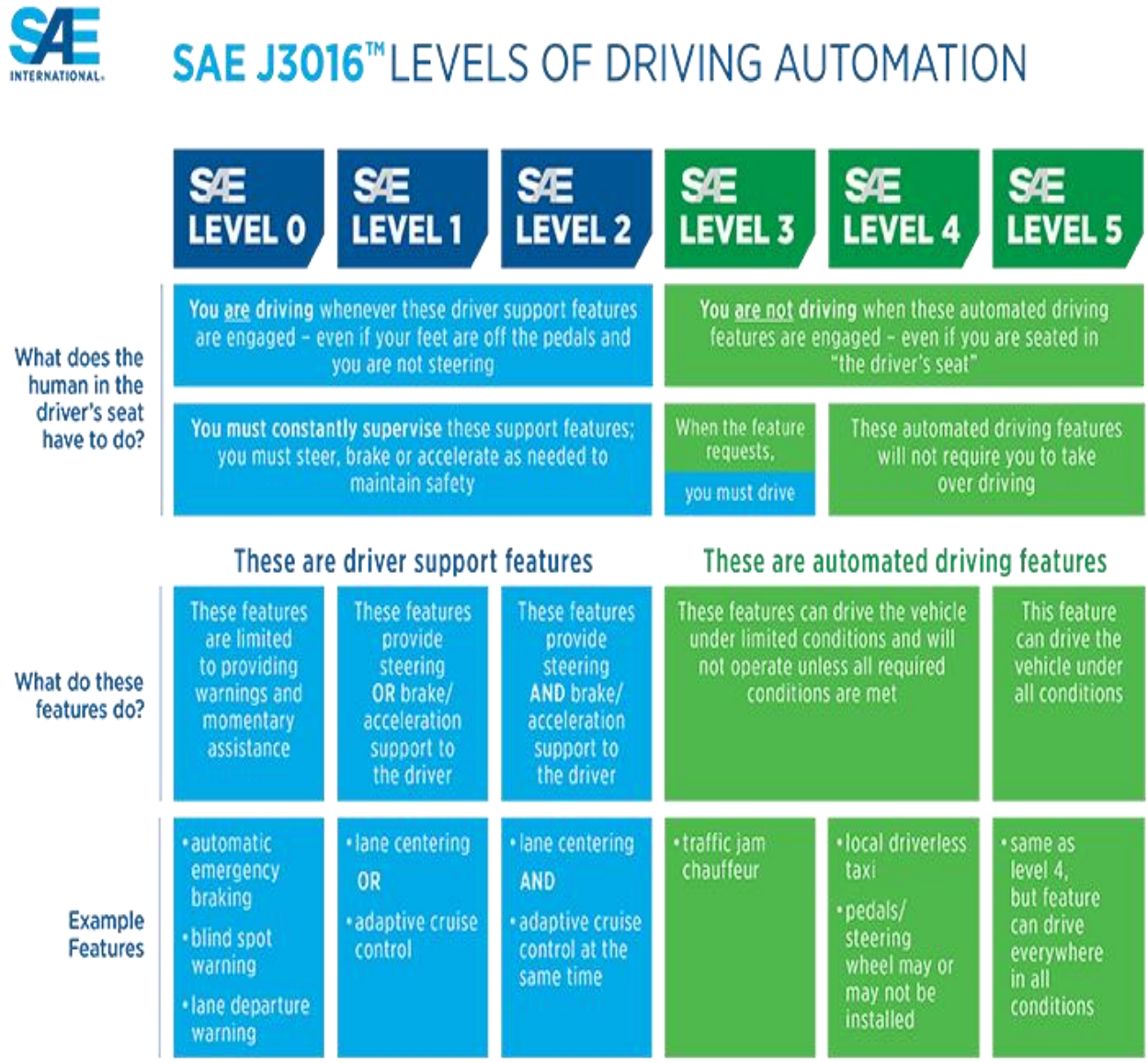

Figure 1 Levels of Driving Automation (Source: (SAE - Society of Automation Engineers, 2018))

With respect to willingness to adopt and pay for the vehicle automation technology, based on a study across all the united states, 38 percent of respondents reported they were quite or very much interested in using an automated car, and 17 percent indicated they would be quiet or very likely to purchase one in the future (Ward et al., 2017). Previous studies showed that willingness to adopt autonomous vehicles (AVs) is higher among young men, living in dense urban areas (Becker and Axhausen, 2017). Based on another study in the US, 14 percent will adopt the highest level of AV as soon as available, 15 percent when 10 percent of friends adopt, 32 percent when 50 percent of friends adopt, and 39 percent will never adopt it; Individuals with higher annual vehicle miles traveled (VMT) appear to be willing to pay more for a fully automated vehicle (Bansal and Kockelman, 2016). With respect to willingness to pay in the US, respondents are willing to pay slightly more than $3,500 for partial levels of automation and about $4900 for full automation (Daziano et al., 2017). Previous studies have shown a passion for driving and traffic conditions can influence the decision to adopt AVs (Schoettle and Sivak, 2014; Gurumurthy et al., 2018; Abraham et

al., 2017; Power 2012; and Kyriakidis et al., 2015). Multiple other studies have also measured willingness to pay (Bansal et al., 2016; Jardim et al., 2013; Kyriakidis et al., 2015; Laidlaw and Sweet, 2018) which mainly illustrate that the majority of people are not mostly willing to pay high amounts and/or in early stages. For a better understanding of underlying reasons for the observed low willingness to pay for the automated vehicle technology, in-depth stated preference choice questions under defined conditions in a full-spectrum survey with lifestyles, attitudes, and travel behavior attributes are desired.

People are not required to drive in the automated world of vehicles, and they can pretty much choose to do various activities while traveling. This driverless feature of AV can improve people's quality of life and productivity depending on how it will be used. Several studies ask people about how they are willing to spend their time in a fully automated car. However, 36 percent of respondents from China, 30 percent from India, 33 percent from Japan, 35 percent from the U.S., 44 percent from the U.K., and 43 percent from Australia would watch the road even though they would not be driving (Schoettle and Sivak, 2014). Another study across Texas showed that 60 percent will be talking to other passengers; 59 percent will be looking at the window; 46 percent will text or talk on the phone (Bansal and Kockelman, 2018). Time use in automated cars can be further explored in future studies to find out how people perceive the value of their driverless travel time during different trip purposes with or without accompaniments. This further exploration can shed light on the extents AV can potentially improve the quality of life and social productivity by releasing some extra time throughout the day. Moreover, increased comfort and the opportunity to multitask could have substantial impacts on AV adaptation patterns (Becker and Axhausen, 2017).

In terms of AV perceived benefits and concerns, safety was listed both as a concern and as a benefit of the AV technology (Becker and Axhausen, 2017). About, 53 percent believe AVs will have very significant results regarding crash reduction (Bansal and Kockelman, 2018). Other studies also support the approximate even split between positive and negative perceptions toward autonomous vehicles' safety (Continental, 2018; Jardim et al., 2013; and, Menon et al., 2015). Of those who would not ride an AV, 30 percent have safety concerns (Smith and Anderson, 2017). When AV becomes widespread, 30 percent believe the number of people killed or injured will increase and 39 percent believe it will decrease (Smith and Anderson, 2017). Oldest age group appears more amenable to using AV as a taxi with a backup driver (Nair et al., 2018). Results of previous studies also indicate that safety concern hinders the public acceptance of autonomous vehicles (Nazari at al., 2018). Because safety has an important role in shaping people's perceptions with respect to AVs, it is important to be investigated from different angles such as pedestrians, bicyclists, other non-AV vehicles, shared vs. owned AV vehicles, and responsible parties in crash events across various populations segments. This enhanced understanding of perceptions toward safety could improve awareness campaigns, auto manufacturers, and policymakers initiatives to build a safe car, conduct standard safety tests, and convince the public about the improved safety of autonomous vehicles compared to human-driven vehicles.

Other AV concerns that have been studied are security, privacy, reliability, and liability. 41 percent of Texas residents reported that lack of trust in this technology is one reason for not intending to use self-driving vehicles (Zmud and Sener, 2017). Disclosure of personal information/tracking records is a very likely potential concern of AVs for more than 40 percent of respondents (Shabanpour et al., 2018). 68 percent of respondents from China, 59 percent from India, 31 percent from Japan, 51 percent from the U.S., 49 percent from the U.K., and 44 percent from Australia are concerned about safety consequences of equipment/system failure when using fully AVs (Schoettle and Sivak, 2014). Equipment and system safety concerns more than 67 percent of the respondents (Nazari at al., 2018). While various studies present

considerable level of concerns about security and reliability of the technology among the public (Bansal and Kockelman, 2016; Jardim et al., 2013; and Nordhoff et al., 2018), it is important to understand who are the people that have such perceptions and what are the underlying reasons.

Regarding the impact of AVs on travel patterns, around 40 percent reported a willingness to use AVs for their everyday trips, but just one-third planned to use them for their or their children's school trips (Bansal and Kockelman, 2016). People also believe the number of long-distance trips they make will increase, by an average of 1.3 per month, after they have acquired an AV (Bansal and Kockelman, 2016). People who drove quite infrequently or almost never expressed a strong intention to use self-driving vehicles; 66 percent said their annual VMT would stay the same; and, 25 percent indicated it would increase (Zmud and Sener, 2017). 76 percent agree that they would like to use AVs in the carsharing scheme across the world (Nordhoff et al., 2018). However, Texas residents (59 percent) indicated that they would be more interested in owning a self-driving vehicle than in using a shared AV like a Car2Go or Uber (Zmud and Sener, 2017).

While previous studies did a good job of collecting users' perceptions around familiarity, adoption, benefits, and concerns of autonomous vehicles, less has been done around understanding the potential impacts of AVs on travel patterns, vehicle ownership, and residential choice. One reason is that it is difficult to correctly collect information about what people are willing to do under a scenario in the future which is not yet real and therefore easy to imagine. However, finding out the potential direction of travel behavior changes and follow-up longer-term decisions on vehicle ownership and the residential choice is essential to plan accordingly for the successful implementation of automotive technology with minimum negative impacts.

Ridehailing Services

Another transformative change in the transportation sector that has been started in the past decade is the introduction of shared mobility services. Carsharing, ridesharing, bike-sharing, and e-scooter sharing services are all shared mobility services that are currently under use in most urban areas across the US. Among these services, ridesharing (e.g. Uber and Lyft) is most popular and it has been defined under terms such as transportation network companies (TNCs), ridehailing, ride-sourcing, ridesharing, and mobility-on-demand services and can be easily requested in most urban areas using a cellphone app. Fares are calculated based on distance and time and paid through registered credit/debit cards on mobile apps. The service is offered in two forms of single-user and shared formats in some places while it is offered only in single-user form in other places.

Figure 2 illustrates the annual ridership increase of ridehailing services in comparison to the decrease in transit and taxi usage during the last decade. Ridehailing plus taxi ridership will exceed total bus ridership by 2018. The rapid adoption of ride-hailing poses significant challenges for transportation researchers, policymakers, and planners, as there are limited information and data about how these services affect travel patterns. Given the long-range business, policy, and planning decisions that are required to support transportation infrastructure (including public transit, roads, bike lanes, and sidewalks), multiple survey-based studies across the US have explored ridehailing attributes and potential impacts. Based on a previous survey study in California, 26 percent of American adults have used ride-hailing; while, 12 percent have never heard of these services (Alemi et al., 2018). Among those who indicated using the service, about half used the service less than once a month (Alemi et al., 2018). According to the Pew Research Center study, ridehailing is popular among young adults, college grads, high-income groups, and urbanites. Based

on another survey study in the Chicago area (Mahmoudifard et al. 2017), social activities represent 54 percent of the ridehailing trip purposes following by shopping (14 percent) and work (13 percent) trips.

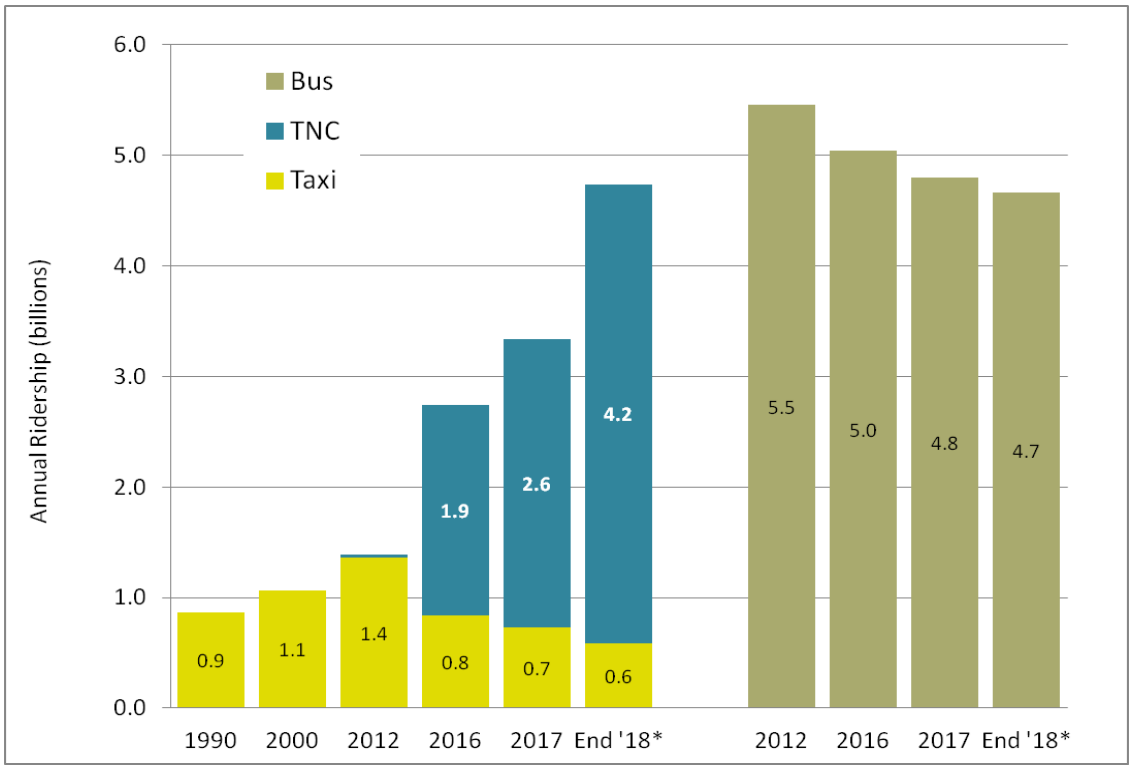

Figure 2 Ridehailing Annual Ridership; Source: Growth and Impacts of New Mobility Services. Bruce Schaller, TRB 2018 Annual Meeting, Washington DC.

One of the few studies that evaluated ridehailing services in seven major U.S. cities, in two phases from 2014 to 2016 (Clewlow and Mishra, 2017), found that in the absence of these services for the same trip 24 percent of users walk or bike; 21 percent use car or taxi; 18 percent carpool and 17 percent use transit. The potential negative impact of ridehailing travel mode on other more sustainable choices (transit, walk, and bike) has also been found in other studies (Alemi et al., 2018; Henao, 2017; and Rayle et al., 2016) with various amounts which warrant more research and a better understanding of the significance and reasons of this transition. Similarly, the impacts of ridehailing services on vehicle ownership and residential choice have not been consistent and comprehensively understood.

Literature Review Conclusion

While the findings of previous studies with respect to ridehailing services and autonomous vehicles shed light on some general attributes of these transformative changes, they are not conclusive in all aspects and many research questions are still on the table that needs rich data sources for studying. One reason is that their sample sizes are generally very limited (less than 500) which prevents deep learning of travel behavior across various population segments. The other reason is that they are limited in terms of geographical coverage and mostly represent one metro area. Studies that represent one metro area have all the characteristics of that metro area imported in the results as a latent factor inevitably and there is no way to remove the study area effect without comparison across multiple locations. Moreover, previous surveys

were not comprehensive in terms of collecting general attitudes as well as current travel behavior in addition to perceptions toward new transport technologies. Lastly, none of the studies before have approached ridehailing services and autonomous vehicles in one study to be able to understand their relationships as two main changes that the transport sector is facing.

Table 1 shows most of the recent survey-based studies related to AVs and ridehailing services that were presented in TRB 2018, with the addition of other relevant publications. The complete list of references used in Table 1 is presented at the end of this report in the references section. The table columns are survey data elements that have been covered in each one of the reviewed studies, while each row represents one study. This review helped us identify data gaps that needed to be addressed. Many of the previous surveys were missing data elements such as AV willingness to pay, AV residential location choice, AV ridehailing services, AV and vehicle ownership, AV impacts on travel patterns, policies related to AV, ridehailing services impacts on vehicle ownership and residential choices, impacts of AV and ridehailing services on other modes, micro-mobility services, and inclusion of AV and ridehailing services in the same study. Our designed and ready to implement T4 survey includes all the stated data elements. Moreover, the sample size of the proposed study will be significantly larger than previous studies, and this study will cover multiple southern metro areas across the United States.

Table 1 Comparison of similar surveys presented at the 97th Annual Meeting of TRB

Reference	**Autonomous vehicle**	**AV perception**	**AV adoption**	**AV willingness to pay**	**AV Residential location**	**AV ridesharing**	**AV+Ride hailing services**	**Ridehailing**	**RH perception**	**RH shared rides**	**Attitudes/ Lifestyle**	**Stated preference**	**Changes in travel behavior**	**Car ownership**	**Value of time/ time use**	**Multi-tasking**
Proposed Survey	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Asgari et al., 2018	✓	✓	⚠	✓	✗	✓	✓	✓	⚠	✓	✓	✓	✓	✗	✗	✓
Alemi et al., 2018	✗	✗	✗	✗	✗	✗	✗	✓	✓	✗	✓	✗	✓	⚠	✓	✗
Shabanpour et al., 2018	✓	✗	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	⚠	✗	✗	✗
Petrik et al., 2018	✗	✗	✗	✗	✗	✗	✗	⚠	⚠	✓	✓	✓	✗	✓	✓	✗
Hao et al., 2018	✓	✓	✗	✓	✗	✓	✗	✗	✗	✗	✗	✓	✗	✗	✗	✗
Bailey et al., 2018	✓	✓	✗	✗	✗	✗	✓	✓	✗	✗	✓	✗	✗	✗	✓	✓
Lahkar et al., 2018	✗	✗	✗	✗	✗	✗	✗	✓	✓	✗	⚠	✗	⚠	✗	✗	✗
Wang et al., 2018	✓	⚠	✓	✗	✓	✗	✗	✗	✗	✗	✓	✗	✗	⚠	✗	✗
Sener et al., 2018	✓	✓	✓	✗	✗	✗	⚠	✗	✗	✗	✓	✗	✓	✓	✗	✗
Nazari et al., 2018	✓	✓	✓	✗	⚠	✓	✓	✓	✗	✗	✓	✗	⚠	✓	✗	✗
Wadud et al., 2018	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✓	✓
Noblet et al., 2018	✓	✓	✓	✗	✗	✗	✗	✗	✗	✗	✓	✓	⚠	✗	✗	✗
Harb et al., 2018	✓	✗	✗	✗	✗	⚠	✗	✗	✗	✗	✓	✗	✓	✗	✗	✗
NASEM, 2018	✗	✗	✗	✗	✗	✗	✗	✓	⚠	⚠	⚠	✗	✓	✗	✗	✗
Circella et al., 2018	✗	✗	✗	✗	✗	✗	✗	✓	✓	⚠	✓	✗	✓	⚠	✓	✓

PROJECT GOALS AND OBJECTIVES

Considering the gaps and open research questions identified in the literature review section, a complete list of survey goals, objectives, and detailed research questions were compiled. The goal of the T4 survey is to understand people's perceptions and potential responses towards new transportation technologies, as well as to measure how general attitudes (e.g., technology savviness, environment friendliness, etc.) influence attitudes towards new transportation technologies. The complete list of the survey objectives is listed below:

- Collecting a random sample of 4000+ complete responses across four southern metro areas in the US (Phoenix, AZ; Austin, TX; Atlanta, GA, and Tampa, Fl)
- Testing the survey instrument through pilot recruitment to enhance the questionnaire and finalize the survey instrument method
- Collecting a rich dataset including
    - Socioeconomic profiles and a full spectrum of general and transportation-related attitudes
    - Current travel behavior (both commute and non-commute) including long-distance trips
    - Vehicle ownership status, and residential preferences and attributes
    - Current use and perceptions of mobility-on-demand services including ridehailing services (private and shared), carsharing services, and micro-mobility services (bicycles and e-scooters)
    - Perceptions of shared and automated mobility, and willingness to adopt
    - Potential impacts of shared and automated mobility on travel patterns, residential choices, vehicle ownership, and mode choice decisions
    - People attitudes and perceptions toward policies and restrictions related to operation and deployment of autonomous vehicles
- Analyze and model the collected datasets to enlighten the short-term and long-term impacts of transformative transportation technologies on people's lifestyle, time-use, and well-being, as well as travel, energy consumption, emissions, and congestion, and thus revise future demand models and activities forecasting models accounting for adaptation of these new transportation technologies. A list of the initial research questions identified in the literature review process and are planned for studying after the data collection is below. Further research studies can also be developed later.
    - How do various survey administration methods affect sample attributes and attitudes?
    - How women's willingness to share autonomous vehicles are different and why?
    - How many people are willing to pay for buying/riding autonomous vehicles using stated preference questions?
    - What are people's attitudes and perceptions toward policies and restrictions related to the operation and deployment of autonomous vehicles?
    - What is the relationship between the current use of ridehailing services and willingness to adopt autonomous vehicles in the future?
    - What might be the potential impacts of autonomous vehicles on mobility patterns/choices?
    - How much socioeconomics, attitudes, vehicle, and residential choice, and current mobility choices explain the adoption of new mobility options?
    - Who are the current users/non-users of ridehailing services? An in-depth attitudinal examination.
    - How much location matters in multi-city and intra-city comparison and analysis of perceptions towards and (potential) adoption of new mobility options?

- What types of trips are made by current ridehailing services and shared bicycle and e-scooter services and how other modes are impacted?
- When people make shared ridehailing trip choices using stated preference data?
- How people make transportation mode choices in a world of shared autonomous vehicles and ridehailing services? Rank-order analysis approach.
- Are there any generational differences in attitudes towards and potential adoption of emerging transportation technologies?

SURVEY DESIGN

The questionnaire and wording of the questions were carefully designed by a team with members from all the four institutes where the full survey will be deployed: Arizona State University, University of South Florida, the University of Texas at Austin, and Georgia Institute of Technology. Particularly, this report list of authors corresponds to the list of main people contributing to developing the T4 survey. The survey design team, consisting of junior and senior members of the field across different TOMNET core institutes, met regularly every week during the first phase of the project and discussed all details of the survey questionnaire with full consideration. Each question and/or sentence in the questionnaire has gone through multiple rounds of thought, design, and reviews to make sure it is in its best form in all aspects.

The review team consists of multiple survey design and travel behavior pioneers in the field both from and outside the TOMNET core researchers including but not limited to Dr. Patricia Mokhtarian, Dr. Ram Pendyala, Dr. Chandra Bhat, and Dr. Peter Stopher. Therefore, the survey questionnaire itself is a valuable source for collecting a comprehensive attitudinal travel behavior survey with a major focus on new mobility choices. It is highly recommended that this valuable piece of work be implemented across more metro areas to generate a larger harmonic sample across the US to improve the existing travel demand models by incorporating attitudes and perceptions toward new transport technologies. After many rounds of survey design and review processes, the survey questionnaire became ready and its paper version is attached in Appendix I. The online version of the survey has been designed using Qualtrics with the implementation of smart logics that facilitates the survey design compared to the paper survey for both the design team as well as the respondents.

Section A of the survey consists of 29 Likert-scale (strongly agree, agree, neutral, disagree, strongly disagree) attitudinal statements that shed light on personality traits and general lifestyle attributes including concerns around privacy and sharing, environment-friendliness, tech-savviness, and preferences around time use. Additionally, several statements with respect to general transportation perceptions and residential location preferences have been asked. For each of the attitudinal construct, multiple statements have been asked to make sure about the robustness of that attitudinal construct.

Section B of the survey is about vehicle ownership and residential choice. The attributes (Make, model, model year, and mileage driven annually) of all the vehicles available at the household have been asked in a table format. Furthermore, the availability of automated features on the vehicle that the respondent uses most often has been questioned. For the residential preferences, the attributes of the residential place of the respondents have been asked. Moreover, the attributes of the residential place that the respondents might consider when making a residential choice in the past or future have been asked in a Liker scale format (must have, want, neutral, and do not want).

It should be noted that section A (attitudinal statements) and section B (vehicle ownership and residential choice) are not directly about new transportation technologies. However, the relationship of adopting new transportation technologies as a function of attitudes, vehicle ownership, and residential

preferences found to be one of the shortcomings of the previous studies and the highlight of the T4 survey. With the availability of a large unbiased data and solid analysis, the research team is hoping for a better understanding of the impact of transformative forces in transport on vehicle and residential choices in the future. The findings of this study will help policymakers pave the technology adoption path for a better quality of life and minimize potential negative impacts.

Section C of the survey collects information about mode choice and travel patterns of the respondents for both commute and non-commute trips in detail. For commute trips, length, duration, parking status, and the number of days of the commute have been asked. The frequency of using each transport mode for both commute and non-commute trips have been also asked. Additionally, the information about mode, frequency, and purpose of long-distance trips (75 miles one-way) has been questioned. The data collected in this section will be analyzed in conjunction with attitudes toward new transport technologies to understand how people with various travel behavior patterns perceive and may respond to new transportation technologies differently. Additionally, this section is valuable by itself to be analyzed as a function of attitudinal statements to find out how people with various lifestyles travel differently. These findings are valuable for today's travel demand models to be enhanced by incorporating attitudes according to the core missions of TOMNET UTC.

Sections D and E are about new transportation technologies and services. Section D is devoted to mobility-on-demand services and section E is devoted to autonomous vehicles. Section D collects information on the current perceptions and usage pattern of mobility-on-demand and shared mobility services, including ridehailing services (such as Uber and Lyft) that can be requested in areas with service availability using mobile apps. The shared ridehailing services (such as UberX and Lyft Line) matches multiple rides with close origins and destinations together to save on travel costs with additional travel time. Carsharing services and micro-mobility services (bicycle and e-scooter sharing services such as Lime and Bird) were also included in this section.

Section D starts with a table that asks about the familiarity and frequency of using each one of the mobility-on-demand services explained in the previous paragraph. From those respondents who indicated themselves as users of ridehailing services, the complete details of the last ridehailing trip that the respondent remembers have been asked including location, length, time of the trip, presence of accompaniments, purpose, and substitute travel mode. A similar question has been asked from micro-mobility service users. Impacts of ridehailing usage on other travel modes have also been questioned. To measure people (users or non-users) perceptions toward ridehailing services advantages and disadvantages, a series of Likert scale statements have been provided. Lastly, the willingness to share the ridehailing service ride in presence of lower travel costs and longer travel time with additional passengers has been asked in a stated preference choice question with block design.

Section E focuses on autonomous vehicles' attitudes, perceptions, and potential usage. It should be noted that designing sensible survey questions around a technology that has not been yet introduced to the market was very challenging. For this matter, the survey team spent a tremendous amount of time on this survey trying to design questions that are comprehensible without any ambiguity to answer. The first paragraph of section E explained what this survey means by autonomous vehicle to clarify the operating scenario for the respondents. As it was explained in the body of the survey: "An autonomous vehicle (AV) is a vehicle that drives itself without human supervision or involvement. It picks up and drops off passengers including those who do not drive (e.g., children, elderly), goes and parks itself after dropping off passengers, and picks up and delivers goods and services. When AVs become available, ridehailing companies are likely to use them to provide rides without a human driver in the vehicle."

The respondents were asked to assume a future in which AV technologies are widely adopted, but human-driven vehicles are still present. Section E starts with familiarity with AVs, and willingness to buy and ride AVs. Although these questions have been collected in previous surveys, they haven't collected in a rich dataset to study the familiarity and willingness to use AVs across various demographic, transport-related, and attitudinal population segments. Moreover, familiarity and willingness to buy/ride AV should be collected across time and locations to enhance our understanding of market demand and perceptions in response to various factors. The willingness to commute longer, change vehicle ownership, and move residential place with accessibility to AVs have been also asked. The impact of AV on commute distance and consequently residential and/or workplace are very important to collect and have not been well addressed in previous studies. If people feel the convenience of the driverless nature of AVs and the productivity and/or relaxation that they can achieve during the AV ride, they may decide to move to farther locations to have access to better residential or workplaces based on their preferences. Although this seems attractive for AV users, it is against society's sustainability and transportation goals and it will add to congestion and carbon footprints. In addition to residential and workplaces, if people shift to choosing more distant destinations when AVs are accessible to them to reach more desired stores or restaurants, for example, it can similarly increase total VMT which is an important and possible concern with respect to AVs. This survey is trying to cover these important travel behavior implications of AVs comprehensively.

Next, a battery of attitudinal agree/disagree Liker-scale statements collects users' perceptions toward various potential benefit and concerns of AVs including the ability to multitask, serve people who can't drive, give a ride to children, safety, data security, reliability, sharing preferences, and etc. Lastly willingness to pay for AV has been covered in a regular multiple-choice question which asks for the extra amount people are willing to pay to have and AV upgrade on a regular rental car. Furthermore, willingness to pay has also been covered in stated preference questions with block design in a scenario when people want to make a decision on buying a new vehicle. The survey outline is summarized in the following and the detailed survey questions can be found in Appendix 1.

Survey Outline

- Section A: Attitudes and Preferences
    - A series of general attitudinal statements with Likert scale agree/disagree response options
    - Attitudinal themes: privacy and willingness to share; environment-friendly lifestyle; tech-savviness; personal time use; general transportation perceptions; and residential location preferences.
- Section B: Residential Choice and Vehicle Ownership
    - Current home address, type, and tenure, and choice process
    - Detailed residential preferences
    - Number and types of vehicles owned at the household
    - Vehicles driving assistant options
    - Respondent's and household members' driving status
- Section C: Current Travel Patterns
    - Commuting status, destination type, and address
    - Commuting frequency, duration, distance, and parking status
    - Frequency of different commuting travel mode
    - Frequency of different leisure/shopping/social trips travel mode
    - Physical or mental conditions

    - Total miles drive weekly
    - Long-distance trips frequency, modes, and distance
- Section D: Mobility on Demand and Shared Mobility Services
    - Ridehailing services use frequency
    - Details about the respondent's last trip with ridehailing services
    - Total amount spent on ridehailing monthly
    - Impact of ridehailing on the usage of other travel modes
    - A series of attitudinal statements with Likert scale agree/disagree response options
    - Stated preference choice question
- Section E: Autonomous Vehicles
    - Familiarity with AVs
    - Potential reaction to AVs whenever they become available in the market
    - Impact of AV usage on residential choice and commuting duration
    - Impact of AV on vehicle ownership and renting
    - Perception of the time remaining to publicly availability of AVs
    - A series of attitudinal statements with Likert scale agree/disagree response options
    - Stated preference choice question
- Section F: Background Information
    - Age, Gender, Race, Place of birth, Education, Household structure, and Income

CONCLUSIONS AND POLICY IMPLICATIONS

Disruptive transportation technologies such as autonomous vehicles and mobility-on-demand services are bringing transformative changes in the urban area. To enhance our understanding of various impacts of these new mobility options on travel behavior and relative consequences, people's attitudes towards and perceptions of these technologies and services need to be measured and understood. This project goal is to collect such information in multiple jurisdictions through a comprehensive attitudinal and behavioral survey. This report particularly covers the first phase of the project including literature review, defining the study goals and objectives, and survey design.

During the first phase of the project, a comprehensive literature review around two main transformative changes that the transport sector is facing has been conducted. Mobility-on-demand or shared mobility, and automation are the main changes that this study is aiming to address. With understanding the findings of the previous research studies and the research questions that are still under investigation, the project goals and objectives have been defined. The unique aspects of this survey are the combination of AV and ride-hailing services in a single survey; inclusion of battery of general attitudinal questions/statements (in addition to specific attitudinal statements on AV and ride-hailing services); random address-based sample (not convenient sample); consideration of residential location (long term), vehicle ownership (medium-term), and activity-travel (short term) impacts; and stated preference choice scenarios.

The goal is to collect a sample of 4000 responses across four southern metro areas of Phoenix (Arizona), Tampa (Florida), Atlanta (Georgia), and Austin (Texas) during the next phase of the project. Further work will go into an in-depth analysis of the survey results to respond to numerous research questions still unsolved about the usage pattern and perceptions around new transportation technologies. For further information on this project and accessing related project reports please visit the TOMNET UTC website at www.tomnet-utc.org or contact the project director at Sara.Khoeini@asu.edu.

REFERENCES

Abraham, H., Lee, C., Brady, S., Fitzgerald, C., Mehler, B., Reimer, B., & Coughlin, J. F. (2017, January). Autonomous vehicles and alternatives to driving: trust, preferences, and effects of age. In Proceedings of the Transportation Research Board 96th Annual Meeting (TRB'17).

Alemi, F., Circella, G., Handy, S., & Mokhtarian, P. (2018). What influences travelers to use Uber? Exploring the factors affecting the adoption of on-demand ride services in California. Travel Behaviour and Society, 13, 88-104.

Alemi, F., Circella, G., Mokhtarian, P., & Handy, S. (2018). On-demand ride services in California: Investigating the factors affecting the frequency of use of Uber/Lyft (No. 18-05563).

Asgari, H., Jin, X., & Corkery, T. (2018). A Stated Preference Survey Approach to Understanding Mobility Choices in Light of Shared Mobility Services and Automated Vehicle Technologies in the US. Transportation Research Record, 2672(47), 12-22.

Bailey, N., Rosenfield, A., & Zhao, J. (2018). Attitudes Toward Effective Time Use in Autonomous Mobility-on-Demand Services in Singapore (No. 18-00783).

Bansal, P., Kockelman, K. M., & Singh, A. (2016). Assessing public opinions of and interest in new vehicle technologies: An Austin perspective. Transportation Research Part C: Emerging Technologies, 67, 1-14.

Bansal, P., & Kockelman, K. M. (2016). Are Americans ready to embrace connected and self-driving vehicles? A case study of Texans. In 95th Annual Meeting of the Transpiration Research Board. Washington DC: TRB.

Bansal, P., & Kockelman, K. M. (2018). Are we ready to embrace connected and self-driving vehicles? A case study of Texans. Transportation, 45(2), 641-675.

Becker, F., & Axhausen, K. W. (2017). Literature review on surveys investigating the acceptance of automated vehicles. Transportation, 44(6), 1293-1306.

Circella, G., Alemi, F., Tiedeman, K., Handy, S., & Mokhtarian, P. (2018). The adoption of shared mobility in California and its relationship with other components of travel behavior.

Clewlow, R. R., & Mishra, G. S. (2017). Disruptive transportation: The adoption, utilization, and impacts of ride-hailing in the United States.

Continental, 2015. It's mine. Yes to mobility, insight and outlook 2015 continental mobility study, technical report. Retrieved at: http://report.conti-online.com/report2014/service/download/docs/mobility_study_2015_en.pdf.

Daziano, R. A., Sarrias, M., & Leard, B. (2017). Are consumers willing to pay to let cars drive for them? Analyzing response to autonomous vehicles. Transportation Research Part C: Emerging Technologies, 78, 150-164.

Driverless car market watch. 2018. www.driverless-future.com. Accessed May 8, 2018.

Frankfurter Allgemeine Zeitung. 2015. www.faz.net/aktuell/wirtschaft/unternehmen/verkehrsminister-foxx-selbstfahrende-autos-in-10-jahren-standard-13811022.html. Accessed June 8, 2019.

Gkartzonikas, C., & Gkritza, K. (2019). What have we learned? A review of stated preference and choice studies on autonomous vehicles. *Transportation Research Part C, 98*, 323-337. doi:10.1016/j.trc.2018.12.003

Growth and Impacts of New Mobility Services. Bruce Schaller, TRB 2018 Annual Meeting, Washington DC. Available at: www.schallerconsult.com/rideservices/schallertrb2018.pptx

Gurumurthy, K. M., & Kockelman, K. M. (2018). Analyzing the dynamic ride-sharing potential for shared autonomous vehicle fleets using cellphone data from Orlando, Florida. *Computers, Environment and Urban Systems, 71*, 177-185.

Hao, M., Li, Y., & Yamamoto, T. (2018). Assessing Public Preference and Willingness to Pay for Services of Shared Autonomous Vehicles: a Stated Preference Study in Nagoya, Japan (No. 18-02485).

Harb, M., Xiao, Y., Circella, G., Mokhtarian, P. L., & Walker, J. L. (2018). Projecting travelers into a world of self-driving vehicles: estimating travel behavior implications via a naturalistic experiment. *Transportation, 45*(6), 1671-1685.

Henao, A. (2017). Impacts of Ridesourcing-Lyft and Uber-on Transportation Including VMT, Mode Replacement, Parking, and Travel Behavior. University of Colorado at Denver.
IEEE news. 2012. www.ieee.org/about/news/2012/5september_2_2012.html. Accessed June 6, 2017.
Jardim, A. S., Quartulli, A. M., & Casley, S. V. (2013). A Study of Public Acceptance of Autonomous Cars.
Kyriakidis, M., Happee, R., & de Winter, J. C. (2015). Public opinion on automated driving: Results of an international questionnaire among 5000 respondents. Transportation research part F: traffic psychology and behaviour, 32, 127-140.
Lahkar, P., Murray-Tuite, P., & Hancock, K. (2018). Familiarity and Use of Transportation Network Company (TNC) Services in Virginia (No. 18-00230).
Laidlaw, K., & Sweet, M. N. (2018). Estimating Consumer Interest in Private Ownership and Shared Use of Autonomous Vehicles in the Greater Toronto-Hamilton Area (No. 18-01664).
Mahmoudifard, S. M., Kermanshah, A., Shabanpour, R., & Mohammadian, A. (2017). Assessing public opinions on Uber as a ridesharing transportation system: explanatory analysis and results of a survey in Chicago area (No. 17-01198).
Menon, N., A.R. Pinjari, Y. Zhang, and L. Zou. (2015). Consumer Perception and Intended Adoption of Autonomous Vehicle Technology – Findings from a University Population Survey. Presented at the 94th Annual Meeting of the Transportation Research Board, Washington, D.C.
Nair, G. S., Astroza, S., Bhat, C. R., Khoeini, S., & Pendyala, R. M. (2018). An application of a rank ordered probit modeling approach to understanding level of interest in autonomous vehicles. Transportation, 45(6), 1623-1637.
Nazari, F., Noruzoliaee, M., & Mohammadian, A. (2018). Shared Mobility Versus Private Car Ownership: a Multivariate Analysis of Public Interest in Autonomous Vehicles (No. 18-04289).
Noblet, C. L., Rubin, J., Eslin, A., & Jennings, R. (2018). What's 'Driving'Adoption of Automated Vehicles? (No. 18-01448).
Nordhoff, S., De Winter, J., Kyriakidis, M., Van Arem, B., & Happee, R. (2018). Acceptance of driverless vehicles: Results from a large cross-national questionnaire study. Journal of Advanced Transportation, 2018.
Petrik, O., Martínez, L. M., Furtado, F., & Kauppila, J. (2018). Are transport users willing to share? Focus groups and stated preferences study on shared mobility in Auckland, NZ, Dublin, IR, and Helsinki, FI (No. 18-04866).
Pew Research Center. 2016. "Shared, Collaborative and On Demand: The New Digital Economy". May 2016.
Power, J. D. (2012). Vehicle owners show willingness to spend on automotive infotainment features. Retrieved July, 24, 2017.
Rayle, L., Dai, D., Chan, N., Cervero, R., & Shaheen, S. (2016). Just a better taxi? A survey-based comparison of taxis, transit, and ridesourcing services in San Francisco. Transport Policy, 45, 168-178.
Schoettle, B., & Sivak, M. (2014). A survey of public opinion about autonomous and self-driving vehicles in the US, the UK, and Australia. University of Michigan, Ann Arbor, Transportation Research Institute.
Sener, I. N., Zmud, J., & Williams, T. (2019). Measures of baseline intent to use automated vehicles: A case study of Texas cities. Transportation research part F: traffic psychology and behaviour, 62, 66-77.
Shabanpour, R., Golshani, N., Shamshiripour, A., & Mohammadian, A. K. (2018). Eliciting preferences for adoption of fully automated vehicles using best-worst analysis. Transportation research part C: emerging technologies, 93, 463-478.
SAE - Society of Automation Engineers. (2018). Levels of Driving Automation. Warrendale, PA, United States of America. Retrieved from https://www.sae.org/news/press-room/2018/12/sae-international-releases-updated-visual-chart-for-its- percentE2 percent80 percent9Clevels-of-driving-automation percentE2 percent80 percent9D-standard-for-self-driving-vehicles
Smith, A., & Anderson, M. (2017). Automation in everyday life. *Washington: Pew Research Center*.
Wadud, Z., & Huda, F. Y. (2018). The potential use and usefulness of travel time in fully automated vehicles (No. 18-01566).

Wang, S., & Zhao, J. (2018). How Risk Preferences Influence the Usage of Autonomous Vehicles (No. 18-00785).
Ward, C., Raue, M., Lee, C., D'Ambrosio, L., & Coughlin, J. F. (2017, July). Acceptance of automated driving across generations: The role of risk and benefit perception, knowledge, and trust. In International Conference on Human-Computer Interaction (pp. 254-266). Springer, Cham.
Zmud, J. P., & Sener, I. N. (2017). Towards an understanding of the travel behavior impact of autonomous vehicles. Transportation research procedia, 25, 2500-2519.

APPENDIX I - SURVEY INSTRUMENT

Arizona State University

September 24, 2018

Dear Phoenix Area Resident,

We are doing a research study to better understand residents' travel needs and opinions about transportation, and design future transportation options in the region. Your participation is very important. We ask that the adult (18 years old or older) with the birthday closest to today's date (month/day only) complete this survey. If that person is unwilling or unable to do so, any other adult in the household can complete the survey.

We are interested in your answer to every question, even those dealing with topics that might be less familiar to you. As a token of appreciation, the first 100 respondents will receive a **$10 Amazon e-gift card or $10 Visa gift card.**

Your participation in the study is purely voluntary and your individual responses will be treated in strict confidence. The results of the study will be published only in summary form, so that your identity and privacy are protected. The survey will take about 30-40 minutes to complete, but we think you'll find it interesting and fun to do.

You may return the completed questionnaire using the enclosed business reply envelope. Or, if you prefer, you can take the survey online at **www.asutransportsurvey.com** using the following access code:

Access Code: XXXX

Please mail completed surveys by **October 30, 2018.** Even if you are unable to send the completed survey by that date, we would still welcome your response as soon as possible.

Thank you in advance for your participation in this important study. Reports of our findings will be posted at www.asutransportsurvey.com/reports as they become available. If you have any questions about the study, please do not hesitate to contact the study coordinator, Denise Silva, at denise.silva@asu.edu or 480-727-3613.

Sincerely,

Ram M. Pendyala, PhD
Professor and Interim Director, School of Sustainable Engineering and the Built Environment
Director, USDOT Tier 1 University Transportation Center

Your submission of the completed survey (whether online or by mail) implies that you agree to participate in this study and are 18 years or older. This research is funded by the US Department of Transportation and conducted by Arizona State University. This study has been reviewed and approved by the Arizona State University Institutional Review Board for the protection of study participants. If you have any questions about your rights as a subject/participant in this research, or if you feel you have been placed at risk, you may contact the Institutional Review Board, through the ASU Office of Research Integrity and Assurance, at (480) 965 6788.

Section A: Attitudes and Preferences

1. To begin, we would like to learn about your attitudes and opinions on transportation and life in general. Please check the response that most closely fits your reaction to each of the following statements. *There are no right or wrong answers. Even if a statement does not apply to you (e.g., if you do not commute), please imagine that it does apply and answer accordingly.*

	Strongly disagree	*Disagree*	*Neutral*	*Agree*	*Strongly agree*
I like to be among the first people to have the latest technology.	☐1	☐2	☐3	☐4	☐5
The government should raise the gas tax.	☐1	☐2	☐3	☐4	☐5
I feel uncomfortable around people I do not know.	☐1	☐2	☐3	☐4	☐5
I prefer to do one thing at a time.	☐1	☐2	☐3	☐4	☐5
Most of the time, I have no reasonable alternative to driving.	☐1	☐2	☐3	☐4	☐5
I am too busy to do many of the things I like to do.	☐1	☐2	☐3	☐4	☐5
Car crash deaths are an unfortunate but unavoidable part of a modern, efficient transportation system.	☐1	☐2	☐3	☐4	☐5
I am generally satisfied with my life.	☐1	☐2	☐3	☐4	☐5
I am committed to an environmentally friendly lifestyle.	☐1	☐2	☐3	☐4	☐5
Having to wait can be a useful pause in a busy day.	☐1	☐2	☐3	☐4	☐5
I prefer to shop in a store in person rather than online.	☐1	☐2	☐3	☐4	☐5
Learning how to use new technologies is often frustrating for me.	☐1	☐2	☐3	☐4	☐5
I would be fine with renting out my car to people I don't know.	☐1	☐2	☐3	☐4	☐5
Having internet connectivity everywhere I go is important to me.	☐1	☐2	☐3	☐4	☐5
I prefer to live close to transit even if it means I'll have a smaller home and live in a more densely populated area.	☐1	☐2	☐3	☐4	☐5
Sharing my personal information or location via internet-enabled devices concerns me a lot.	☐1	☐2	☐3	☐4	☐5
My daily travel routine is generally satisfactory.	☐1	☐2	☐3	☐4	☐5
When traveling in a vehicle, I prefer to be a driver rather than a passenger.	☐1	☐2	☐3	☐4	☐5
I prefer to live in a spacious home even if it is farther from public transportation or many places I go.	☐1	☐2	☐3	☐4	☐5
I am committed to using a less polluting means of transportation (e.g., walking, biking, and public transit) as much as possible.	☐1	☐2	☐3	☐4	☐5
Public transit is a reliable means of transportation for my needs.	☐1	☐2	☐3	☐4	☐5
I tend to feel sick if I read while in a moving vehicle.	☐1	☐2	☐3	☐4	☐5
I like trying things that are new and different.	☐1	☐2	☐3	☐4	☐5
I try to make good use of the time I spend traveling.	☐1	☐2	☐3	☐4	☐5
The level of congestion during my daily travel bothers me.	☐1	☐2	☐3	☐4	☐5
I definitely like the idea of owning my own car.	☐1	☐2	☐3	☐4	☐5
The time I spend going to places provides a useful transition between activities.	☐1	☐2	☐3	☐4	☐5
The functionality of a car is more important than its brand.	☐1	☐2	☐3	☐4	☐5
I like the idea of having stores, restaurants, and offices mixed among the homes in my neighborhood.	☐1	☐2	☐3	☐4	☐5

Section B: Vehicles You Have and Where You Live

Learning about the vehicles you have and where you live will help us better understand mobility and lifestyle choices. For your residence, please answer questions based on the location where you currently live most of the time. For example, if you are a college student, please consider your local address when answering all questions.

1. Do you have a driver's license? ☐1 No ☐2 Yes

2. How many people in your household have a driver's license (including you)?_____
*By "household" we mean "people who live together and share at least some financial resources." Ordinary housemates/roommates are usually **not** considered members of the same household.*

3. How many motorized vehicles (including four-wheelers and two-wheelers) are available in your household?_____
If you have **zero motorized vehicles** in your household, please enter "0" and **proceed to Question 6.**

4. Please provide details of all motorized vehicles (including four-wheelers and two-wheelers) available to your household. If your household has more than four vehicles, consider the four vehicles used the most. Please specify **Vehicle 1 as the vehicle you use most often.**

Vehicle	*Make*	*Model*	*Model Year*	*Year Acquired*	*Fuel Type*	*Annual Miles Driven (Estimate)*
Example	*Toyota*	*Camry*	*2004*	*2008*	■1 Gasoline ☐2 Electric ☐3 Hybrid ☐4 Other	*12,000*
1					☐1 Gasoline ☐2 Electric ☐3 Hybrid ☐4 Other	
2					☐1 Gasoline ☐2 Electric ☐3 Hybrid ☐4 Other	
3					☐1 Gasoline ☐2 Electric ☐3 Hybrid ☐4 Other	
4					☐1 Gasoline ☐2 Electric ☐3 Hybrid ☐4 Other	

5. Which of the following driving assistance features does **Vehicle 1** have? *Please check all that apply.*

☐1 Lane keeping system
☐2 Backup camera
☐3 Adaptive cruise control (ACC)
☐4 Automated braking system (ABS)
☐5 Other (please specify): _____
☐6 None
☐7 Not sure

6. What best describes the home you **currently** live in?

☐1 Stand-alone home
☐2 Mobile home
☐3 Attached home/townhome
☐4 Other (please specify): _____
☐5 Condo/apartment

7. Do you rent or own your home?

☐1 Rent
☐2 Provided by somebody else (e.g., relative, employer)
☐3 Own
☐4 Other (please specify): _____

8. What year did you move into your current home (*e.g.,* 2010)? _____

9. Did you choose your current home **location**? ☐₁ No, my home location was chosen by others
☐₂ Yes, I chose or helped choose my current home location

10. This question focuses on your preferences about homes and neighborhoods. If you participated in choosing your current home, please tell us what features led you to choose **your current residence.** If not, imagine that you are planning a move now: which of the following features would you seek for **your future home**?

	Do not want	*Neutral*	*Want*	*Must have*
Large home	☐₁	☐₂	☐₃	☐₄
Backyard	☐₁	☐₂	☐₃	☐₄
Single family home (stand-alone home)	☐₁	☐₂	☐₃	☐₄
Short commute	☐₁	☐₂	☐₃	☐₄
Close to shops/services	☐₁	☐₂	☐₃	☐₄
Close to parks/nature	☐₁	☐₂	☐₃	☐₄
Close to family/friends	☐₁	☐₂	☐₃	☐₄
Good public schools	☐₁	☐₂	☐₃	☐₄
Easy to walk or bike around neighborhood	☐₁	☐₂	☐₃	☐₄
Good access to public transit	☐₁	☐₂	☐₃	☐₄
Low crime neighborhood	☐₁	☐₂	☐₃	☐₄

Section C: Current Travel Patterns

1. Which one of the following best describes your current work/study status:

☐₁ Worker (part-time or full-time) ☐₃ Student (part-time or full-time)
☐₂ Both worker and student ☐₄ Neither worker nor student: *Please **go to Question 8** on page 4.*

2. On average, how many **days per week** do you…

a. Travel to work: _____ b. Travel to school: _____ c. Telecommute for work: _____

"Telecommute" refers to working from home or a location close to home, without the need to travel to the regular workplace at all.

3. If you physically travel to work/school, please **answer the following questions 3-7 for the most frequent destination.** Select the location for which you are answering this block of questions. If your school and work location are the same, please check both.

☐₁ School ☐₂ Work

4. How far do you live from your main work/school location? _____ Miles (Estimate of one-way trip distance)

5. On a typical day, how long does it take you to get from home to your main work/school location? _____ Minutes

*If you **do not commute by driving a car, please go to Question 7.***

6. Approximately how much time and money, do you spend for parking at work/school?

a. Cruising to find a parking spot: _____ Minutes
b. Walking from parking spot to my destination: _____ Minutes
c. Out-of-pocket parking cost *(Please report 0 if free or paid by employer)*: $ _____ per ☐₁ day, ☐₂ week, ☐₃ month, ☐₄ year

7. Considering only your **commute to work/school**, please indicate how often you typically use the following means of transportation for any part of your commute.

	Never use	*Less than once a month*	*1-3 times a month*	*1-2 times a week*	*3 or more times a week*
Drive private vehicle, alone	☐1	☐2	☐3	☐4	☐5
Drive private vehicle, with passengers	☐1	☐2	☐3	☐4	☐5
Ride in private vehicle, with others	☐1	☐2	☐3	☐4	☐5
Public transit (e.g., bus, light rail)	☐1	☐2	☐3	☐4	☐5
Uber/Lyft (any ridehailing service)	☐1	☐2	☐3	☐4	☐5
Taxi	☐1	☐2	☐3	☐4	☐5
Bicycle	☐1	☐2	☐3	☐4	☐5
Walk	☐1	☐2	☐3	☐4	☐5
Other (please, specify): _____	☐1	☐2	☐3	☐4	☐5

8. Considering only your **errands/shopping/social/recreational/eat-out/medical trips**, please indicate how often you typically use the following means of transportation for any part of your trips:

	Never use	*Less than once a month*	*1-3 times a month*	*1-2 times a week*	*3 or more times a week*
Drive private vehicle, alone	☐1	☐2	☐3	☐4	☐5
Drive private vehicle, with passengers	☐1	☐2	☐3	☐4	☐5
Ride in private vehicle, with others	☐1	☐2	☐3	☐4	☐5
Public transit (e.g., bus, light rail)	☐1	☐2	☐3	☐4	☐5
Uber/Lyft (any ridehailing service)	☐1	☐2	☐3	☐4	☐5
Taxi	☐1	☐2	☐3	☐4	☐5
Bicycle	☐1	☐2	☐3	☐4	☐5
Walk	☐1	☐2	☐3	☐4	☐5
Other (please, specify): _____	☐1	☐2	☐3	☐4	☐5

9. Do you have any conditions that prevent or limit you from …

	Yes	*To some extent*	*No*
Driving in general	☐1	☐2	☐3
Driving at night	☐1	☐2	☐3
Driving on freeways	☐1	☐2	☐3
Being driven to places as a passenger	☐1	☐2	☐3
Taking public transit	☐1	☐2	☐3
Biking	☐1	☐2	☐3
Walking	☐1	☐2	☐3
Traveling in an airplane	☐1	☐2	☐3

10. Are there any adults (i.e., 18 years old or older) in your household other than yourself with conditions that either partially or fully limit their ability to drive? ☐1 No ☐2 Yes

11. On average, how many total miles **do you drive** in a week? If you drive for your job (e.g., bus, truck, and taxi), please **do not include** miles you drive while "on the clock" for your job.

☐₁ Zero ☐₂ 1-50 miles ☐₃ 51-150 miles ☐₄ 151-300 miles ☐₅ 301-500 miles ☐₆ More than 500 miles

12. Please provide an estimate of the number of trips you have made over the past **3 months** that were **at least 75 miles** (**one-way**) from your home. Do **not** include commute trips. If you visited **multiple destinations** on a journey, treat that as one long distance trip.

_____ Trips (Total long-distance trips)

a. How many of your long-distance trips were done by car? _____ Trips by car

b. How many of your long-distance trips were done by airplane? _____ Trips by airplane

c. How many of your long-distance trips were within US? _____ Trips within US

Section D: Mobility on Demand and Shared Mobility Services

This section asks about your use of **ridehailing services** such as Uber and Lyft, which provide door-to-door transportation via a smartphone app. This section also includes questions about carsharing and bike/scooter sharing services. Even if you have not used these services, please answer all questions to the best of your ability.

1. Please indicate how often you use the following transportation services?

	I am not familiar with it	*I am familiar but not a current user*	*I use it less than once a month*	*I use it 1-3 times a month*	*I use it 1-2 times a week*	*I use it 3 or more times a week*
Single-passenger ridehailing (e.g., Uber, and Lyft)	☐₁	☐₂	☐₃	☐₄	☐₅	☐₆
Shared ridehailing (e.g., uberPOOL, and Lyft Line)	☐₁	☐₂	☐₃	☐₄	☐₅	☐₆
Carsharing (e.g., Zipcar, and car2go)	☐₁	☐₂	☐₃	☐₄	☐₅	☐₆
Bicycle/scooter sharing (e.g., Lime, ofo, Spin, and Bird)	☐₁	☐₂	☐₃	☐₄	☐₅	☐₆

*If you have **never used ridehailing services, please go to Question 5 on page 7.***

2. As a result of ridehailing (e.g., Uber/Lyft), how has your use of each of the following travel options changed?

		Because of ridehailing I use this …		
	*I have changed usage, but **not** because of ridehailing*	*less often*	*about the same*	*more often*
Drive private vehicle, alone	☐₁	☐₂	☐₃	☐₄
Drive private vehicle, with others	☐₁	☐₂	☐₃	☐₄
Ride in private vehicle, with others	☐₁	☐₂	☐₃	☐₄
Public transit	☐₁	☐₂	☐₃	☐₄
Taxi	☐₁	☐₂	☐₃	☐₄
Bike	☐₁	☐₂	☐₃	☐₄
Walk	☐₁	☐₂	☐₃	☐₄

3. Consider the **last trip** you can recall using ridehailing services. Please answer the questions below for this trip. If you don't remember all of the information precisely, your best guess is fine. You can also refer to your trip history in the app.

What type of ridehailing service did you use?	☐$_1$ Single-passenger ridehailing (e.g., Uber, Lyft) ☐$_2$ Shared ridehailing (e.g., uberPOOL, Lyft Line)
Where did you travel using this service? *Provide major cross-streets or landmark and city name.*	From: _____ To: _____
When did you use it?	☐$_1$ Weekday daytime ☐$_2$ Weeknight (excluding Friday night) ☐$_3$ Weekend daytime ☐$_4$ Weekend night time (including Friday night)
About how long was your **wait time** for this trip?	_____ Minutes
About how long was the **travel time**?	_____ Minutes
About how much did the **trip cost**?	$_____ or ☐$_0$ I don't know because someone else called the ride.
What was the main **purpose** of the trip? Please check **the best answer**.	☐$_1$ Work/school ☐$_2$ Shopping/errands ☐$_3$ Eating/drinking ☐$_4$ Social/recreational ☐$_5$ To airport ☐$_6$ To public transit ☐$_7$ Medical/dental ☐$_8$ Going/returning home from another location ☐$_9$ Other (please specify): _____
How many **other passengers** traveled with you?	☐$_1$ I was the only passenger *OR* _____ family members, friends or colleagues _____ other passengers matched via the app (for shared ridehailing)
How would you have made the trip if this service were **not** available? *Choose the most likely option.*	☐$_1$ Drive alone ☐$_2$ Carpool (e.g., get a ride from a friend or family member) ☐$_3$ Public transit ☐$_4$ Bike or walk ☐$_5$ Taxi ☐$_6$ Other (please, specify): _____ ☐$_7$ I would not have made this trip, at this time or location
Assume that shared ridehailing (e.g., uberPOOL or Lyft Line) was available for this trip, allowing for cheaper fares but longer travel times to reach your destination. What is the maximum additional travel time you would have accepted if the fare was **half** of what you paid?	☐$_1$ I already made this trip using shared ridehailing ☐$_2$ I would not have used shared ridehailing for this trip ☐$_3$ 1-5 minutes ☐$_4$ 6-10 minutes ☐$_5$ 11-15 minutes ☐$_6$ 16 or more minutes

4. In the **last month**, about how much did you spend on all ridehailing services?

☐$_1$ $0 - $9 ☐$_2$ $10 – $29 ☐$_3$ $30 - $49 ☐$_4$ $50 - $74 ☐$_5$ $75 - $100 ☐$_6$ More than $100

5. Please rate your level of agreement with each of the following statements regarding ridehailing services (e.g., Uber/ Lyft). Even if you do not currently use these services, your opinions about them are important to us.

	Strongly disagree	*Disagree*	*Neutral*	*Agree*	*Strongly agree*
Ridehailing services are expensive.	☐1	☐2	☐3	☐4	☐5
Ridehailing services are reliable.	☐1	☐2	☐3	☐4	☐5
Ridehailing services help save time and money on parking.	☐1	☐2	☐3	☐4	☐5
Ridehailing services help avoid impaired driving (e.g., driving under the influence).	☐1	☐2	☐3	☐4	☐5
Ridehailing services are good alternatives when my car is temporarily unavailable (e.g., when it is being repaired).	☐1	☐2	☐3	☐4	☐5
Ridehailing services are good alternatives when I am away from home.	☐1	☐2	☐3	☐4	☐5
Ridehailing services help me get to/from public transit facilities.	☐1	☐2	☐3	☐4	☐5
Ridehailing services are good alternatives when or where public transit (e.g., bus, light rail) is not available.	☐1	☐2	☐3	☐4	☐5
Ridehailing services allow me to live with fewer or no cars.	☐1	☐2	☐3	☐4	☐5
Traveling with a driver who I don't know concerns me a lot.	☐1	☐2	☐3	☐4	☐5
For shared ridehailing services, traveling with strangers (e.g., other passengers) makes me feel uncomfortable.	☐1	☐2	☐3	☐4	☐5
For shared ridehailing services, the lower cost is worth the additional time picking up and dropping off other passengers.	☐1	☐2	☐3	☐4	☐5
The lack of a child safety seat prevents me from using ridehailing services.	☐1	☐2	☐3	☐4	☐5
The lack of equipment to accommodate disabilities prevents me from using ridehailing services.	☐1	☐2	☐3	☐4	☐5
Ridehailing service availability affects where I choose to live and/or work or go to school.	☐1	☐2	☐3	☐4	☐5

6. Imagine that you call a ride through a smartphone app. For each of the **trip purposes** below (*i.e.*, **for each row**), check the option you would choose. Choose either the single-passenger (Option 1) or shared (Option 2) ridehailing options based on the trip attributes (trip cost/travel time/additional passengers). *Note that the travel times include your waiting time and the extra time picking up/dropping off other passengers if there are any.*

	Option 1: **Single-passenger ridehailing** (e.g., Uber and Lyft)	**Option 2:** **Shared ridehailing** (e.g., uberPOOL and Lyft Line)
Social/Recreation	☐1 $ 18.00/ 20 minutes	☐2 $ 12.00/ 35 minutes/ three additional passengers
Shopping	☐1 $ 13.00/ 15 minutes	☐2 $ 10.00/ 25 minutes/ two additional passengers
Work/School	☐1 $ 8.00/ 10 minutes	☐2 $ 6.00/ 15 minutes/ one additional passenger

Section E: Autonomous Vehicles

PLEASE READ THIS SECTION CAREFULLY.

An **autonomous vehicle (AV)** is a vehicle that drives itself without human supervision or involvement. It picks up and drops off passengers including those who do not drive (e.g., children, elderly), goes and parks itself after dropping off passengers, and picks up and delivers goods and services. When AVs become available, ridehailing companies are likely to use them to provide rides without a human driver in the vehicle. When answering the questions in this section, please assume a future in which AV technologies are widely adopted, but human-driven vehicles are still present.

1. Which of the following statements best describes your **familiarity with AVs**?

   ☐ 1 I have never heard of AVs before.
   ☐ 2 I have heard of AVs, but don't know anything about how they work.
   ☐ 3 I have heard of AVs and am somewhat familiar with how they work.
   ☐ 4 I have heard of AVs and am very familiar with how they work.
   ☐ 5 I have actually taken a ride in an AV.

2. Imagining a future with AVs, please rate your level of agreement with each of the following statements:

	Strongly disagree	*Disagree*	*Neutral*	*Agree*	*Strongly agree*
I will be one of the first people to buy an AV.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
I will eventually buy an AV, but only after AVs are common on our roads.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
I would ride in an AV alone or with others I know.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
I would use an AV ridehailing service with other passengers who are strangers to me.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
I will never use an AV.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

*If you **do not commute** to work/school, **go to Question 4**.*

3. Imagine you have access to an AV by owning or borrowing such a vehicle, or using AV ridehailing services. Given that it is possible to engage in other activities (e.g., work, eat, sleep, play, watch video) during the ride, **how much longer** would you be willing to **commute** to or from work/school if you were riding in an AV?

   ☐ 1 Not a single minute more than my current commute
   ☐ 2 Up to 5 minutes more (one-way)
   ☐ 3 Between 5 and 10 minutes more (one-way)
   ☐ 4 Between 11 and 20 minutes more (one-way)
   ☐ 5 Between 21 and 30 minutes more (one-way)
   ☐ 6 31 minutes or more (one-way)

4. Would you **change where you live** if AVs were available? *Please check the single best answer.*

   ☐ 1 Yes, I would move closer to the locations I visit most often (e.g., workplace or school).
   ☐ 2 No, the availability of AVs would not change where I live.
   ☐ 3 Yes, I would move farther from the locations I visit most often (e.g., workplace or school) so that I can be closer to recreational opportunities or live in a large home with a big yard and open space.

5. How much do you agree with the following statements about AVs?

	Strongly disagree	*Disagree*	*Neutral*	*Agree*	*Strongly agree*
Riding in AVs would allow me to use travel time for other activities.	☐1	☐2	☐3	☐4	☐5
I would travel farther (longer distances) when AVs are available.	☐1	☐2	☐3	☐4	☐5
I would make additional trips using AVs (that I don't make at this time).	☐1	☐2	☐3	☐4	☐5
I would send an AV to pick up groceries/laundry/food orders by itself.	☐1	☐2	☐3	☐4	☐5
I would send an AV to serve family members and friends without me.	☐1	☐2	☐3	☐4	☐5
I would feel comfortable having an AV pick-up/drop-off children without adult supervision.	☐1	☐2	☐3	☐4	☐5
I would be willing to pay a few additional dollars to have a backup human driver inside the AV during my ridehailing service ride.	☐1	☐2	☐3	☐4	☐5
I would be comfortable leasing my AV to ridehailing companies to earn extra money when the vehicle is not in use.	☐1	☐2	☐3	☐4	☐5
Autonomous vehicles are significantly safer than human-driven vehicles.	☐1	☐2	☐3	☐4	☐5
I would be concerned about the safety of pedestrians and cyclists in an AV future.	☐1	☐2	☐3	☐4	☐5
An AV should prioritize the safety of its own passengers over that of pedestrians, bicyclists, and other vehicles on the road.	☐1	☐2	☐3	☐4	☐5
I would support laws requiring AVs to travel at lower speeds on city streets to avoid a collision if a person steps in front of the vehicle.	☐1	☐2	☐3	☐4	☐5
In an AV crash, the vehicle's owner and her/his insurance company should be held responsible (rather than the manufacturer).	☐1	☐2	☐3	☐4	☐5

6. Considering **the number of cars** your household currently owns, would that **change if AVs were available for purchase or use as a ridehailing service**?

☐1 Very likely to own fewer cars
☐2 Somewhat likely to own fewer cars
☐3 Most likely to own the same number of cars
☐4 Somewhat likely to own more cars
☐5 Very likely to own more cars

7. Imagine you are **renting** a regular human-driven vehicle for a **long-distance leisure trip (over 75 miles one-way)** at the rate of **$40 per day**. Suppose the car rental company offered you an AV as an upgrade. What is the highest amount you would be willing to pay to rent the AV?

☐1 Would not rent the AV, regardless of the price
☐2 $40 per day (that is, same as non-AV option)
☐3 $50 per day
☐4 $75 per day
☐5 $100 per day

8. How many years do you think it will take for AVs to make up **more than half** the vehicles on the roads?

☐1 5 years or less
☐2 16-25 years
☐3 6-10 years
☐4 More than 25 years
☐5 11-15 years
☐6 Never

9. Imagine that AVs are now available for purchase, lease/rent, or to use via ridehailing services. What would you do when **faced with your next car purchase decision** in each of the following scenarios? Please rank the **options based on your preference (1=most preferred; 3=least preferred).**

***Scenario 1: About 25%** of all vehicles around you are AVs.*

Options	**Option 1:** Buy a regular vehicle	**Option 2:** Buy an AV	**Option 3:** Don't buy a vehicle and use AV ridehailing/rental services
Costs	$ 200/month + $ 0.25/mile	$ 250/month + $ 0.50/mile	$ 0/month + $ 1.00/mile
Rank	_____	_____	_____

***Scenario 2: About 75%** of all vehicles around you are AVs.*

Options	**Option 1:** Buy a regular vehicle	**Option 2:** Buy an AV	**Option 3:** Don't buy a vehicle and use AV ridehailing/rental services
Costs	$ 300/month + $ 0.75/mile	$ 300/month + $ 0.50/mile	$ 0/month + $ 1.20/mile
Rank	_____	_____	_____

Section F: Background Information

We would like to know a little more about you and your household for purely statistical purposes.

1. In what year were you born? _____ (e.g., 1975)

2. What is your gender identity? ☐$_1$ Male ☐$_2$ Female ☐$_3$ Other ☐$_4$ Prefer not to answer

3. Where were you born? ☐$_1$ United States or U.S. territory ☐$_2$ Other country ☐$_3$ Prefer not to answer

4. Are you Hispanic or Latino? ☐$_1$ No ☐$_2$ Yes ☐$_3$ Prefer not to answer

5. How would you describe yourself? Please check **no more than two categories** that you most closely identify with.

   ☐$_1$ White/Caucasian ☐$_3$ Black/African American ☐$_5$ Native American
   ☐$_2$ Asian or Pacific Islander ☐$_4$ Prefer not to answer ☐$_6$ Other (please specify): _____

6. What is your educational background? Check the highest level of education you have attained.

   ☐$_1$ Some grade/high school ☐$_3$ Completed high school or GED ☐$_5$ Some college/technical school
   ☐$_2$ Bachelor's degree(s) ☐$_4$ Some graduate school ☐$_6$ Completed graduate degree(s)

7. How many people live in your household (**including yourself**) in each of the following age categories?
   *By "household" we mean "people who live together and share at least some financial resources". Ordinary housemates/roommates are usually **not** considered members of the same household.*

   _____ Children (up to 4 years old) _____ Children (5 to 12 years old) _____ Children (13 to 17 years old)

   _____ Adults (18 to 24 years old) _____ Adults (25 to 64 years old) _____ Adults (65 and more years old)

8. Who lives with you? *Please check all that apply.*

   ☐$_1$ I live alone (nobody else lives with me) ☐$_4$ My partner/spouse
   ☐$_2$ My or my partner's child(ren) or grandchild(ren) ☐$_5$ My or my partner's parent(s) or grandparent(s)
   ☐$_3$ Unrelated housemate(s) ☐$_6$ Other (please specify): _____

9. Please indicate the number of people in your household (include children **and** yourself) that belong to each of the groups shown below:

   _____ Part-time workers _____ Full-time workers _____ Part-time students _____ Full time students

10. Knowing more about your **home location** will help us better understand your choices and opinions. Please provide your address or, if you prefer, major cross streets near your home. *An address is required if you choose to receive the **$10 Visa gift card**.*

    _____

    City: _____ State: _____ Zip code: _____

11. Please check the appropriate category for your annual *household* income before taxes.

    ☐$_1$ Less than $25,000
    ☐$_2$ $75,000 to $99,999
    ☐$_3$ $25,000 to $49,999
    ☐$_4$ $100,000 to $149,000
    ☐$_5$ $50,000 to $74,999
    ☐$_6$ $150,000 or more

12. Knowing more about your **workplace/school location** will help us design more convenient commute options. Please give the address or, if you prefer, major cross streets close to your main workplace/school location. *If you travel to more than one location on a regular basis, enter the location to which you travel most often.*

    _____

    City: _____ State: _____ Zip code: _____

REWARDS! Please choose your preferred reward option and provide the required contact information below (only the first 100 respondents who provide complete information will be eligible for a gift card).

☐$_1$ $10 Amazon e-gift card (Please provide your **email** in the next section below.)
☐$_2$ $10 Visa gift card (Please provide your home **address** in question 10 above so that the gift card can be mailed)

OPTIONAL! If you are willing to be contacted for future studies and surveys, please provide your contact information. We will use your information only for the purposes you authorize (please check permitted uses of your contact information):

☐$_1$ For any questions on your answers to this survey
☐$_2$ For a follow-up transportation-related survey sometime in the future
☐$_3$ Only to email rewards

Name: _____

Email: _____

Telephone: _____

Thanks for your valuable participation in this study!