Autonomous Driving or Teleportation? Travel Time Use, Usefulness, and Other Insights from a Survey of Long-Distance Recreational Travelers

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Supplemental Information

I. Survey Frame, Questions, and Descriptive Statistics

The data used in this study was gathered from a survey the authors conducted in the Summer of 2022 (see Acharya, 2023). The survey was part of a larger study designed to assess long-distance recreational travel behavior and preferences toward autonomous vehicles (AVs). In the survey, long-distance recreational travel was defined as travel intended for pleasure and recreation and involving at least 75 miles of travel one-way. Thus, the respondents of the survey were those who had visited one of the national parks of the US in 2022 by driving at least 75 miles one way, and no air travel was involved in the trip. The detailed information provided by the respondents about their most recent trips to national parks, including how they used the travel time and travel preferences especially with the hypothetical travel modes, is used in this study. Before asking the questions related to AVs, a brief introduction of an AV was presented in the questionnaire: "*An autonomous vehicle (AV) is a vehicle having full self-driving capabilities such that no driver is needed to drive. The vehicle uses various in-vehicle technologies and sensors to drive itself*." The survey was distributed online using Qualtrics and 696 complete responses were collected. The descriptive statistics of the socio-demographic and trip characteristics of the sample are presented in **Table 2**.

The sample consisted of adults only such that the age was at least 18 years. Among them, more than half (58.85%) belonged to the 35-64 years age category. The proportion of females (56.90%) was slightly higher than that of males (43.10%). In terms of race, more than three-quarters of respondents were white. More than half of the sample had at least an undergraduate degree (58.19%). The proportions of students (26.44%) and unemployed individuals (30.17%) in the sample were almost equal. The annual household income of almost half of the sample (49.14%) lay between $25,000 and $75,000. The average number of adults (age >18 years) and children (age <18 years) in the household of the sample were 2.18 and 0.98, respectively. All respondents had a driving license, and the average driving experience reported was 25.66 years. The average number of household vehicles in the sample was 1.52. Respondents reported that they typically make 3.32 long-distance recreational trips in a year, on average.

The socio-demographic characteristics of the US population (obtained from the American Community Survey Data (US Census Bureau, 2021)) are compared with the respondents' characteristics to assess the representativeness of the sample (**Table 2**). The sample and US population distribution look fairly similar for age, gender, race, and income. Compared to the US population, middle-aged (35-64 years) individuals, females, whites, and individuals from middle-income households ($25-100k) were slightly overrepresented in our sample.

The sample had an average one-way travel time of 10.89 hours and an average travel cost of $193.30 for their recent long-distance recreational trip. The majority of the sample (87.79%) used their owned or leased vehicles for the trip, with SUVs (45.83%) and sedans/hatchbacks (37.64%) being the most common vehicle types. In terms of advanced vehicle features, adaptive cruise control (57.47%) was the most prevalent, followed by the collision warning feature (37.21%). The following paragraphs present the wording of the questions in the survey pertaining to key variables used in this study.

First, the questions related to travel-based activities (TBAs) in human-driven vehicle (HV) and AV scenarios were worded as follows:

A. *Which of the following activities did you do in-vehicle during the trip? Consider the activities you did both ways. Select all that apply.*
B. *Hypothetically, consider that you drove in an autonomous vehicle instead of your vehicle during the last trip so that you didn't have to drive. In this scenario, which of the 219 following activities would you do while traveling? Consider the trip both ways. Select all that apply.*
    a) *Listening to music, radio, or other audio*
    b) *Singing, dancing*
    c) *Interacting with other passengers*
    d) *Talking on phone*
    e) *Texting, emailing, or other messaging; teleconference*
    f) *Reading newspapers, books, websites, etc.*
    g) *Using social websites or apps (Facebook, Instagram, Twitter, LinkedIn, etc.)*
    h) *Watching movies / TV / other entertainment*
    i) *Playing games*
    j) *Working or studying*
    k) *Caring for or playing with children or pets*
    l) *Eating food, drinking beverage, smoking*
    m) *Sleeping or snoozing*
    n) *Viewing scenery; watching people*
    o) *Thinking or daydreaming*
    p) *Watching the road*
    q) *Other: ……..*

Second, the questions related to travel time usefulness (TTU) in HV and AV scenarios were worded as follows:

A. *How useful or worthwhile would you rate the time you spent traveling?*
B. *How useful or worthwhile would you rate the time you spent traveling in an autonomous vehicle for this hypothetical trip scenario?*
    a) *Mostly wasted*
    b) *Somewhat wasted*

c) *Neither wasted nor useful*
d) *Somewhat useful*
e) *Mostly useful*

Finally, the question of the ranked-choice between HV, AV, and teleportation was worded as follows:

A. *Suppose you had two additional mobility options (along with your current mode) to travel for your trip to [DESTINATION] and cost wouldn't be the issue. First was an autonomous vehicle having the self-driving ability, and second was teleportation where you could snap your fingers or blink your eyes and be instantly transported to wherever you want. In this scenario, which option would you choose for your last trip to [DESTINATION]? Please rank these three options based on your preference such that the first ranked option (1) is the most preferred and the last ranked (3) is the least preferred.*
   a) *The same vehicle you drove for the last trip.*
   b) *An autonomous vehicle with self-driving capability.*
   c) *Instantaneous teleportation.*

Table 2: Descriptive statistics of the sample (n = 696).

Variable	***Sample***				***US population***
	#	*%*	***Mean***	***SD***	*%*
Socio-demographic characteristics					
Age					
18-34 years	191	27.44			29.14
35-64 years	404	58.05			49.23
65+ years	101	14.51			21.63
Gender					
Female	359	56.90			49.50
Male/other	337	43.10			50.50 (male)
Race/ethnicity					
White	576	82.76			72.90
Others	120	17.24			27.10
Education					
No college degree	291	41.81			56.20*
Undergraduate degree	278	39.94			30.00*
Graduate degree or higher	127	18.25			13.80*
Student					
No	512	73.56			
Yes, part-time	46	6.61			26.60 (college enrollment only)
Yes, full-time	138	19.83			
Employment					
No	210	30.17			40.10~
Yes, part-time	90	12.93			59.90 ~ (total Yes)
Yes, full-time	396	56.90			
Household income (annual)					

< $25k	110	15.80			17.40
$25-50k	187	26.87			19.10
$50-75k	155	22.27			16.80
$75-100k	99	14.22			12.80
≥$100k	145	20.83			34.00
# adults in household (age ≥18 years)			2.18	0.98	
# children in household (age <18 years)			0.90	1.15	
Driving experience (years)			25.66	16.61	
Traffic citations in the past: no	291	41.81			
Crash experience in the past: no	234	33.62			
# of household vehicles			1.52	0.77	
Commute mode: car	612	87.93			
Familiarity with AV technology (1: Not familiar at all – 5: Extremely familiar)			2.77	1.22	
Trip-specific characteristics					
Travel time (hours, one-way)			10.89	12.83	
Travel cost (dollars, one-way)			193.40	202.52	
Owned/leased vehicle used during the trip: yes	611	87.79			
Vehicle type					
Sedan/hatchback	262	37.64			
SUV	319	45.83			
Truck	69	9.91			
Electric	21	3.02			
Vehicle feature					
Blind-spot monitoring	219	31.47			
Lane-keep assistance	188	27.01			
Adaptive cruise control	400	57.47			
Automatic emergency braking	192	27.59			
Driver monitoring	132	18.97			
Parking assistance	180	25.86			
Collision warning	259	37.21			

* indicates statistics for the 25+ years old population.
~ indicates statistics for the 16+ years old population.

Table 3: Measurement structures of attitudinal latent variables based on confirmatory factor analysis.

Latent variables and their indicators	***Coeff.***	***t-stat***
AV usefulness		
AVs will drive me safely to wherever I want.	1.000	n/a
Using an AV will improve my (and others') driving efficiency.	1.093	28.79
I could multitask while traveling in an AV (e.g., work, sleep, surf the internet).	0.934	23.16
Using an AV will reduce my driving burden/stress.	1.112	28.84
AVs will improve the mobility of overall transportation.	1.057	30.21

AVs will offer economic and social benefits in overall.	1.055	29.60
I would feel comfortable having an AV pickup/drop off children without adult supervision.	0.942	19.68
AVs would make me feel safer on the streets as a pedestrian or as a bicyclist.	1.049	24.66
AVs would perform well even in poor weather or other unexpected conditions.	0.911	22.11
AV concern		
I am concerned about the potential failure of AV sensors, equipment, technology, and system safety.	1.000	n/a
I am concerned about the legal liability for drivers or owners of AVs in accidents/crashes.	0.981	20.56
I am concerned about the data privacy and security breaches/hacking in AVs.	0.792	15.84
I am worried about the higher purchase, maintenance, and insurance costs associated with AVs.	0.893	17.79
Technology savviness		
I like to be among the first to have the latest technology.	1.000	n/a
Having internet connectivity everywhere I go is important to me.	0.661	14.84
Driving enjoyment		
I enjoy driving myself.	1.0000	n/a
I prefer not to have the responsibility of driving.	-2.417	-10.62
I feel stressed or nervous when driving.	-2.026	-11.11
Polychronicity		
I like to be engaged in two or more activities simultaneously.	1.000	n/a
I believe people should aim at performing multiple tasks simultaneously.	1.026	23.34
It makes me feel good to be involved in multiple activities simultaneously.	1.080	24.88
Environmental concern		
I am concerned about current environmental pollution and its impact on health.	1.000	n/a
I don't change my behavior based solely on concern for the environment.	-1.557	-10.56
I rarely worry about the effects of pollution on myself and my family.	-1.402	-10.74
Estimator and goodness-of-fit statistics		
Estimator = Wishart log-likelihood (MLW)		
χ^2 /df = 909.36/237 = 3.84		
CFI/TLI/RMSEA = 0.924/0.913/0.063		
# of observations = 696		

References

Acharya, S. (2023b). *Long-Distance Recreational Travel Behavior and Implications of Autonomous Vehicles*. [Doctoral Dissertation]. https://digitalcommons.usu.edu/etd/8909.

US Census Bureau. (2021). American Community Survey Data. Accessed 29 November 2022. https://www.census.gov/programs-surveys/acs/data.html.