

1 **How Older Adults Use Ride-hailing Booking Technology in California**

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43 **ABSTRACT**

44

45 Ride-hailing services like Lyft and Uber have the potential to improve mobility for many older
46 adults, especially those who cannot or prefer not to drive. We used survey data from 2,917
47 Californians 55 years and older to investigate (1) how older adults who currently ride-hail
48 booked their trips, and (2) what personal characteristics, including attitudes towards technology,
49 were correlated with booking trips online versus by phone or with help. We specified four binary
50 probit models in which the outcome variables are the manner in which a respondent accessed
51 ride-hailing services: self-booked by phone, self-booked by app, booked by a
52 family/friend/caregiver but rode alone, or booked by others and rode with them. We controlled
53 for two attitudinal constructs (confident and cautious about technology), residential location,
54 general travel behavior, physical health, and standard socio-economic factors. We found that
55 respondents who were more confident using technology booked via apps, while those who were
56 more cautious about technology were less likely to book using apps. This latter group was more
57 likely to book by phone or rely on others for help. Other characteristics associated with higher
58 likelihood of booking via apps were: living in the suburbs, not relying on others for rides, having
59 physical health issues, being college educated, and being non-Hispanic. Our findings provide a
60 basis to think about expanding ride-hailing to other older adults, particularly those who are not
61 comfortable with technology, through convenient access to ride-hailing booking.

62

63 *Keywords:* attitudes; factor analysis; older adults; probit; ride-hailing; technology adoption

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65

66 **Highlights**

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- 68 ● Contrary to popular belief, many over 65 years ride-hail, often self-booking rides
- 69 ● Older adults who are more comfortable with technology book via the app
- 70 ● Those who are less comfortable with technology rely on others or use phone booking
- 71 ● Those with health issues and disabilities are *more* likely to book trips using an app
- 72 ● More seniors would likely use ride-hailing if the booking process is made easy for everyone

73

1. Unequal access to ride-hailing: An impact of attitude to technology?

The population is aging and many older Americans are aging in place (Peek et al. 2014; Warner et al. 2016). Alternative mobility solutions can contribute to quality of life in old age (Pangbourne et al. 2010). Among new forms of transportation services, ride-hailing is now ubiquitous in most urban areas (Alemi et al. 2018; Gehrke et al. 2019; Sikder 2019). Ride-hailing is attractive because it relaxes the schedule- and location-based constraints of traditional transit services and provides door-to-door travel for users. Ride-hailing services can also be a boon for the community-dwelling senior who has ceased driving, for whom driving has become risky due to medical conditions, or who simply would prefer alternatives to driving (Coughlin 2009; Dobbs 2012). Ride-hailing is widespread in California throughout urban and suburban counties, and even available to some extent in most rural communities (Brown 2019; Gehrke 2020). However, is it a feasible option for older adults? Some studies have concluded that many older adults do not want to, or are not able to, use the service (Shirgaokar 2018; Vivoda et al., 2018). This inability or unwillingness may be due to discomfort with smartphone technology and online financial tools. Though some ride-hailing companies and third-party service providers, such as GoGoGrandparent, facilitate connecting older adults to ride-hailing without using apps, many older adults do not have access to such support services.

Our research specifically tested technology barriers explored in earlier studies (Mitra et al., 2019; Shirgaokar 2018; Vivoda et al. 2018). These studies did not incorporate the attitudinal basis for behavior (Ajzen 1991). In this paper, we advanced these earlier efforts by including attitudinal constructs that we hypothesized would encourage technology acceptance (Davis et al. 1989; Venkatesh and Davis 2000). Peek et al. (2014) performed a systematic review of the research literature investigating factors that influenced the intention to use and the actual use of electronic technology for aging in place. They found that pre-adoption studies abound but post-adoption studies were rare, and most studies did not rely on quantitative methods. Our contribution is to investigate post-adoption views on ride-hailing using quantitative methods.

Shirgaokar (2018) and Vivoda et al. (2018) relied on convenience sampling which limited the generalizability of the results. We used quota sampling to match the California population of adults 55 and over based on age, gender, race, ethnicity, income, education, and community type. Because our sample represents the California population, the findings are generalizable to all adults 55 and older. For this research, we defined older adults (or seniors) as those who were 65 years of age or older. The literature has consistently shown that age is an important variable. Higher age and female gender are correlated with worse outcomes for mobility (Luiu et al. 2017; Rosenbloom 2004). In this paper, we took a different approach and were interested in learning what Californians in the *younger* ten-year cohort (55-64 years) thought about ride-hailing, because this group likely constitutes a large portion of the future market for ride-hailing services.

In this paper, we investigated how older adults respond to one aspect of ride-hailing technology, i.e., the process of booking trips. More specifically, we posed the following research questions:

1. How do older adults who ride-hail access the service? Do they book trips themselves by phone, book ride-hailing trips themselves by app, take rides (on their own) that were booked by a third party such staff at a medical office, or ride with another person who booked the trip?

- 119 2. Does owning connected devices (smartphones, computers, tablets), or comfort using
120 online tools and financial services, correlate with attitudes towards technology? Do these
121 attitudes in turn affect choices about how a ride-hailing trip is booked?
122 3. What socio-demographic and travel behavior characteristics correlate with any of these
123 choices about how a trip is booked?

124 We answered these questions by studying weighted distributions, and running four binary
125 probit models, one for each type of ride-hailing booking interaction. To understand attitudes
126 towards technology adoption, we relied on confirmatory factor analysis to extract two attitudes,
127 confident and cautious towards technology.
128

129 **2. Ride-hailing, comfort with technology, and acceptance of technology: A literature review** 130

131 *2.1 The ride-hailing market with a focus on older adults* 132

133 A number of researchers have written about the need for expanding technology-based travel
134 options for older adults (Hubers and Lyons 2013; Pangbourne et al. 2010; Peek et al. 2014; Peek
135 et al. 2016). Few have studied the specific link between travel options such as ride-hailing and its
136 potential for older adults' mobility. Researchers have asked about who rides in Uber/Lyft-like
137 services (Alemi et al. 2018; Alemi et al. 2019; Brown 2019; Conway et al. 2018; Grahn et al.
138 2019; Sikder 2019; Tirachini 2019). We know that ride-hailing services are particularly attractive
139 to the young, educated, employed, and urban segments of the population; older adults more
140 rarely ride-hail (Mitra et al. 2019; Shirgaokar 2018; Vivoda et al. 2018).

141 Some researchers have addressed questions such as differences between ride-hailing and
142 taxi markets (Conway et al., 2018), which is an important consideration since some older adults
143 rely on taxi services for their transportation (Habib 2019; Schmöcker et al. 2008). However, the
144 taxi industry has shrunk due to the success of ride-hailing, creating issues for the travel of older
145 adults with/out disabilities. Researchers (Cochran 2020; Deakin et al. 2020) show that public
146 agencies could effectively partner with ride-hailing companies to expand mobility for this group.
147 Researchers have also studied the nature of the shared ride-hailing market (Gehrke et al. 2019;
148 Middleton and Zhao 2019), since shared rides are more cost effective and may be attractive to
149 older adults with limited income. Leistner and Steiner (2017) investigated a case in Gainesville,
150 FL of a transit agency's partnership with a ride-hailing service aimed at providing travel options
151 for older adults. They learned that older women found ride-hailing attractive and kept using it for
152 the length of the program, especially for social, shopping, and medical trips. Shirgaokar et al.
153 (2021) found that older adults from suburbs and small towns were more likely to ride-hail
154 compared to those from cities. Some characteristics of ride-hailing patrons, namely, use by
155 individuals from households with fewer cars than drivers, the disabled, and occasional riders
156 (Brown 2019; Tirachini 2019) suggest that this service is also likely to be useful for older adults.
157

158 *2.2 Comfort with technology* 159

160 Those who are comfortable with technology, for example millennials and generation Xers, are
161 also likely to be users of technology-enabled services (Alemi et al. 2019; LaMondia et al. 2018).
162 Being *uncomfortable* with using technology can become a critical barrier to exploring new
163 options including transportation (Kim et al. 2016; Pangbourne 2018). Though it is popular
164 opinion that older adults today are not comfortable with technology, researchers have shown this
165 is not always the case (Agrawal et al. 2020; Anderson 2017; Faber and van Lierop 2020). In

166 contrast, some researchers have found that old age is related to a lack of comfort with technology
167 (Heart and Kalderon 2013; Pangbourne et al. 2010). Yet, Peek et al. (2016) learned that comfort
168 and acceptance of technology in older adults is context-dependent. For example, older women
169 were more accepting of ride-hailing compared to older men in a demonstration project for using
170 Uber instead of transit for trips (Leistner and Steiner 2017). Vivoda et al. (2018), however,
171 observed that older men have more e-hail knowledge compared to older women, demonstrating
172 higher comfort with technology.

173 Researchers have also shown that older adults are willing to learn and adopt new tools
174 but may not be comfortable with the ways in which they have to teach themselves to use
175 technology (Abraham et al. 2017). This is especially important because the ecosystems (i.e.,
176 rules, objects, motives, and community) of smartphone-based transportation technology vary
177 (Ettema 2017; Pangbourne et al. 2010). Other socio-economic barriers remain in addition to
178 acceptance and comfort with technology. Researchers have shown that low-income individuals
179 and persons of color might face far more barriers with access to the smart-technology ecosystem
180 (Golub et al. 2019; Groth 2019). Further concerns, such as privacy, might remove potential users
181 of new technology from the market (Groth 2019).

182 183 *2.3 Acceptance of technology models*

184
185 Ajzen presented the theory of planned behavior (TPB). He proposed that the attitudes towards a
186 behavior (e.g., positive feelings about ride-hailing), subjective norms (e.g., other friends ride-hail
187 so it is acceptable), and perceived behavior control (e.g., ease of booking the service) nudged
188 intentions leading to behaviors (e.g., actual booking) (Ajzen 1991, pg. 182). Within the
189 technology acceptance models (TAM), Davis et al. (1989, Pg. 985) and Venkatesh and Davis
190 (2000, pg. 188) offered a related but different view with a particular link to perceived behavior
191 control from TPB. They proposed that the intention to use a system (e.g., book ride-hailing) was
192 determined by attitudes that included two constructs, namely, perceived ease of use (how easy it
193 is to book a ride-hailing trip) and perceived usefulness (how useful is ride-hailing). Given how
194 older adults view technology such as ride-hailing (Mitra et al., 2019; Shirgaokar 2018; Vivoda et
195 al. 2018), these two constructs are particularly salient to our work. Our research includes insights
196 from both TPB (Ajzen 1991) and TAM (Davis et al. 1989; Venkatesh and Davis 2000). For the
197 curious reader, Taherdoost (2018) offers a comprehensive review of the various proposed
198 models.

199 Researchers have used TPB (Ajzen 1991) to understand the psychology of travel
200 behavior. For example, Dill et al. (2014) used TPB to study bicycling. The technology
201 acceptance model (TAM) (Davis et al. 1989) has been the lens to study older adults' use of social
202 networking sites (Braun 2013), electric vehicle acceptance (Globisch et al. 2018), and ICT use
203 (Macedo 2017). Some studies, like ours, used constructs from both TPB and TAM to investigate
204 technology acceptance (Buckley et al. 2018; Heart and Kalderon 2013). More generally,
205 researchers have studied the role of attitudes in travel behavior for some time including
206 examination of acceptance of technology along with attitudes. For example, Alemi et al. (2018)
207 included attitudes in their analysis of ride-hailing acceptance among millennials and genXers.

208
209 Overall, this literature review showed that a smaller percentage of older adults ride-hail
210 but their travel needs point to a suppressed market for such services. Research on comfort with
211 technology indicates that older adults may use technology more widely than is commonly

212 assumed; yet using technology comfortably remains a challenge for this demographic. Mobility
213 options that rely heavily on technology need to come to terms with concerns around access for
214 older adults who may be on limited incomes or identify as persons of color. The challenge of
215 using technology can be investigated using models such as the theory of planned behavior and
216 the technology acceptance model. In this paper, we addressed the gap in the literature by
217 showing how attitudes towards technology were linked to technology use for booking ride-
218 hailing trips in older adults.

219

220 **3. Data collection and sample characteristics**

221

222 Our study examined data from California, which has a large and growing population of adults 55
223 years and over. Projections indicate that the population over 55 will grow from 11.1 million in
224 2020 to 14.6 million in two decades (California Dept. of Finance, 2021). We collected data on
225 Californians 55 years and older using an online survey platform, an increasingly common
226 method for surveys of the general population (e.g., Alemi et al., 2019; Middleton and Zhao
227 2019).

228

229 While an online survey would have excluded a large fraction of older adults a decade
230 ago, today a majority of Californians 55 and older do use online technologies. American
231 Community Survey microdata show that, based on 5-year estimates from 2018, 73% of adults 55
232 and over in California had smartphones and 86% had internet access through at least one device.
233 Among adults 65 and over in California, 65% had smartphones, while 82% had internet access.
234 Just a year later in 2019, the year of the survey, even these very high rates of smartphone and
235 internet use are likely underestimates, given the continuing growth in the proportion of adults
236 who are online (Anderson 2017). Assuming this trend continues, even more *future* older adults
237 are likely to be comfortable with online technology.

238

239 An important consideration with respect to an online survey is that the method can
240 exclude adults who are, on average, most likely to be older, lower income, less educated, and
241 living in rural communities (Perrin and Atske 2021). We compensated for this limitation by
242 using quota sampling. The sampling quotas were set up to be comparable to the population in
243 terms of basic socio-demographics. Specifically, with respect to gender, race and ethnicity,
244 employment status, annual household income, and age as reported in 2017 American Community
245 Survey (5-year estimates), the sample is similar to the California population 55 years and older.
246 Yet, even with quota sampling, there remains the possibility that our study oversampled in a
247 group of Californians 55 and over who are comfortable with technology use, thus biasing our
248 results. In future work, we hope to use in-person/phone-based survey and interview techniques to
249 specifically explore how those with low levels of access and comfort to technology think of ride-
250 hailing services. Likewise, in future analyses with the current data, we hope to incorporate finer
251 measures such as age as a continuous variable as well as explore spatial aspects of ride-hailing
252 behaviors among older adults.

253

254 The survey questionnaire was designed to measure the extent to which respondents were
255 using ride-hailing, how they accessed the services, and their opinions about ride-hailing. In
256 addition, we collected information on factors that we hypothesized might influence ride-hailing
257 use and opinions: communication access; comfort with use of technology; frequency of use of
ride-hailing services; valuing features of ride-hailing; comfort with using ride-hailing, credit
cards, etc.; benefits of ride-hailing; and the standard socio-economic factors of age, gender, race,
ethnicity, employment status, and household income.

258 Qualtrics fielded the survey from June 19 to September 9, 2019, using their online survey
 259 applications and with a panel they recruited. Agrawal et al. (2020) discuss further details about
 260 the survey methodology and the survey instrument is presented in the **Appendix**. We received
 261 completed records for 2,917 respondents. For weighted statistics of variables used in the models
 262 for this paper, see **Table 1**.
 263
 264

Table 1 Weighted summary statistics for full sample (users and non-users)

	N	Mean/ Propor- -tion	Std. Dev.	Median	Min.	Max
<i>Outcome Variables</i>						
Booked a ride-hailing trip myself over the telephone with a live agent	2,824	9%			0	1
Booked a ride-hailing trip myself using an app	2,871	29%			0	1
Taken a ride-hailing trip that was booked for me	2,838	24%			0	1
Ridden along on a ride-hailing trip with a family member/friend/caregiver who booked the trip	2,861	31%			0	1
<i>Explanatory Variables</i>						
Urban	2,910	28%			0	1
Suburban	2,910	50%			0	1
Rural	2,910	22%			0	1
Number of days commuting per week	1,014	3.98	1.45	5	1	5
Can drive alone	2,903	83%			0	1
Gets a ride from family	2,895	65%			0	1
Gets a ride from friends/neighbors	2,880	38%			0	1
Has disability	2,905	16%			0	1
Has physical health issues	2,908	9%			0	1
Female	2,903	61%			0	1
Senior (65 years and over)	2,917	44%			0	1
White	2,917	53%			0	1
Hispanic	2,917	32%			0	1
College educated	2,910	24%			0	1
Household income (\$)	2,917	69,869	66,487	37,500	2,500	250,000

Note: These statistics are weighted to represent the population of California 55 years and older.

265
 266
 267 **Figure 1** presents weighted distributions of the manner in which Californians 55 and
 268 older interact with ride-hailing booking (see Q. 13 in **Appendix**). As expected, more respondents
 269 in the 55-64 year cohort used various methods to access ride-hailing compared to the 65 and
 270 older group.
 271

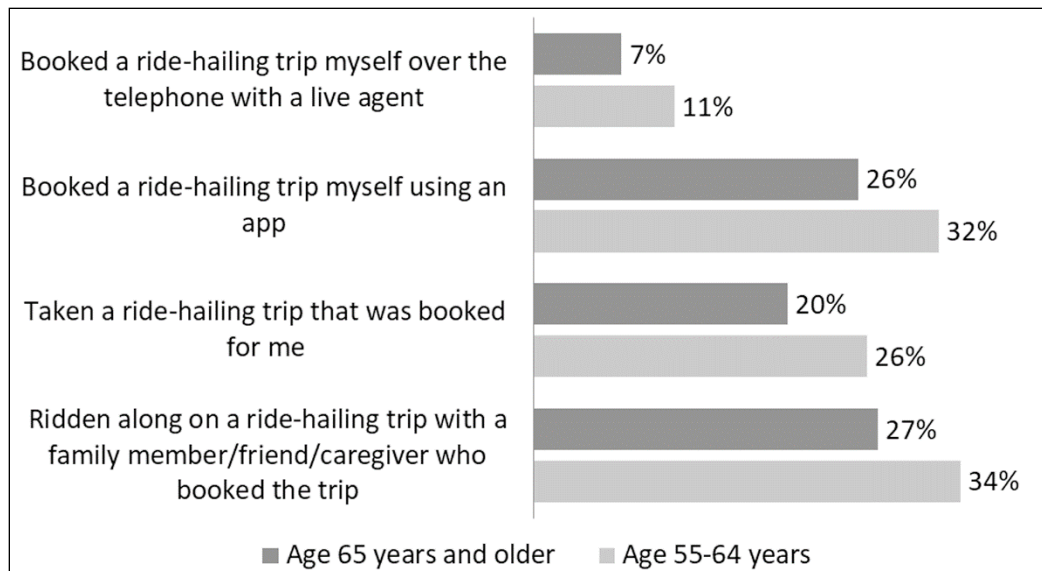


Figure 1 Interactions with Ride-hailing among Californians 55 years and older

We estimate that 48% of the 55-64 year cohort and 44% of the 65 years and older group have experienced ride-hailing in at least one of the four ways listed in **Figure 1**. Further, 34% of the 55-64 year cohort and 27% of the 65 years and older group have booked a trip themselves using the app or over the phone.

4. Analytical Approach

For this analysis, we used the following survey question: “Have you used ride-hailing in any of the following ways?” Respondents had four options to choose from for this question (trip booked by themselves using app; or over phone; trip booked by others for them; and trip booked by others that was taken with them), and for each option, they could either answer yes or no. We used binary discrete choice models to relate their choices with their attitudes and socio-demographic attributes. For explanatory variables that can capture attitudes of comfort with technology adoption, we used factor analysis to identify items within the survey that can be used as surrogates for these attitudes.

4.1 Confirmatory factor analysis

Analysts use factor analysis to identify patterned variation among some or all the observed variables and group them into relevant meaningful factors, thus reducing multi-collinearity and dimensionality within the data (Rummel 1988; Thurstone 1947). Factor analysis is built upon the understanding that variability within the data can be decomposed into a few main components. A part that is common among the variables i.e., the trend or pattern in variation, also known as communality among the variables, and another part that is distinctive to any variable, also known as uniqueness of any variable. The unique part of the variation can again be decomposed into random and explained parts.

The role of factor analysis is to uncover the communalities among variables such that variables sharing high communalities, and having a meaningful explanation of doing so, can be grouped together into a factor. Factor analysis can be exploratory or confirmatory. As the name

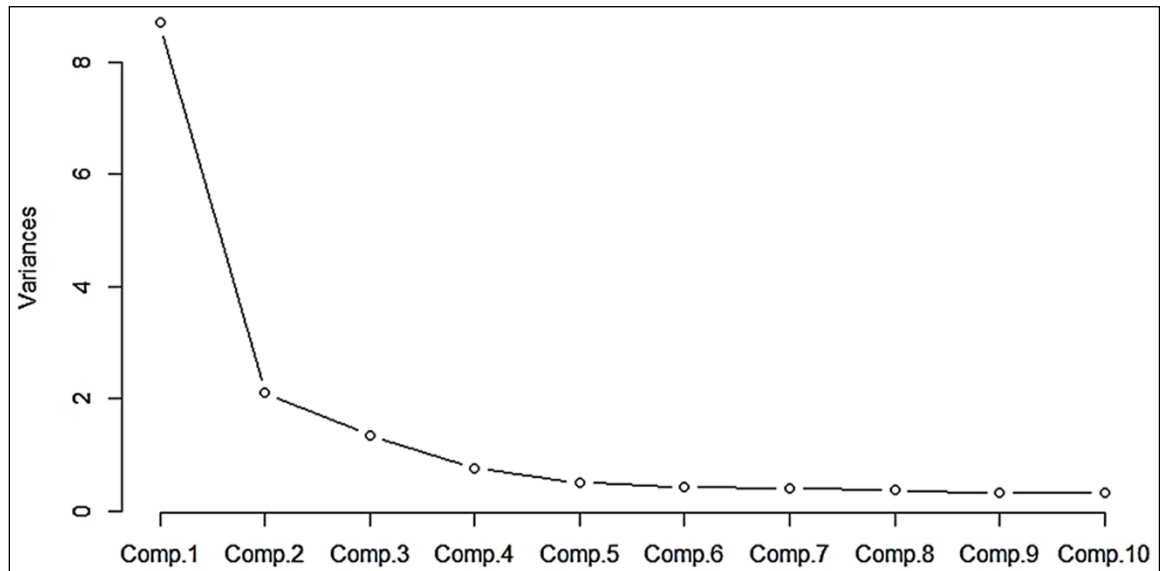
304 suggests, exploratory factor analysis is used to identify relations between seemingly unrelated
305 variables, while confirmatory factor analysis is used to justify a previously decided upon
306 hypothesis or correlation among variables. While factor analysis is a popular method of
307 dimensionality reduction and latent trend identification, there has been significant criticism about
308 factor analysis being used in post-hoc data analyses to force data into some relational structure
309 (Fabrigar et al. 1999, Fabrigar and Wegner 2012).

310 In the travel behavior literature, researchers have used factor analysis widely to extract
311 latent constructs from responses to survey questions (e.g., Shirgaokar and Habib 2018). We used
312 confirmatory factor analysis in our research, since we were cognizant of the criticisms of
313 exploratory factor analysis. We designed the survey questions based on the conjecture that
314 participants owning and using newer technology such as smartphones were likely to be similar in
315 preference to those who used internet-based services like e-payment systems, booked ride-
316 hailing trips over apps, or used ride-hailing services overall. Our factor analysis was, therefore, a
317 confirmatory factor analysis to test our assumptions, using the data collected. Specifically, the
318 confirmatory factor analysis focused on the following:

- 319 1. Communication access (5 items – landline phone, simple cell phone (no internet
320 browsing), smartphone connected to the internet with apps, computer with internet
321 access, tablet with internet access).
- 322 2. Comfort with use of technology (8 items – using an app on a smartphone or tablet,
323 sending and receiving text messages, making a video call, searching for information
324 online, paying bills online, buying something at a store with a credit card, buying
325 something online with a credit card, checking a bank balance online).
- 326 3. Frequency of use of ride-hailing services (3 items – frequency of use in hometown,
327 frequency of use when out of town, use at night). We use frequency here as a surrogate
328 measure of familiarity with ride-hailing services. In particular, difference in use when in
329 hometown, out of town, and at night gives us a more nuanced idea of level of confidence
330 with using ride-hailing services. On the one hand, respondents who do not use ride-
331 hailing frequently in their hometown (low score on the item frequency of use in
332 hometown) but do so out of town (high score on the item frequency of use when out of
333 town) are likely individuals who have access to own cars at home but feel confident using
334 ride-hailing services as they use the service elsewhere. On the other hand, respondents
335 who score low on both these items are people who may not feel confident using ride-
336 hailing services. Thus, including these items in the factor analysis provides us a surrogate
337 to measure confidence of using ride-hailing services.
- 338 4. Valuing features of ride-hailing (6 items – vehicle is accessible, driver is trained to help
339 older passengers, driver gives a paper bill that can be paid at a local store, can book trip
340 over the phone with a live agent, can pay with a pre-loaded card, company helpline to
341 call).
- 342 5. Comfort with using ride-hailing, using credit card, etc. (4 items – riding with unknown
343 driver, sharing credit-card with ride-hailing company, using ride-hailing after dark, or
344 sharing trip with other unknown passengers).
- 345 6. Benefits of ride-hailing (4 items – can go out without relying on family/friends, can go
346 out at night without the need to drive, do not worry about getting lost when driving, help
347 with carrying bags to my door).

348 Overall, 30 items from the survey were used in the factor analysis. A scree plot (**Figure 2**)
349 based on principal component analysis (PCA) is used to initially determine the approximate

350 number of factors for representing the 30 variables. **Table 2** shows the results of our
 351 confirmatory factor analysis.
 352



353 **Figure 2** Scree plot for factor analysis

354
 355
 356 As seen from the scree plot, either a two-factor or a three-factor solution could capture
 357 most of the variation in the data, and accordingly, we performed factor analysis using three and
 358 two factor solutions. The three-factor solution captured 32% of the variation while a two-factor
 359 solution captured 26% of the variation in the factor variables. However, the two-factor solution
 360 appeared to be more logically consistent in identifying distinct group characteristics, hence, we
 361 relied on the two-factor solution for this paper. We carried out the factor analysis using
 362 VARIMAX rotation in R using the function *factanal*.

363 **Table 2** presents the factor loadings on each of the thirty responses. Any variable with a
 364 score of 0.4 and higher on a factor is used to indicate significant loading on that factor and is
 365 used to define the factor. Similar to most studies utilizing the factor analysis method, this
 366 threshold is determined by the analyst based on previous experience and thresholds used in
 367 similar studies. For an excellent meta-analysis on acceptable factor loadings used in research
 368 historically see Peterson (2000), where the author points out that factor loadings of +/- 0.3 is
 369 considered minimum while +/- 0.4 is considered “more important”. Variables with scores lower
 370 than 0.4 are not considered important in defining that factor; hence, are not presented. However,
 371 we have included the negative loadings in **Table 2** even when they are below the 0.4 threshold.
 372 Our aim is to understand which individual features can negatively impact respondents’
 373 perception and use of ride-hailing services, although they may not be significant when presented
 374 in combination with other features.

375
 376 **Table 2** Factor Loadings on Items

Items	Factor 1 (Confident)	Factor 2 (Cautious)
Has landline		
Has simple cellphone	-0.400	
Has a smartphone with app	0.418	
Has a PC with internet		-0.172
Has a tablet with internet		

Comfortable in using an app	0.672	
Comfortable in sending and receiving text	0.487	
Comfortable in making a video call	0.527	
Comfortable in searching the internet	0.505	
Comfortable in paying bills over the internet	0.590	-0.105
Comfortable in using card payment in stores	0.398	-0.147
Comfortable in using cards for purchase online	0.540	-0.132
Comfortable in checking bank balance online	0.544	-0.129
Use ride-hailing services at night	0.430	
Frequency of use of ride-hailing services when in hometown		0.359
Frequency of use of ride-hailing services when out of town	0.444	
Values accessible vehicle feature		0.662
Values ability to book with a trained agent over phone	-0.295	0.614
Values driver being trained in elder care	-0.100	0.753
Values having a hotline to book a trip		0.640
Values having a paper bill at the end of the trip	-0.135	0.482
Values having a prepaid card for the service		0.602
Comfortable in using ride-hailing at night	0.535	
Comfortable sharing credit card with ride-hailing company	0.539	
Comfortable sharing ride with other unknown passengers		
Comfortable riding with an unknown driver	0.511	
Ride-hailing can help to not rely on others		0.567
Ride-hailing can help in getting help with carrying bags		0.576
Ride-hailing can help with travel at night		0.442
Ride-hailing can help in not getting lost		0.525
	Factor 1 (Confident)	Factor 2 (Cautious)
SS loadings	4.253	3.789
Proportion Var	0.137	0.122
Cumulative Var	0.137	0.259

377 Notes: Test of the hypothesis that two factors are sufficient: The chi-square statistic is 6029.49 on 404 degrees of
378 freedom. The p-value is 0.000.
379

380 As seen in **Table 2**, responses to these items can be grouped into two categories. One
381 group is comprised of elements indicating comfort with the latest technologies and ride-hailing
382 services, which indicate a high-tech, pro-technology adoption attitude. We dubbed this attitude
383 as “confident”. The other group of variables indicates a lack of comfort using technologies in
384 financial transactions and a greater valuing of additional features of ride-hailing services such as
385 paper bills and booking with agents, thus indicating low-tech, pro ride-hailing attitude. We
386 dubbed this attitude “cautious”.
387

388 4.2 Which socio-demographic characteristics are associated with the two attitudes? 389

390 The next step was to investigate whether there are statistically significant relationships between
391 various socio-demographic characteristics and the attitudinal factors. Does being in any
392 particular socio-demographic group increase or decrease the likelihood of being comfortable
393 using online technologies? Our hypothesis was that seniors (i.e., those 65 and older) and female
394 respondents were likely to be less comfortable with technology adoption and use than their male
395 counterparts, while higher education and income would increase the likelihood of being
396 comfortable with technology adoption and use.

397 **Table 3** shows the results of two models relating the two types of attitudes with socio-
398 demographic attributes of the respondents. Since factor scores are continuous, we introduced two

399 proxy binary variables—“confident” and “cautious”—for classifying each respondent. We used
 400 the same cut-off as the factor analysis for group assignment, i.e., if the respondent had a factor
 401 score greater than 0.3 for a particular factor, the respondent is considered being in that attitude
 402 group. In other words, if a respondent scores 0.3 or greater for factor 1, the variable confident is
 403 coded as 1 while if the score is 0.3 or less, the same variable is coded as 0. The binary variables
 404 “confident” and “cautious” are then each separately modeled using discrete probit choice
 405 models. A detailed explanation of discrete choice models, of which probit models are a subclass,
 406 is provided in **Section 5**.

407
 408 **Table 3 Binary Probit Models Relating Attitudes to Socio-demographics**

	<i>Confident</i>			<i>Cautious</i>		
	Estimate	Std. Err.	Sig	Estimate	Std. Err.	Sig
(Intercept)	-0.494	0.138	***	0.637	0.140	***
Living at an Urban Location	0.093	0.116		0.008	0.116	
Living at a Suburban Location	0.144	0.109		-0.360	0.109	***
Being Female	-0.268	0.069	***	0.132	0.071	.
Being Senior	-0.344	0.072	***	-0.188	0.073	**
Being White	0.179	0.073	*	-0.216	0.074	**
Being College Educated	0.086	0.077		-0.261	0.077	***
Household Income(\$10K)	0.036	0.005	***	-0.036	0.005	***
Being Hispanic	0.208	0.098	*	-0.012	0.099	
McFadden’s Rho-sq	0.07			0.10		
	Null deviance: 2,027.7 on 1,467 degrees of freedom			Null deviance: 1,964.8 on 1,467 degrees of freedom		
	Residual deviance: 1,891.6 on 1,459 degrees of freedom			Residual deviance: 1,778.4 on 1,459 degrees of freedom		
	AIC: 1,909.6			AIC: 1,796.4		

409 Notes: Significance codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

410
 411 Following our hypothesis, as compared to male, being female is negatively related to
 412 having a confident attitude but positively related to exhibiting a cautious attitude towards
 413 technology adoption. In contrast, exhibiting confident attitude increases positively with higher
 414 income while being negatively related to exhibiting a cautious attitude. Being college educated is
 415 negatively related to the cautious attitude as is being White. Contrary to our hypothesis, older
 416 adults, relative to those in the 55-64 year group, are less likely to be in either attitudinal group,
 417 possibly indicating the general disinclination to use ride-hailing services among the 65 years or
 418 older group. Thus, these models indicate that females are more likely to be cautious adopters of
 419 technology, while higher income, White and Hispanic individuals, and those who are college
 420 educated are more likely to be confident adopters and users of technology.

421
 422 **5. How Attitudes are linked to Ride-hailing Booking Behavior**

423
 424 In the final stage of this analysis, we used causal models to study how these attitudes towards
 425 technology influenced trip-booking behavior. The dependent variable was the following survey
 426 question: “Have you used ride-hailing in any of the following ways?” Respondents had four
 427 binary choices: (i) booked a ride-hailing trip myself over the telephone with a live agent, (ii)
 428 booked a ride-hailing trip myself using an app, (iii) taken a ride-hailing trip that was booked for
 429 me, and (iv) ridden along on a ride-hailing trip with a family member/friend/caregiver who

430 booked the trip. Each booking option was offered as a binary choice where the respondent could
431 answer yes or no (**Figure 1** and **Appendix Q. 13**).

432 We used discrete choice models in our analysis. Discrete choice models are econometric
433 decision models based on utility maximization theory of consumer behavior. The underlying
434 concept of utility maximization theory is that when faced with competing alternatives,
435 consumers choose the alternative that gives them maximum utility or satisfaction (Ben-Akiva
436 and Lerman 1985; Koppelman and Bhat 2006; McFadden 1974; Train, 2009). Utility is defined
437 as a function of attributes of the alternatives and of the decision maker. Here U_{ij} is the utility that
438 consumer j derives from alternative i , which is given as $U_{ij} = f(x_i, z_j)$, where x_i is the vector of
439 attributes of the alternative i and z_j is the vector of characteristics of consumer j . Since it is not
440 possible for the analyst to know all the factors that go into the decision making process of the
441 consumer, random utility models (RUM) are proposed which split the utility U_{ij} into two
442 components, the deterministic, observed part of the utility V_{ij} and the stochastic, unobserved part
443 of the utility e_{ij} . Following RUM then U_{ij} becomes

$$U_{ij} = V_{ij} + e_{ij},$$

444 where e_{ij} may include unobserved heterogeneity due to alternatives and consumer
445 characteristics. Based on the distribution of difference between e_{ij} , RUM models are classified
446 into different families of models, one of which is the probit model where the e_{ij} are normally
447 distributed as is the difference between e_{ij} (Ben-Akiva and Lerman 1985).

448 The advantage of using probit models instead of the more commonly used logit model is
449 that probit models allow for the unobserved characteristics among alternatives to be correlated.
450 This is more appropriate for our dataset. For example, spatial effects (neighborhood cohorts) or
451 living situation effects (single family versus senior living community) may influence decision
452 and attitude of individuals towards ride-hailing services but these variables are not part of our
453 explanatory variables. These characteristics then become one of the elements of the unobserved
454 part e_{ij} in the utility equation for each individual, introducing correlation among e_{ij} across
455 different individuals. Probit specifications allow us to explicitly model correlated unobserved
456 characteristics among individuals and, hence, are adopted for this analysis.

457 **Table 4** shows the four probit models for the ride-hailing booking choices made by the
458 respondents. The factor variables of attitude towards technology (confident and cautious) were
459 included in the model, as were variables related to location (urban/suburban/rural), general travel
460 behavior (number of weekly commute days, drives alone, relies on family/friends for a ride), and
461 health condition (including disability). Finally, all socio-demographic variables that were used to
462 weight the data for representativeness were included in the model as control variables. To ensure
463 that multicollinearity issues do not affect the model results, we performed Variation Inflation
464 Factor (VIF) tests on each of the models. VIFs values for all variables were below 3, indicating
465 no significant multicollinearity issues in the models.

466 To develop the model, variables were added one at each step and model fit improvements
467 were checked to ensure balance between model fit and interpretability. The model fits of the final
468 models with desired set of explanatory variables are high, ranging from 0.60 to 0.71. Variables
469 that were not significant in any model but had consistent expected signs, and were supported by
470 theory, were kept in the final set of models because they provide insights for future of ride-
471 hailing and policy decisions.

472 Our models show that, having more of the confident attitude towards technology
473 increases the odds of self-booking ride-hailing trips, using an app by 2.4 times, while increasing
474

475 the odds of using phone to book the ride by 1.1 times but decreasing the odds of having the ride
476 booked by someone else. Having more of the cautious attitude towards technology, however,
477 increases the odds of booking ride-hailing trips using an app by 1.2 times but that of booking
478 over phone by 1.5 times, and that of getting the ride booked by someone else by 1.4 times. These
479 findings are in agreement with the technology adoption model (TAM) proposed by Davis et al.
480 (1989) and Venkatesh and Davis (2000). In our case, respondents who are more confident using
481 other technologies are likely to find it easy to adopt new technologies. These individuals have
482 likely come to realize the usefulness of technologies in daily life and are more likely, therefore,
483 to use ride-hailing apps. Respondents in our study who are more cautious about using
484 technologies in general are also less likely to book using ride-hailing apps and more likely to use
485 phone-based booking.

486 The models also show that various personal characteristics increase the odds of self-
487 booking ride-hailing trips. Individuals from urban areas are more likely to book trips by
488 themselves, either using an app or over the phone. We suspect this trend to be a result of
489 prevalence of ride-hailing services in urban areas as compared to suburban or rural areas (Alemi
490 et al. 2018), and the resulting familiarity with related booking technologies among urban peers.
491 This is an example of context dependent acceptance of technology among urban older adults
492 (Peek et al. 2016; Shirgaokar et al. 2021). Respondents who get a ride from friends and family
493 are likely to have trips booked by others and take trips with others, as expected. Individuals
494 having health issues and physical disabilities are *more* likely to book trips using an app or by
495 getting the trip booked by others. While this result is contrary to what we originally expected, it
496 likely points towards people's need for autonomy and acceptance of a technology that can help
497 them achieve that autonomy in some aspects of life (Cochran 2020). College educated
498 individuals are also more likely to take trips with others that have been booked by others, as are
499 female and Hispanic respondents. Hispanic respondents are significantly less likely to book a trip
500 using an app. Even after controlling for attitudes, being White increases the odds of booking trips
501 over phone while being college educated increases the odds of booking trips using an app, both
502 by 1.3 times. The results for the college educated respondents validate earlier research by Alemi
503 et al. (2018) that shows greater adoption of ride-hailing technology among the young and more
504 educated populace. That adoption trend may naturally extend to adoption of ride-hailing apps
505 and their use among the college educated. Women taking trips with others is a traditional
506 gendered trip making behavior, where women are mostly found to take trips with family
507 members, catering to family needs (Luiu et al. 2017; Rosenbloom 2004). However, since our
508 respondents are older adults, the lower app use by women might also be an indicator of older
509 women being less comfortable in using ride-hailing and its related technologies by themselves;
510 hence, making trips with others, which is somewhat in contradiction with the findings from the
511 Gainesville, FL case study by Leistner and Steiner (2017). Studies by other researchers (Golub et
512 al. 2019; Groth 2019) have shown that people of color and low income individuals have more
513 barriers to accessing technologies than others. We suspect that our finding that Hispanic
514 individuals use the ride-hailing app less than non-Hispanic persons is a confirmation of these
515 findings.

516

517 **Table 4 Binary Probit Models for Trip Booking Behavior**

	Booked by Self Over Phone				Booked by Self Using App				Booked by Others				Booked by Others with Whom Ride Taken			
	Coef.	Sig.	Std. Err.	Odds Ratio	Coef.	Sig.	Std. Err.	Odds Ratio	Coef.	Sig.	Std. Err.	Odds Ratio	Coef.	Sig.	Std. Err.	Odds Ratio
Intercept	-1.31	**	0.407	0.27	0.53		0.397	1.70	-0.76	*	0.345	0.47	-0.41		0.353	0.66
“Confident” attitude towards technology	0.10		0.082	1.11	0.86	***	0.085	2.36	0.00		0.068	1.00	0.01		0.068	1.01
“Cautious” attitude towards technology	0.42	***	0.077	1.51	0.16	*	0.075	1.18	0.36	***	0.065	1.43	0.04		0.066	1.04
Urban (<i>Rural ref.</i>)	0.15		0.245	1.16	0.26		0.218	1.30	-0.02		0.198	0.98	-0.34		0.216	0.71
Suburban (<i>Rural ref.</i>)	0.24		0.234	1.27	0.45	*	0.207	1.56	0.11		0.188	1.12	-0.31		0.207	0.73
Number of days commuting per week	0.04		0.044	1.04	-0.07		0.043	0.94	0.03		0.037	1.03	0.02		0.037	1.02
Can drive alone	0.00		0.217	1.00	-0.02		0.226	0.98	0.02		0.199	1.02	0.30		0.197	1.34
Gets a ride from family	-0.22		0.179	0.80	-0.02		0.181	0.98	0.23		0.154	1.26	0.33	*	0.150	1.39
Gets a ride from friends/neighbors	-0.23		0.165	0.79	-0.31	^	0.166	0.73	0.36	*	0.142	1.43	0.68	***	0.143	1.97
Has disability	0.06		0.264	1.06	0.18		0.277	1.20	0.35		0.252	1.41	-0.17		0.251	0.84
Has physical health issues	0.05		0.296	1.06	0.62	^	0.364	1.86	0.09		0.286	1.09	-0.32		0.280	0.73
Female	0.12		0.132	1.12	-0.13		0.129	0.88	0.07		0.112	1.07	0.34	**	0.117	1.40
65 years and over (<i>55-64 years ref.</i>)	-0.09		0.148	0.91	-0.12		0.142	0.88	0.08		0.126	1.09	-0.09		0.129	0.91
White	0.29	*	0.139	1.34	-0.11		0.135	0.90	0.23	*	0.119	1.26	0.00		0.122	1.00
Hispanic	0.05		0.170	1.05	-0.30	^	0.170	0.74	0.16		0.151	1.18	0.30	^	0.160	1.34
College educated	-0.01		0.149	0.99	0.29	^	0.143	1.34	0.06		0.130	1.06	0.23	^	0.132	1.26
Household income (\$10,000)	0.00		0.010	1.00	0.01		0.009	1.01	0.00		0.008	1.00	0.01		0.009	1.01
Number of observations	583				599				579				592			
LL(0)	-639.3				-924.1				-985.3				-924.2			
LL(ρ)	-256.8				-270.4				-371.0				-343.1			
Mcfadden’s ρ ²	0.60				0.71				0.62				0.63			

518 Notes: Significance codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘^’ 0.1 ‘ ’ 1

6. Discussion and Policy Implications

Ride-hailing services can provide accessible mobility to older adults, especially to seniors who have ceased driving an automobile. Our survey found that older adults in California interacted with ride-hailing services in various ways. We investigated four ways of trip booking: self-booking on phone, self-booking via app, riding alone in a trip booked by someone else, and riding along with family/friend/caregiver who booked a trip. Our findings showed that, contrary to the popular belief that those 65 and older do not ride-hail, 44% have experience being on a ride-hail trip and 27% have booked a ride themselves using the app or over the phone. Note that the access methods for three out of four older adults were non-app based, which suggested that the ride-hail app has a limited role in expanding ride-hailing as a means of mobility.

We constructed two latent attitudinal variables using factor analysis, namely, confident with technology, and cautious with technology. Each individual has both attitudes in some measure. Our use of probit models acknowledged that unobserved heterogeneity in ride-hailing booking behavior is likely to be correlated, especially among respondents sharing similar travel behavior and/or living arrangements. The probit models (**Table 4**) showed that attitudes towards technology were significantly related to booking behavior of the respondents. Those who were more confident about technology were more likely to book via the app, while those who tended to be cautious about technology were likely to use all means of accessing ride-hailing including phone booking and relying on others to book a trip for them.

On the one hand, respondents who used ride-hailing services but were not confident adopters of technology indicated discomfort in online or mobile financial transactions, and valued having a prepaid card or a paper receipt at the end of the trip. They also valued having additional features in ride-hailing services such as drivers trained in the care of older adults or having an accessible vehicle, help with carrying bags, and the ability to book rides over phone with a live agent. On the other hand, the confident technology adopters viewed paper bills and booking over phone with an agent as possible negative attributes of the service, and were comfortable sharing financial information online. On trip booking behavior, corroborating Alemi et al. (2018), our findings also indicated that the younger 55-64 year group, and higher income and college educated individuals, were likely to use ride-hailing apps to book trips by themselves.

The study results suggested that changes to certain service features would expand the number of adults 55 years of age and older who use ride-hailing services. Ride-hailing companies can expand the pool of older adults willing to use the services by adding more accessible options for booking trips such as having the ability to book a trip over phone or having a prepaid card. These features could help users feel safe and in greater control since many older adults are uncomfortable with sharing financial information online or through apps. Similarly, value-added features such as accessible vehicles and drivers trained in elder care can go a long way in helping older adults trust and rely on ride-hailing service for their mobility needs. Our work suggests that non-app mechanisms to access ride-hailing such as phone booking are critical and can expand this service to those who do not have internet access and smartphones. In California, based on 2018 American Community Survey 5-year estimates, about 52,000 older adults do not have internet access and 1 million do not have a smartphone.

Ride-hailing companies could partner with public sector agencies (Deakin et al. 2020; Shirgaokar 2018) to expand this service including explore cost-sharing, contracting of specialized vehicles/drivers, phone-based support, and training courses for older adults who wish

to learn how to use these services. The emerging literature in this area and our work (**Table 4**) shows that women (Leistner and Steiner 2017; Luiu et al. 2017) and those with health conditions/experiencing disabilities (Cochran 2020) particularly need support in learning to use ride-hailing services. In conclusion, our study corroborates many findings from the literature on older adults, and suggests that there is a large current and future market for ride-hailing among older adults *if* individuals could find it easy to book a ride.

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Appendix: Survey Instrument

[Group 1: Screening questions for sampling quotas]

1. What is your gender?
₁ Male
₂ Female
₃ Other

2. What is your current age? _____

3. Which of the following describes your race or ethnicity? (Check all that apply)
₁ White
₂ Black or African American
₃ Asian or Asian American
₄ American Indian or Alaska Native
₅ Hispanic, Latino/a, or of Spanish origin
₆ Native Hawaiian or Other Pacific Islander
₇ Other _____

4. What was your total annual household income in 2018 from all sources, before taxes?
₁ \$0 to \$4,999
₂ \$5,000 - \$9,999
₃ \$10,000 - \$24,999
₄ \$25,000 - \$49,999
₅ \$50,000 - \$74,999
₆ \$75,000 - \$99,999
₇ \$100,000 - \$149,999
₈ \$150,000 - \$199,999
₉ \$200,000 or more

5. What is your current employment status?
₁ Working for pay
₂ Unemployed, but looking for work
₃ Not working for pay, by choice (retired, etc.)

[Group 2: Technology adoption]

6. Which of the following do you have and use? (Check all that apply)
₁ Landline phone
₂ Simple cell phone (no internet browsing)
₃ Smartphone connected to the internet with “apps” (like Google Maps)

- ₄ Computer with internet access
₅ Tablet with internet access (like an iPad)

7. How comfortable are you using smart phones/computers to do the following? [Randomize order]

	Very comfortable	Somewhat comfortable	Not at all comfortable
Using an “app” on a smartphone or tablet	<input type="checkbox"/> ₁	<input type="checkbox"/> ₁₁	<input type="checkbox"/> ₂₁
Sending and receiving text messages	<input type="checkbox"/> ₂	<input type="checkbox"/> ₁₂	<input type="checkbox"/> ₂₂
Making a video call (such as Skype or FaceTime)	<input type="checkbox"/> ₃	<input type="checkbox"/> ₁₃	<input type="checkbox"/> ₂₃
Searching for information online (such as bus schedules)	<input type="checkbox"/> ₄	<input type="checkbox"/> ₁₄	<input type="checkbox"/> ₂₄

8. How comfortable are you doing the following? [Randomize order]

	Very comfortable	Somewhat comfortable	Not at all comfortable
Paying bills online	<input type="checkbox"/> ₁	<input type="checkbox"/> ₁₁	<input type="checkbox"/> ₂₁
Buying something <u>at a store</u> with a credit card	<input type="checkbox"/> ₂	<input type="checkbox"/> ₁₂	<input type="checkbox"/> ₂₂
Buying something <u>online</u> with a credit card	<input type="checkbox"/> ₃	<input type="checkbox"/> ₁₃	<input type="checkbox"/> ₂₃
Checking a bank balance online	<input type="checkbox"/> ₄	<input type="checkbox"/> ₁₄	<input type="checkbox"/> ₂₄

9. Can you get help using a smartphone, from someone you know? (For example, a friend or relative)

- ₁ Yes, whenever I need help
₂ Sometimes
₃ No
₄ I don't need help using a smartphone or the internet

[Group 3: Ride-hailing use/familiarity]

Ride-hailing services such as Lyft and Uber connect passengers with drivers who offer rides in their own vehicles for a fee.

10. Have you heard of ride-hailing services?

- ₁ Yes
₂ No

11. As far as you know, are ride-hailing services available in your community?

- ₁ Yes

₂ No

12. Do you have an online account with any ride-hailing services? (Check all that apply.)

₁ Lyft

₂ Uber

₃ GoGo Grandparent

₄ Other _____

13. Have you used ride-hailing in any of the following ways? [Randomize order]

	Yes	No
Booked a ride-hailing trip <u>myself</u> over the telephone with a live agent (such as Lyft Concierge)	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂
Booked a ride-hailing trip <u>myself</u> using an app	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂
Taken a ride-hailing trip that was booked <u>for me</u>	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂
Ridden along on a ride-hailing trip with a family member/friend/caregiver who booked the trip	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂

14. When you are at home, how many days a month do you typically use ride-hailing? (Exclude trips made when you are out-of-town)

Days per month: _____

15. When you are out of town, how often do you use ride-hailing?

₁ Never

₂ Sometimes

₃ Frequently

[Group 4: Ride-hailing trip scenarios]

(Note to reader: This section is the execution of the stated preference design; logic transitions are *not* shown here. For questions 16-24, each survey taker was randomly presented with three of the nine prompts.)

The following questions present simple scenarios. These situations may or may not apply to your daily life. Please imagine being in the scenarios described and select the best answer.

16. Imagine you are making a trip today **to visit friends or family, or go to the movies**. Would you consider using ride-hailing services like Lyft/Uber if the one-way cost of the trip is \$30?

₁ Yes

₂ No

₃ Maybe

17. Imagine you are making a trip today **to visit friends or family, or go to the movies**. Would you consider using ride-hailing services like Lyft/Uber if the one-way cost of the trip is \$20?
- ₁ Yes
₂ No
₃ Maybe
18. Imagine you are making a trip today **to visit friends or family, or go to the movies**. Would you consider using ride-hailing services like Lyft/Uber if the one-way cost of the trip is \$10?
- ₁ Yes
₂ No
₃ Maybe
19. Imagine you are making a trip today **for a pre-scheduled doctor's appointment**. Would you consider using ride-hailing services like Lyft/Uber if the one-way cost of the trip is \$30?
- ₁ Yes
₂ No
₃ Maybe
20. Imagine you are making a trip today **for a pre-scheduled doctor's appointment**. Would you consider using ride-hailing services like Lyft/Uber if the one-way cost of the trip is \$20?
- ₁ Yes
₂ No
₃ Maybe
21. Imagine you are making a trip today **for a pre-scheduled doctor's appointment**. Would you consider using ride-hailing services like Lyft/Uber if the one-way cost of the trip is \$10?
- ₁ Yes
₂ No
₃ Maybe
22. Imagine you are making a trip today **to the grocery store or the pharmacy**. Would you consider using ride-hailing services like Lyft/Uber if the one-way cost of the trip is \$30?
- ₁ Yes
₂ No
₃ Maybe
23. Imagine you are making a trip today **to the grocery store or the pharmacy**. Would you consider using ride-hailing services like Lyft/Uber if the one-way cost of the trip is \$20?
- ₁ Yes
₂ No
₃ Maybe

24. Imagine you are making a trip today **to the grocery store or the pharmacy**. Would you consider using ride-hailing services like Lyft/Uber if the one-way cost of the trip is \$10?

- ₁ Yes
- ₂ No
- ₃ Maybe

25. Which of the following service features might be important for you on the same trip? (Check all that apply) [If answer is “Yes” or “Maybe” for Q. 16-24]

- ₁ The vehicle is accessible (i.e., can store a wheelchair)
- ₂ The driver is trained to help older passengers
- ₃ The driver gives me a paper bill and I pay at a local store
- ₄ I can book the trip over the phone with a live agent (I don’t have to use the app)
- ₅ None of the above
- ₆ Other _____

26. Which of the following service features might make you more likely to consider ride-hailing for the same trip? (Check all that apply) [If answer is “No” for Q. 16-24]

- ₁ The vehicle is accessible (i.e., can store a wheelchair)
- ₂ The driver is trained to help older passengers
- ₃ The driver gives me a paper bill and I pay at a local store
- ₄ I can book the trip over the phone with a live agent (I don’t have to use the app)
- ₅ None of the above
- ₆ Other _____

27. Which of these is the single most important service feature for you?

- ₁ The vehicle is accessible (i.e., can store a wheelchair)
- ₂ The driver is trained to help older passengers
- ₃ The driver gives me a paper bill and I pay at a local store
- ₄ I can book the trip over the phone with a live agent (I don’t have to use the app)
- ₅ The feature I suggested

28. Would you be willing to pay for this one important service feature you selected?

- ₁ Yes
- ₂ No

29. How much would you be willing to pay for this one feature? [If answer is “Yes” for Q. 28]

- ₁ \$2.01-\$4.00
- ₂ \$4.01-\$6.00
- ₃ \$6.01-\$8.00
- ₄ \$8.01-\$10.00
- ₅ \$10.01-\$12.00

[Group 5: Your opinions]

Now think about all the trips you might be able to make using ride-hailing.

30. How much would you value these service features, given your current lifestyle? [Randomize order]

	A lot	Somewhat	Not at all
The vehicle is accessible (i.e., can store a wheelchair)	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃
The driver is trained to help older passengers	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃
The driver gives me a paper bill and I pay at a local store	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃
I can book the trip over the phone with a live agent (I don't have to use the app)	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃
I can pay with a pre-loaded ride-hailing card that is not linked to my bank account/credit card	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃
There is a company helpline I can call	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃

31. How comfortable are you with the following features of ride-hailing? [Randomize order]

	Very comfortable	Somewhat comfortable	Not at all comfortable
Riding with a driver I don't know	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃
Sharing my credit card with the ride-hailing company	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃
Using ride-hailing after dark	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃
Taking a shared ride-hailing trip with other passengers I don't know	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃

32. Now think about all the trips you might be able to make using ride-hailing. Do these statements describe reasons you might want to use ride-hailing, given your current lifestyle? [Randomize order]

	Yes	Maybe	No
I can go out without having to ask family/friends for rides	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃
I can go out at night without having to drive myself	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃
I don't have to worry about getting lost driving myself	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃
I have help carrying heavy bags to my door	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃

[Group 6: Transportation use]

33. During a typical week, how many days do you commute to work? [If answer is “Working for pay” in Q. 5]

- 1 2 3 4 5+

34. Do you volunteer outside your home?

- ₁ Yes
₂ No

35. During a typical week, how many days do you commute for volunteering? [If answer is “Yes” in Q. 34]

- 1 2 3 4 5+

36. What is the most recent time you used each type of travel to get somewhere?

	Last 7 days	Last 30 days	Not used
Drove myself (in a car, truck, motorcycle, etc.)	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃
Rode as a passenger in a personal vehicle (exclude trips in taxis, ride-hailing services like Lyft or Uber, etc.)	<input type="checkbox"/> ₄	<input type="checkbox"/> ₅	<input type="checkbox"/> ₆
Public transit (bus, train, ferry, etc.)	<input type="checkbox"/> ₇	<input type="checkbox"/> ₈	<input type="checkbox"/> ₉
Paratransit	<input type="checkbox"/> ₁₀	<input type="checkbox"/> ₁₁	<input type="checkbox"/> ₁₂
Taxi	<input type="checkbox"/> ₁₃	<input type="checkbox"/> ₁₄	<input type="checkbox"/> ₁₅
Ride-hailing services like Lyft or Uber	<input type="checkbox"/> ₁₆	<input type="checkbox"/> ₁₇	<input type="checkbox"/> ₁₈
Other _____	<input type="checkbox"/> ₁₉	<input type="checkbox"/> ₂₀	<input type="checkbox"/> ₂₁

37. What is the most recent time you have gotten a ride from...

	Last 7 days	Last 30 days	Not used
Family	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃
Friends or neighbors	<input type="checkbox"/> ₄	<input type="checkbox"/> ₅	<input type="checkbox"/> ₆
Paid caregiver	<input type="checkbox"/> ₇	<input type="checkbox"/> ₈	<input type="checkbox"/> ₉

Volunteer driver from a program that helps older adults	<input type="checkbox"/> ₁₀	<input type="checkbox"/> ₁₁	<input type="checkbox"/> ₁₂
Other _____	<input type="checkbox"/> ₁₃	<input type="checkbox"/> ₁₄	<input type="checkbox"/> ₁₅

[Group 7: Health]

38. Do you have any disabilities or illnesses that interfere with your ability to travel outside your home? (Physical, mental, sensory, psychiatric, learning, etc.)

₁ Yes

₂ No

39. Does your current physical health interfere with your ability to carry out everyday activities like shopping, dressing, and preparing meals?

₁ Yes

₂ No

40. How often do you use the following mobility aids?

	Regularly	Occasionally	Never
Walking cane	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃
Walker	<input type="checkbox"/> ₄	<input type="checkbox"/> ₅	<input type="checkbox"/> ₆
Non-motorized wheelchair	<input type="checkbox"/> ₇	<input type="checkbox"/> ₈	<input type="checkbox"/> ₉
Motorized scooter or motorized wheelchair	<input type="checkbox"/> ₁₀	<input type="checkbox"/> ₁₁	<input type="checkbox"/> ₁₂
Other _____	<input type="checkbox"/> ₁₃	<input type="checkbox"/> ₁₄	<input type="checkbox"/> ₁₅

[Group 8: Other]

41. What is the highest level of education that you have completed?

₁ Grade school

₂ High school or GED

₃ Two-year degree or vocational school

₄ Completed some college (less than 4 years)

₅ Graduated from college

₆ Post-graduate degree (MA, MBA, PhD, MD, etc.)

42. How would you describe the area where you live?

- ₁ Urban part of a city/region
- ₂ Suburban part of a city/region
- ₃ Small town
- ₄ Rural area

43. Do you live in a community for older adults? (For example, a retirement community or assisted-living facility.)

- ₁ Yes
- ₂ No

44. Your home is...

- ₁ A single-family house
- ₂ A condo or apartment
- ₃ Other _____

45. Are you living with anyone?

- ₁ A spouse or partner
- ₂ Extended family
- ₃ Other _____
- ₄ No one - I am living alone

46. Is there anything you would like to tell us about ride-hailing services?
