Title
To drive or not to drive? A study of travel behavior for a recent drinking occasion

Authors
MacLeod, Kara E
Thorhauge, Mikkel
Villalobos, Victor
et al.

Publication Date
2020-07-01

DOI
10.1016/j.tbs.2020.02.008

Peer reviewed

HHS Public Access
Author manuscript
Travel Behav Soc. Author manuscript; available in PMC 2021 October 25.

Published in final edited form as:
Travel Behav Soc. 2020 July ; 20: 74–82. doi:10.1016/j.tbs.2020.02.008.

To drive or not to drive? A study of travel behavior for a recent drinking occasion

Kara E. MacLeod[1], **Mikkel Thorhauge**[2], **Victor Villalobos**[3,4], **Jeroen van Meijgaard**[1], **Katherine J. Karriker-Jaffe**[5], **Tara Kelley-Baker**[6], **David R. Ragland**[3,7]

[1]Fielding School of Public Health, University of California, Los Angeles, Los Angeles, CA 90095

[2]Technical University of Denmark, Transport Modeling, Department of Management Engineering, DK-2800 Kgs. Lyngby

[3]School of Public Health, University of California, Berkeley, Berkeley, CA 94720

[4]Mexican Center for Disease Prevention and Control, Mexico

[5]Alcohol Research Group, Public Health Institute, Emeryville, CA 94608

[6]AAA Foundation for Traffic Safety, Washington, DC 20005-2000

[7]Safe Transportation Research & Education Center, University of California, Berkeley, Berkeley, CA 94720-7374

Abstract

Despite decades of education and enforcement campaigns, alcohol-impaired driving persists as a social problem in the U.S. Are there other factors influencing decisions to drive after alcohol consumption that may be amenable to change? We conducted a roadside survey in California in 2012 to assess whether residential accessibility, travel attitudes (indicated by ratings of convenience and safety for travel options), and perceptions of arrest risk affect travel choices made subsequent to alcohol consumption. We conducted hybrid choice modeling for 580 participants. Mode-specific travel attitudes were valid constructs and predictive of travel behavior. Perceived level of service (speed) increased the utility for taxi and getting a ride. Perceiving high risk of arrest affected mode choice through travel attitudes. Not everyone assessed their mode options in the same way. For example, frequent binge drinkers appear to be more willing to consider taxis, men had stronger preferences towards active modes, and younger drivers were less pro-driving in this context. Past drinking and driving behavior affected one's attitude towards driving, while the number of drinks was related to mode choice. While our accessibility measure was not significantly related to attitudes or choice, decreasing urbanicity corresponded with stronger preferences for driving. This pilot study suggests that improving level of service

Kara MacLeod: Conceptualization, Methodology, Software, Formal Analysis, Data Curation, Writing - Original; **Mikkel Thorague:** Methodology, Software, Validation, Formal Analysis, Writing – Review & Editing; **Victor Villalobos:** Conceptualization, Methodology; **Jeroen van Meijgaard:** Methodology, Software, Formal Analysis; **Katherine Karriker-Jaffe**: Methodology, Writing – Review & Editing**; Tara Kelley-Baker**: Investigation, Writing – Review & Editing; **David Ragland:** Conceptualization, Investigation, Writing – Review & Editing.

(speed), convenience, and overall safety are considerations for public health in terms of promoting alternatives to drinking and driving. This line of research also has implications for emerging options, such as ride hailing, and how these might be optimized for specific segments of the population.

Keywords

accessibility; environment; drinking and driving; risk perceptions; transportation

BACKGROUND

Preventable deaths and social and economic burdens are caused by traffic crashes. Alcohol-impaired driving persists as a major risk factor for traffic-related injury and death, despite decades of public education and enforcement campaigns. In California over the past few years, alcohol-impaired driving fatalities per 100 million vehicle miles traveled have increased from 0.27 in 2013 to 0.33 in 2016 (California Office of Traffic Safety [CA OTS], 2018). The proportion of traffic fatalities that involved alcohol-impaired driving also increased slightly from 28% in 2013 to 31% in 2017 (CA OTS, 2018). Among adult drivers intercepted at gas stations in California, past 6 month driving after having too much alcohol to drive safely has varied slightly over time with reports of 5.5% in 2012, 6.2% in 2013, 8.8% in 2014, 6.6% in 2016, 10.1% in 2017, and 6.3% in 2018 (CA OTS, 2013; CA OTS, 2014; CA OTS, 2016; CA OTS, 2017; CA OTS, 2018).

Previous studies have consistently identified drinking and driving as more common among men and younger drivers (Bergen, Shults, Beck, & Qayad, 2012; Compton, & Berning, 2009; Dunaway, Will & Sabo, 2011; Gruenewald, Mitchell & Treno, 1996). Lower socioeconomic status and higher alcohol consumption patterns tend to also be related (Bergen, Shults, Beck, & Qayad, 2012; Birdsall, Reed, Huq, Wheeler & Rush, 2012; Chia et al., 2011; Dunaway, Will & Sabo, 2011; Gruenewald, Mitchell & Treno, 1996). Where and how people prefer to drink and the distribution of drinking establishments can influence drinking and driving behavior (Gruenewald, Johnson & Treno, 2002) and may explain some of the sociodemographic patterns. Although this might be changing with new mobility options (Murray-Tuite, Anderson, Lahkar, & Hancock, 2019).

Efforts to address this problem in communities include publicized sobriety checkpoints, which, continue to be effective and designated driver programs where more evidence is needed (Bergen, Pitan, Qu, Shults, Chattopadhyay, Elder, Sleet, Coleman, Compton, Nichols, Clymer, & Calvert, 2014; Ditter, Elder, Shults, Sleet, Compton, & Nichols, 2005). Land use and transportation is increasingly being recognized as important to health behaviors (Frank, Iroz-Elardo, MacLeod & Hong, 2019). Land use patterns and transportation availability may also impact travel behavior in the context of social and drinking-related activities.

There is a small body of research to that shows improving attitudes towards transportation alternatives and improving transportation level of service (LOS) may reduce drinking and driving (Jackson & Owens, 2011; Scagnolari, Walker, & Maggi, 2015; Turrisi & Jaccard, 1992). Results of a northeastern study found that reducing embarrassment about needing a ride when drunk, decreasing the cost of the ride, and increasing trust towards taxi drivers would promote alternatives to driving drunk (Turrisi & Jaccard, 1992). In a natural experiment in Washington D.C., decreases in driving under the influence (DUI) arrests were observed as a result of extending metro service hours. These decreases were only observed in areas where bars were within walking distance to transit stations (Jackson & Owens, 2011). Similarly, hypothetical scenarios presented to young Swiss drivers where LOS improved, increased the willingness to choose bus/train and taxi (Scagnolari, Walker, & Maggi, 2015). Finally, as a last example, Israeli patrons who were intercepted outside a pub and surveyed, indicated they were less likely to drive if public transportation was accessible (Bord, Gesser-Edelsburg, & Baron-Epel, 2017).

How land is used influences what activities are available in a community. The combination of land use and transportation systems can promote transportation mode choices through destinations that have attractive power and through routes that make it possible and convenient to reach these destinations (Ewing & Cervero, 2010; Frank, Iroz-Elardo, MacLeod & Hong, 2019). Overall, travel time and cost are well established predictors of transportation mode choice, but comfort and convenience may also be important (Frank, Bradley, Kavage, Chapman & Lawton, 2007; Walker, 2011). In addition, transportation decision modeling is increasingly considering psychological and other factors, such as, attitudes, perceptions, emotions, personality, lifestyle, and habit (Kamargianni & Polydoropoulou, 2014). Finally, programs that intervene on drinking and driving will also impact travel decisions in this context. For example, the Community Preventive Task Force recommends publicized sobriety checkpoints. This program reduces alcohol crash fatalities, partly, by increasing perceived risk of arrest (Bergen, Pitan, Qu, Shults, Chattopadhyay, Elder, Sleet, Coleman, Compton, Nichols, Clymer, & Calvert, 2014). Deterrence relies on the perception of an increased likelihood that one will be detected and punished if detected.

Thus, one's travel behavior may be informed by the environment, in addition to preferences and perceptions of risk. In an effort to better understand how to improve alternatives for different segments of the population in this context, the research questions for this paper are:

- **1a)** Is travel choice associated with residential accessibility?
- **1b)** Is the effect of residential accessibility on travel choice mediated by travel attitudes (ratings of convenience and safety)?
- **2a)** Is travel choice associated with perceptions of arrest risk about drinking and driving?
- **2b)** Is the effect of perceptions of arrest risk on travel choice mediated by travel attitudes (ratings of convenience and safety)?

METHODS

Study

We conducted a roadside survey in California in 2012 to provide an estimate of the prevalence of substance use and driving among California weekend nighttime drivers. Nine jurisdictions within the northern (Eureka, Redding, and San Rafael), central (Modesto, Fresno), and southern (Ontario, Gardena, Anaheim, Chula Vista) areas of California, U.S.A. were selected. Data were collected from a sample of 1,375 weekend nighttime drivers on Friday and Saturday nights from 10 pm to midnight and 1 am to 3 am from June to August 2012. For 8 of the jurisdictions, data collection occurred over one weekend. In Modesto the data collection occurred over 2 weekends.

For the first vehicle at each site, the third vehicle was selected from the flow of traffic at select locations near well-lit parking lots. After that, non-commercial vehicles were selected. Vehicles were usually waved in by a uniformed police officer. Driver participation was voluntary and this was indicated with road signs at the parking lot entrance. Drivers who agreed to participate were given a $20 cash incentive. A longer description of the study procedures can be found elsewhere (BLINDED1).

Survey

Trained surveyors obtained anonymous data on alcohol and drug use. Participants were asked a variety of questions about their drinking behavior. Among participants who indicated drinking in the past year, additional survey items asked about the occasion they last drank alcohol outside the home, excluding the survey evening. This additional survey item used a revealed preference approach asking respondents to report for the last occasion (revealing their preference versus reporting what they would ideally do).

Analysis population

Weekend nighttime drivers were approached (n=1715) and 99.1% met the eligibility criteria (age 16+, not driving a commercial vehicle, spoke English or Spanish, were able to understand this was a voluntary research study and willing and able to provide informed consent). The 1,375 that consented to participate in the roadside survey represent 81% of the eligible population invited to participate. Of the 889 who reported drinking alcohol in the past year, 78% participated in the survey. Of the 689, 84% had complete demographic characteristics, risk perceptions, and binge drinking information and provided a 5-digit ZIP code within California and information about their travel choices. Among the 582, only 2 chose public transit, therefore, we excluded public transit from the model. Thus, 580 represents the analysis population for this paper.

Variables

Travel choice—Participants provided their travel choice based on the main way they traveled back home for the last time they drank alcohol outside the home. They indicated their choice from a targeted list that included: “Drove myself” (driving); “Caught a ride with someone” (ride); “Took a taxi” (taxi); “Took a bus or train” (only 2 chose this option and were excluded); “Walked or biked” (walking or biking); or “Did not go home” (no travel). These options were developed based on National Survey of Drinking and Driving Attitudes and Behaviors (Moulton, Peterson, Haddix, & Drew, 2010).

Perceived level of service and travel attitudes—In addition to the option they chose, participants indicated which additional options (driving, ride, taxi, walking or biking, no travel) were available for that occasion and rated the level of service (cost - inexpensive, speed - fast) and their attitude (convenient and overall safety – personal and/or traffic-related) towards each option. For example, if they indicated driving, and taxi were available they would provide ratings of cost, speed, convenience and overall safety for each of the 2 options. All 4 of the attributes for each of the options indicated were coded on a 4-point Likert scale where a higher score was better (i.e. cheaper, faster, more convenient, and safer). LOS indicators were not included in the analysis for no travel / staying over.

Residential accessibility—Walk Score® was used as a proxy for residential accessibility, which can be defined as the spatial distribution of travel destinations relative to places of residence (Williams, 1989). Accessibility can impact travel patterns. Walking increases with more land use diversity, destinations within a walkable distance, and connectivity. Use of public transportation also increases with more land use diversity and better street network connectivity (Ewing & Cervero, 2010). A Walk Score® was obtained for each participant's self-reported residential ZIP code to represent residential accessibility. Walk Score® aims to measure the walkability of addresses and ranges from 0–100 where a higher score indicates better walkability. The measure is derived by calculating the distance to amenities and takes into account population density, block length, and intersection density (Walk Score®, 2014).

Residential urbanicity/rurality—Residential ZIP code to county crosswalks were obtained from the U.S. Department of Housing and Urban Development for the 3rd quarter of 2012 to identify the residential county (U.S. Department of Housing and Urban Development, 2018). Using the residential county, rural-urban continuum codes 2013 from the United States Department of Agriculture Economic Research Service were assigned (U.S. Department of Agriculture Economic Research Service, 2019). The codes were 1 = Metro – Counties in metro areas of 1 million population or more (51%); 2 = Metro – Counties in metro areas of 250,000 to 1 million population (27%); 3 = Metro – Counties in metro areas of fewer than 250,000 population (12%); 4= Non-metro – Urban population of 20,000 or more, adjacent to a metro area (1%); 5= Non-metro – Urban population of 20,000 or more, not adjacent to a metro area (8%); 6= Non-metro – Urban population of 2,500 to 19,999, adjacent to a metro area (<1%); 7= Non-metro – Urban population of 2,500 to 19,999, not adjacent to a metro area (<1%); and 8= Non-metro – Completely rural or less than 2,500 urban population, adjacent to a metro area (<1%). For the analyses, categories 4–8 were collapsed. Metropolitan areas are based on the Office of Management and Budget classifications (U.S. Census, n.d.).

High arrest likelihood—Deterrence of drinking and driving could be affected by the perception of an increased likelihood that one will be detected and punished if detected. Therefore, participants also answered the question "How likely do you think it is that a person drinking and driving could be arrested for impaired driving?" Response options were then dichotomized and coded as 1 for very likely (63%) vs. 0 for less likely. The legal blood alcohol limit (BAC) was 0.08 g/dL at the time of the survey and continues to be the limit in California, although a BAC of 0.05 is considered high enough to alter judgment and reaction times (Centers for Disease Control and Prevention, 2011).

Participant characteristics and behaviors—Sociodemographic characteristic consisted of age, sex, race, ethnicity and education. Age was collected as a continuous variable and then classified by the investigators as <21, 21–34, 35–49, and 50+. Dummy variables were derived for these age categories with age 21–34 as the reference group. This age group was the largest group and tends to have higher rates of drinking and driving (Jewett, Shults, Banerjee, & Bergen, 2015). Female sex was coded as 1 vs. 0 (males). Hispanic or Latino ethnicity was coded as 1 vs. 0 (non-Hispanic or Latino). Race categories were collapsed (Black, Asian and Other) as choice didn't significantly differ by specific race groups. Education was coded as bachelor's degree and beyond vs. less than bachelor's degree.

Participants were asked about their drinking behavior in general. For binge drinking frequency, respondents were asked "In the past year, how often did you have six (five for a woman) or more drinks on one occasion?" Dummy variables were created for less than monthly and monthly or more frequently, with the reference group as never. Participants were also asked about their alcohol consumption for the drinking occasion of interest (the last time they drank alcohol outside the home, excluding the survey evening): "Approximately how many drinks did you have?" Participants were also asked "In the past 12 months, did you ever drive after drinking enough that you might be considered to be legally under the influence?" (past year drinking and driving).

Hybrid choice modeling

Hybrid choice modeling was selected as it allows for incorporating psychological factors, in this case travel attitudes, into the choice process and improves the model specification. Choice is modeled using a structural equation for the utility function conditional on a set of explanatory variables. The observed choice corresponds to the alternative that maximizes the individual utility function, which is represented by a measurement equation. The utility function is stochastic, so the results are interpreted as the choice probability of individual n choosing alternative i. Hybrid choice models incorporate latent variables into the choice model. The latent variables are explained through structural and measurement equations (Ben-Akiva et al., 1999; Ben-Akiva et al., 2002; Bolduc, Boucher, & Alvarez-Daziano, 2008; Walker, 2001; Walker & Ben-Akiva, 2002).

For this analysis, there were 5 choices (driving, ride, taxi, walking or biking, no travel) and 5 latent variables (car, ride, taxi, walking or biking, no travel) with 2 travel attitude indicators (convenience and safety) for each latent variable. The latent variable represents the "attitude" towards that travel option. The modeling framework is shown in Figure 1. The measurement model represents the relationship between the indicators and the latent variable (X*). To avoid inconsistent estimates by assuming that the measurement equations are linear and continuous, we specified ordered measurement equations for the indicators (following the specification used in Daly, Hess, Patruni, Potoglou, & Rohr, 2012; Thorhauge, Swait, & Cherchi, 2020; Valeri & Cherchi, 2016). The structural model represents the relationship between the latent variable and the explanatory variables (X). Utility is measured by the choice indicator (Y). Utility is a function of the both explanatory variables and the latent variables. The dashed arrows represent the measurement equations and the solid arrows represent the structural equations.

To develop the Hybrid Choice model, discrete choice modeling was conducted for each alternative and participant characteristics were included one at a time. The Integrated Choice and Latent Variable (ICLV) framework consists of a choice model and a latent variable model. Participant characteristics were included in the latent variable model if the association was significant at the 20% level.

There are 5 equations described in Appendix A. The likelihood function for a given observation is the joint probability of observing the choice and the attitudinal indicators as follows:

$$\int_{X^*} P(Y_{in} \mid X_{in}, X^*_n; \Gamma_i, \alpha_i, \beta_i) f(I_{nmk} \mid X^*_n; a_{mk}, \lambda_{mk}) f(X^*_n \mid X_n; \delta_m, \gamma_m) \partial X^*$$

where i is the alternative chosen by individual n and m is the latent variable and k is the indicator for the latent variable; and

$P(Y_{in} \mid X_{in}, X^*_n; \Gamma_i, \alpha_i, \beta_i)$	represents the measurement component of choice given explanatory variable and latent construct;
$f(I_{nmk} \mid X^*_n; a_{mk}, \lambda_{mk})$	represents the measurement of the latent variable model;
$f(X^*_n \mid X_n; \delta_m, \gamma_m)$	represents the structural component of the latent variable model; and
∂X^*	the integral of X* and represents the marginal estimates from the joint probability of Y_{in}, I_{nmk}, X^*_n.

An example joint probability of observing the choice given the attitudinal indicators is the probability that, for example, a participant chooses to take taxi (Y) and rates taxi safe (I) given they are female (X). The central decision rule is utility maximization, where it is assumed that one will choose the alternative with the highest utility among the options perceived as available. Essentially, the assumption is that one is weighing or trading off the perceived attributes (risks and benefits) of the different travel alternatives.

In addition, we tested for possible substitution effects by testing single, multi-level, non-driving-related nesting. All modeling was conducted using Python Biogeme 2.6 (EPFL, Ecublens, Switzerland). Descriptive and logistic regression analyses were conducted using SAS 9 (SAS Institute, Cary, NC).

RESULTS

Descriptive

The descriptive results are presented in table 1. The leading choices in this sample were driving oneself (43%), getting a ride (32%), and not traveling home (16%). On average, participants had 2 drinks on that last drinking occasion and 18% reported binge drinking at least monthly. Among this sample, 41% were female, 12% were younger than 21 years of age, 9% were age 50 or older, 40% were white non-Hispanic, 29% had at least a college education, and 63% perceived it to be highly likely for one to be arrested for drinking and driving and 7% report drinking and driving in the past year.

The residential Walk Score® was normally distributed, with a mean of 43 and median of 42. According to Walk Score® cutpoints, 4% of participants live in very walkable (most errands can be accomplished by foot), 22% somewhat walkable (some errands can be accomplished by foot), 66% car dependent (most errands require a car), and 7% very car dependent (almost all errands require a car) ZIP codes, respectively (not shown in table). On average, participants reported 5 of the 6 options being available for the travel occasion. Average ratings of speed, inexpensiveness, convenience, and safety were high for the options chosen, with walking or biking rated relatively lower in speed and taxis rated relatively lower in inexpensiveness.

Hybrid choice model

In the tests for possible substitution effects (single and multi-level models, including non-driving-related nesting), we found that the models were not internally consistent and that the nesting parameters were not significantly different from 1, suggesting no need to account for nesting in the final models.

As depicted in Figure 1, the model included travel or mode specific attitudes and perceived level of service indicators for speed and inexpensiveness. In addition, participant characteristics and drinking behaviors, residential Walk Score®, county urbanicity/rurality, perception of arrest risk, and number of drinks were also used as explanatory variables. The mode attitudes were explained by explanatory variables and two indicators were used for each attitude. The full results of the hybrid choice model are presented in Appendix B. Results significant with 95% confidence are presented in figure 2. We tested for systematic heterogeneity by interacting our level of service attributes with participant characteristics (sex, age, race/ethnicity, education, drinking, residential Walk Score®, and county urbanicity/rurality). Perceived level of service decreased with increasing rurality for some modes but were not significant when adding the latent variables. We did not find any of the other effects to be significant. We also interacted residential Walk Score® and county urbanicity/rurality with participant characteristics (sex, age, race/ethnicity, education, and drinking); however, we did not find any of the effects to be significant. Furthermore. we also tested for random effects for travel time and cost, which captures random heterogeneity in the preferences, but can also be seen as a test for heteroscedasticity with respect to time and cost. We found the effect to be insignificant.

Thus, the final model specification appears robust for this sample.

Ratings about the travel options were important for choice. All of the latent variables significantly influenced choice and the largest coefficient was for driving followed by not traveling, taxi, ride, and walking and biking. The results indicate that perceived level of service (speed) significantly influences choice for some modes. For example, speed was positively related to choosing ride and taxi.

In terms of the first research question, travel behavior was not significantly associated with residential accessibility. The effect of residential accessibility on travel choice was not mediated by attitudes towards these alternatives (not included in the final model). However, as county-level rurality increased the preference for driving increased and the preference for not traveling decreased. In terms of the second research question, perceptions of arrest risk influenced travel behavior indirectly through travel attitudes. High fear of arrest was positively and significantly associated with attitudes towards ride, taxi, walking or biking, and not traveling (staying at the location). Past drinking and driving behavior and not perceptions of arrest risk affected one’s attitude towards driving.

Sociodemographic characteristics were not significantly related to choice directly. Sociodemographic relationships did not vary by alternative (alternative-specific sociodemographic relationships not shown). Sociodemographic characteristics were only significantly related to choice indirectly through preferences towards travel. For example, compared to the 21-<35 age group, being younger than 21 was negatively and older age (50+) was positively associated with pro car attitude (i.e. perceives personal driving to be convenient and safe); and being middle age was positively associated with pro taxi attitude. Compared to men, females had a negative attitude towards walking or biking and a positive attitude towards ride. Higher educational status was negatively associated with attitudes towards not traveling or staying over. Compared to other race/ethnicities, non-white and Hispanic participants tended to have pro attitudes towards getting a ride and non-white participants had a negative attitude towards walking or biking.

Drinking patterns also played a role. In general, the number of drinks decreased the utility for driving oneself compared to other options. Binge drinking monthly or more impacted travel choice indirectly through attitude towards taxi.

DISCUSSION

Despite decades of education and enforcement campaigns, alcohol-impaired driving persists as a social problem in the U.S. Using data from a survey of intercepted night-time drivers, we aimed to better understand how different segments of the population evaluated their travel options. We found that mode-specific travel attitudes, indicated by convenience and overall safety, were valid constructs predictive of travel behavior. Respondents’ choice of travel mode after alcohol consumption was associated with perceptions of risk of arrest through effects on travel attitudes (convenience, personal safety and traffic safety). Our measure of residential accessibility appeared to exert little, if any, effect on choice of travel mode choice. However, as level of urbanicity decreased, preference for driving increased. Taxi and rides were seen as a good alternative in terms of speed. Among a small body of literature, this study supports the possibility that increasing level of service, convenience, and safety may increase the use of alternatives to drinking and driving (Bord, Gesser-Edelsburg, & Baron-Epel, 2017; Jackson & Owens, 2011; Scagnolari, Walker, & Maggi, 2015).

Not everyone assessed their mode choices in the same way. Frequent binge drinkers, for instance, had a positive attitude towards taking a taxi, and younger drivers appeared to be more willing to not drive, as seen in prior studies (Scagnolari, Walker, & Maggi, 2015). Males viewed active modes more favorably than women, which also has been noted by others (Murray-Tuite, Anderson, Lahkar, & Hancock, 2019). Interestingly, past drinking and driving behavior affected one's attitude towards driving, but it did not affect mode choice. However, the number of drinks was related to the actual mode choice, decreasing utility for driving oneself.

While the present study did not focus on Transportation Network Companies (TNCs) or ride hailing (rides that can be requested via smart phone applications), these are a growing option in the U.S., and there is some indication they may be useful for reducing drinking and driving (Dills & Mullholland, 2018; Morrison, Jacoby, Dong, Delgado, & Wiebe, 2018). We found 36% chose ride or taxi for travel home on a recent drinking occasion in 2012. In a California 2018 survey where drivers were intercepted at gas stations, 31% reported in the past 6 months that they always take taxi or ride service when drinking (CA OTS, 2018). Results from the prior surveys suggest that use has been increasing over time with 11% in 2014, 21% in 2016, and 26% in 2017 reporting always using taxi or ride service when drinking (CA OTS, 2014; CA OTS, 2016; CA OTS, 2017).

Specific to drinking alcohol, focus groups in Texas revealed that cost was the leading barrier to using TNCs. Other common barriers included social context, personal safety (traveling alone, driver trust), and accessibility (availability, distance, wait time), and other inconveniences (not having smart phone, having to leave your car at a drinking venue) (Elgart, Shipp, Cardenas, Hansen, & Pant, 2016). In California, use of TNCs is more common among higher educated, older millennials and in locations with higher land-use diversity and accessibility (Alemi, Circella, Handy, & Mokhtarian, 2018). In Virginia the use of TNCs for alcohol-related outings is more common among younger adults (Murray-Tuite, Anderson, Lahkar, & Hancock, 2019). Consistent with this small body of research on TNCs, we found that convenience, safety, and level of service (speed) to be important for travel behavior in this context and cost did not significantly factor into travel choice. In addition, travel attitudes of convenience and safety were associated with sociodemographic characteristics. This has implications for promoting and optimizing various alternatives for specific segments of the population.

The role of driving is deeply embedded in the U.S. society. Among a sample of weekend night-time drivers in California, a majority reside in car oriented locations and living in a more rural county may make driving more convenient. Virtually no one in this sample chose public transit despite its reported availability. The cross-sectional nature of the data are a limitation. It is, for example, possible that people perceive the risk based on the choice they wish to make. Or, that they drink based on the mode they prefer, rather than choosing their mode based on their drinking behaviours. However, our model is probabilistic and indirectly captures this as the probability of taking car is higher if people drink less. In addition, residential accessibility using Walk Score® was only marginally related to behaviors such as walking or biking. While it may generally inform decisions and how one travels, at the ZIP code-level it may not capture the accessibility of the entire trip. We did find that level of urbanicity/rurality at the county-level to be associated with one's outlook towards driving. Future research can better understand the environmental aspects of travel patterns and choices through mobile devices, intercepting participants at drinking venues (Bord, Gesser-Edelsburg, & Baron-Epel, 2017), and incorporating social influences into choice (Elgart, Shipp, Cardenas, Hansen, & Pant, 2016; Kamargianni, Ben-Akiva & Polydoropoulou, 2014). Finally, while we ask about a different occasion than the survey night, the survey was administered by study staff, and the officer directing traffic did not have the authority to intervene, it is possible that the survey conditions affected reporting of recent behavior. In our analysis population, 6.9% reported past year driving after drinking enough that might be considered to be legally under the influence. In a California survey where drivers were approached by surveyors at gas stations, 5.5% in 2012 and 6.2% in 2013 reported in the past 6 months, they had driven when they thought they “had too much alcohol to drive safely” (CA OTS, 2013).

Despite the study limitations, the results of this pilot study suggest that improving level of service (speed), convenience, and both personal safety and traffic safety are new considerations for public health and promoting travel behaviors as alternatives to drinking and driving. As level of service, convenience, and safety are routinely considered in the transportation field, transportation and public health could work together to address this ongoing issue of drinking and driving. This problem, like many societal problems, is complex. For example, Melbourne initiated a program in 2016 that made public transportation available all night on Fridays and Saturdays. This program cost nearly $300 million (2016–2020, including patrolling for personal safety) and they promoted this program as a safe and convenient way to travel. An evaluation of the program found no immediate change in traffic crashes, assaults or emergency services. They did observe more people out and using transportation during the extended hours, as well as increases in intoxication at nightclubs (Curtis, Droste, Coomber, Guadagno, Mayshak, Hyder, Hayley & Miller, 2019a; Curtis, Droste, Coomber, Guadagno, Mayshak, Hyder, Hayley & Miller, 2019b). Improvements to public transportation may also displace alcohol problems. Evaluation of a natural experiment in Washington, D.C. documented improvements in some relevant locations, but also noted increases in arrests for other types of alcohol problems when metro schedules were extended (Jackson & Owens, 2011). Thus, it seems important to balance improved transportation convenience, speed and safety with other public health policies.

While personal driving has been the norm in U.S. society, mobility patterns are shifting with the introduction of new options, growing concern over sustainable options, and increased intersectoral collaborations. In this pilot study, we aimed to better understand how different segments of the population evaluated their travel options. We implemented a revealed preference approach to assess what weekend nighttime drivers actually do, versus what they say they would ideally do. This can be particularly relevant in our study as drinking and driving can be subject to social desirability biases. In future studies, a stated preference approach could further inform developing alternatives that are not currently available (Hensher, 1982; Louviere & Hensher, 1983) in less urban locations. A stated preference approach can also help to inform improvements to existing alternatives in terms of speed, convenience, and safety. This line of research – how different populations assess their travel mode choices – has implications for informing and enhancing safe travel behavior after drinking.

Author Manuscript
Author Manuscript
Author Manuscript

ACKNOWLEDGEMENTS

The main study was a collaborative effort of the California Office of Traffic Safety, the University of California at Berkeley Safe Transportation Research and Education Center, and the Pacific Institute for Research and Evaluation and was funded as a part of the California Traffic Safety Program through the support of the California Office of Traffic Safety and the National Highway Traffic Safety Administration. Dr. MacLeod was supported by Award Number T32AA007240, Graduate Research Training on Alcohol Problems from the National Institute on Alcohol Abuse and Alcoholism and Award Number T32CA009492, Cancer Control and Epidemiology Research Training from the National Cancer Institute. The content is solely the responsibility of the authors and does not necessarily represent the official view of the National Institutes of Health, the State of California Business Transportation and Housing Agency, the U.S. Department of Transportation, or the National Highway Traffic Safety Administration.

The authors would like to thank Dr. Bob Schneider for his comments on the mode choice survey and Drs. Joan Walker and Ashkay Vij for their guidance on the modeling approach. The authors would like to acknowledge John Lacey who was an Investigator for the main study. We are also grateful to Dr. Brian Cole for his feedback on the manuscript. We would also like to acknowledge Dr. Bill Satariano, a colleague and mentor who was dedicated to the study of the built environment and mobility, who passed away before this manuscript was finalized.

Appendix A: Hydrid choice model equations

The structural equations are:

$$X_{nm}^{*} = \delta_m + X_n\gamma_m + \sigma_{nm} \quad \text{(A.1)}$$

$$U_{in} = \alpha_i + X_{in}\beta_i + X_n^{*}\,\Gamma_\text{i} + \varepsilon_{in} \quad \text{(A.2)}$$

The measurement equations are:

$$\text{I}_{nmk} = a_{mk} + \lambda_{mk}X^{*}{}_{nm} + \upsilon_{nmk} \quad \text{(A.3)}$$

$$Y_{in} = 1, \text{ if } U_{in} = max\{U_{jn}\} \text{ or 0, otherwise} \quad \text{(A.4)}$$

where i is the alternative chosen by individual n and m is the latent variable and k is the indicator for the latent variable; and

$X^{*}{}_n$	is a vector of latent variables;
X_n	is a vector of explanatory variables;
δ_m	is a vector of constants;
γ	is a matrix of unknown parameters;
σ_n	is a vector of error terms;
U_n	is a vector of utilities;
α_i	is the alternative-specific constant;
β_n	is a vector of parameters;
Γ	is a matrix of unknown parameters;
ε_n	is a vector of error terms;
I_n	is a vector of indicators of latent variables;
a_n	is a vector of constants;

λ_n	is a matrix of unknown parameters; and
υ_n	is a vector of error terms.

The likelihood function for a given observation is the joint probability of observing the choice and the attitudinal indicators as follows:

$$\int_{X^*} P(Y_{in} \mid X_{in}, X^*_n; \Gamma_i, \alpha_i, \beta_i)\, f(I_{nmk} \mid X^*_n; a_{mk}, \lambda_{mk})\, f(X^*_n \mid \delta_m, \gamma_m)\, \partial X^* \quad \text{(A.5)}$$

where

$\mathrm{P}(Y_{in} \mid X_{in}, X^*_n; \Gamma_i, \alpha_i, \beta_i)$	represents the measurement component of choice given explanatory variable and latent construct;	(A.5a)
$f(I_{nmk} \mid X^*_n; a_{mk}, \lambda_{mk})$	represent the measurement of the latent variable model;	(A.5b)
$f(X^*_n \mid X_n; \delta_m, \gamma_m)$	represents the structural component of the latent variable model; and	(A.5c)
∂X^*	the integral of X* and represents the marginal estimates from the joint probability of Y_{in}, I_{nmk}, X^*_n.	(A.5d)

APPENDIX B.: Choice model for travel home on last drinking occasion, California Roadside Survey 2012 (N = 580)

	Car			Ride			Taxi			Walking or Biking			No Travel		
	Choice model: Structural equations														
	Est	**SE**	***p***	**Est**	**SE**	***p***	**Est**	**SE**	***p***	**Est**	**SE**	***p***	**Est**	**SE**	***p***
ASC				−0.23	1.33	0.86	−2.18	1.56	0.16	−1.20	1.83	0.51	−0.07	1.28	0.96
Speed	0.33	0.26	0.20	0.45	0.21	<0.05	0.63	0.33	0.05	0.30	0.26	0.26	N/A		
Speed Missing	1.28	1.30	0.32	2.20	1.23	0.07	N/A			0.29	1.12	0.79	N/A		
Inexpense	0.33	0.22	0.13	0.30	0.24	0.21	0.13	0.25	0.59	0.40	0.49	0.41	N/A		
Inexpense Missing	2.85	1.16	<0.05	1.91	1.34	0.15	N/A			2.73	2.34	0.24	N/A		
Age															
<21	1.07	0.66	0.10	Ref			Ref			Ref			Ref		
21-<35		Ref		Ref			Ref			Ref			Ref		
35-<50	0.43	0.39	0.27	Ref			Ref			Ref			Ref		
50+	−0.43	0.69	0.54	Ref			Ref			Ref			Ref		
Female vs. Male	---			---			---			---			---		
Non-white vs. white	0.55	0.34	0.11	Ref			Ref			Ref			Ref		
Hispanic vs. Non-hispanic	−0.09	0.34	0.79	Ref			Ref			Ref			Ref		
College + vs. <College	---			---			---			---			---		
Binge drinking															
Never		Ref		Ref			Ref			Ref			Ref		
<Monthly	0.49	0.39	0.21	Ref			Ref			Ref			Ref		
Monthly+	0.90	0.49	0.06	Ref			Ref			Ref			Ref		
Number of drinks	−0.27	0.09	<0.001	Ref			Ref			Ref			Ref		
Drinks missing	−0.88	0.71	0.21	Ref			Ref			Ref			Ref		
Perception of high arrest likelihood vs. not	---			---			---			---			---		
Walk Score®	0.02	0.01	0.16	Ref			0.01	0.02	0.38	0.02	0.01	0.14	0.02	0.01	0.08
County urbanicity/rurality	---			---			---			---			---		
Attitude	1.10	0.34	<0.001	0.67	0.16	<0.001	0.84	0.37	<0.05	0.56	0.28	0.05	0.86	0.17	<0.001
	Latent variable model: Structural equations														
Constant	1.33	0.31	<0.001	2.82	0.28	<0.001	2.29	0.27	<0.001	1.16	0.21	<0.001	3.65	0.43	<0.001

	Car			Ride			Taxi			Walking or Biking			No Travel		
	Choice model: Structural equations														
	Est	SE	*p*	Est	SE	*p*	Est	SE	*p*	Est	SE	*p*	Est	SE	*p*
Age															
<21	−1.23	0.37	<0.001	---			−0.44	0.24	0.07	---			---		
21-<35	Ref			---			Ref			---			---		
35-<50	0.23	0.31	0.46	---			0.48	0.19	<0.05	---			---		
50+	1.57	0.45	<0.001	---			−0.21	0.29	0.47	---			---		
Female vs. Male	---			0.40	0.20	<0.05	---			−0.39	0.19	0.05	---		
Non-white vs. white	---			0.52	0.21	<0.05	---			−0.41	0.19	<0.05	---		
Hispanic vs. Non-hispanic	---			0.42	0.20	<0.05	---			0.11	0.19	0.57	---		
College+ vs. <College	−0.56	0.25	<0.05	---			−0.25	0.16	0.13	---			−0.56	0.25	<0.05
County urbanicity/rurality	0.25	0.13	0.05	---			−0.10	0.07	0.16	---			−0.23	0.10	<0.05
Binge drinking															
Never	Ref			---			Ref			---			---		
<Monthly	−0.14	0.27	0.61	---			0.29	0.17	0.08	---			---		
Monthly+	−0.39	0.31	0.21	---			0.48	0.22	<0.05	---			---		
Past year drinking and driving vs. not	1.36	0.37	<0.001	---			---			---			---		
Perception of high arrest likelihood vs. not	---			0.42	0.19	<0.05	0.40	0.15	<0.05	0.50	0.23	<0.05	0.55	0.23	<0.05
σ	0.77	0.13	<0.001	0.55	0.11	<0.001	0.18	0.12	0.13	0.56	0.15	<0.001	0.67	0.11	<0.001
	Latent variable model: Measurement														
Indicator 1: Convenience															
λ1	1			1			1			1			1		
τ1,2	1.02	0.14	<0.001	1.71	0.21	<0.001	2.13	0.18	<0.001	2.08	0.25	<0.001	1.50	0.20	<0.001
τ1,3	2.63	0.27	<0.001	3.86	0.31	<0.001	3.80	0.23	<0.001	3.54	0.38	<0.001	3.57	0.31	<0.001
Indicator 2: Safety															
λ2	0.97	0.15	<0.001	1.95	0.35	<0.001	1.96	0.27	<0.001	2.24	1.16	0.05	1.93	0.48	<0.001
τ2,2	1.59	0.20	<0.001	2.05	0.46	<0.001	1.52	0.27	<0.001	3.57	1.35	<0.05	1.71	0.47	<0.001
τ2,3	3.61	0.35	<0.001	6.21	0.94	<0.001	4.87	0.58	<0.001	6.38	2.31	<0.05	5.58	1.19	<0.001

NOTES:

--- indicates not included; and

N/A indicates not applicable.

REFERENCES

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.

Ben-Akiva M, McFadden D, Train K, Walker J, Bhat C, Bierlaire M, et al. (2002). Hybrid choice models: Progress and challenges. Marketing Letters, 13(3), 163–175.

Ben-Akiva M, Walker J, Bernardino AT, Gopinath DA, Morikawa T & Polydoropoulou A (1999). Integration of choice and latent variable models. Retrieved from http://web.mit.edu/its/papers/WALKER/%5BLatent_Variables%5D.pdf

Bergen G, Shults RA Beck LF, & Qayad M (2012). Self-reported alcohol-impaired driving in the U.S., 2006 and 2008. Am J Prev Med, 42(2), 142–149. [PubMed: 22261210]

Bergen G, Pitan A, Qu S, Shults RA, Chattopadhyay SK, Elder RW, Sleet DA, Coleman HL, Compton RP, Nichols JL, Clymer JM, & Calvert WB; Community Preventive Services Task Force. (2014). Publicized Sobriety Checkpoint Programs. A Community Guide Systematic Review. Am J Prev Med, 46(5), 529–39. [PubMed: 24745644]

Birdsall WC, Reed BG, Huq SS, Wheeler L & Rush S (2012). Alcohol-impaired driving: average quantity consumed and frequency of drinking do matter. Traffic Inj Prev, 13(1), 24–30.

Bolduc D, Boucher N & Alvarez-Daziano. (2008). Hybrid choice modeling of new technology for car choice in Canada. Transportation Research Record, 2082, 63–71.

Bord S, Gesser-Edelsburg A, & Baron-Epel O (2017). Public transportation availability and alcohol impaired driving among young adult pub patrons in Israel. Journal of Transport & Health, 5, s10.

California Office of Traffic Safety (2013). Annual report. Retrieved from https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/ca-fy2013ar.pdf

California Office of Traffic Safety (2014). Annual report. Retrieved from https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/ca-fy2014ar.pdf

California Office of Traffic Safety (2016). Annual report. Retrieved from https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/documents/ca_fy16_annual_report.pdf

California Office of Traffic Safety (2017). Annual report. Retrieved from https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/documents/california_fy2017_ar.pdf

California Office of Traffic Safety (2018). Annual report. Retrieved from https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/documents/ca_fy2018_ar.pdf

Chia G, Zhou X, McClure TE, Gilbert PA, Cosby AG, Zhang L, Robertson AA & Levinson D (2011). Gasoline prices and their relationship to drunk-driving crashes. Accident Analysis & Prevention, 43, 194–203. [PubMed: 21094313]

Centers for Disease Control and Prevention. (2011). Drinking and driving: A threat to everyone. Retrieved from http://www.cdc.gov/vitalsigns/pdf/2011-10-vitalsigns.pdf

Compton R & Berning A (2009). Results of the 2007 National Roadside Survey of alcohol and drug use by drivers. Traffic Safety Facts DOT HS 811 175.

Curtis A, Droste N, Coomber K, Guadagno B, Mayshak R, Hyder S, Hayley A, & Miller P (2019). Off the rails-Evaluating the nightlife impact of Melbourne, Australia's 24-h public transport trial. Int J Drug Policy, 63, 39–46. [PubMed: 30476877]

Curtis A, Droste N, Coomber K, Guadagno B, Mayshak R, Hyder S, Hayley A, Crossin R, Scott D, Smith K, & Miller PG (2019). The Impact of Twenty Four-Hour Public Transport in Melbourne, Australia: An Evaluation of Alcohol-Related Harms. J Stud Alcohol Drugs, 80(3), 314–318. [PubMed: 31250796]

Daly A, Hess S, Patruni B, Potoglou D, & Rohr C (2012). Using ordered attitudinal indicators in a latent variable choice model: a study of the impact of security on rail travel behaviour. Transportation, 39, 267–297.

Dills AK & Mullholland SE (2018). Ride-sharing, fatal crashes, and crime. Southern Economic Journal, 84(4), 965–991.

Ditter SM, Elder RW, Shults RA, Sleet DA, Compton R, Nichols JL; Task Force on Community Preventive Services. (2005). Effectiveness of designated driver programs for reducing alcohol-impaired driving: a systematic review. Am J Prev Med., 28(5 Suppl), 280–7. [PubMed: 15894161]

Dunaway K Will KE, & Sabo CS (2011). Alcohol-Impaired Driving. In Drew BE (Ed.), Handbook of Traffic Psychology. London: Academic Press.

Elgart Z, Shipp E, Cardenas J, Hansen T, & Pant A (2016). Transportation Network Companies present opportunities to increase safety and broaden TTI's research. Report Number TTI/SRP/16/165608–1

Ewing R & Cervero R (2010). Travel and the built environment. Journal of American Planning Association, 76(3), 265–294.

Ferguson SA (2012). Alcohol-impaired driving in the United States: Contributors to the problem and effective countermeasures. Traffic Injury Prevention, 13(5), 427–441. [PubMed: 22931172]

Frank LD, Bradley M, Kavage S, Chapman J, & Lawton K (2007). Urban form, travel time, and cost relationships with work and non-work tour complexity and mode choice. Transportation, 35 (1), 37–54.

Frank LD, Iroz-Elardo N, MacLeod KE & Hong A (2019). Pathways from built environment to health: A conceptual framework linking behavior and exposure-based impacts. Journal of Transport & Health, 12, 319–335.

Gruenewald PJ, Mitchell PR & Treno AJ (1996). Drinking and driving: drinking patterns and drinking problems. Addiction, 91(11), 1637–1649. [PubMed: 8972922]

Gruenewald PJ, Johnson FW & Treno AJ (2002). Outlets, drinking and driving: a multilevel analysis of availability. J Stud Alcohol., 63(4):460–8. [PubMed: 12160105]

Hensher DA (1982). Functional-measurement, individual preference and discrete-choice modeling - Theory and application. Journal of Economic Psychology, 2, (4), 323–335.

Hensher DA & Louviere JJ (1983) Identifying individual preferences for international air fares - An application of Functional-Measurement Theory. Journal of Transport Economics and Policy, 17, (3), 225–245.

Jackson CK & Owens EG (2011). One for the road: Public transportation, alcohol consumption, and intoxicated driving. Journal of Public Economics, 95, 106–121.

Jewett A, Shults RA, Banerjee T & Bergen G (2015). Alcohol-impaired driving among adults — United States, 2012. Morbidity and Mortality Weekly Report, 64(30), 814–7. [PubMed: 26247434]

Kamargianni M, Ben-Akiva M & Polydoropoulou A (2014). Incorporating social interaction into Hybrid Choice Models. Transportation Research Board Report 14–5023.

McKnight AJ, Langston EA, McKnight AS, Resnick A & Lange JE (1995). Why people drink and drive: The bases of drinking-and-driving decisions. DOT HS 808 251

Morrison CN, Jacoby SF, Dong B, Delgado MK, & Wiebe DJ, (2018). Ridesharing and Motor Vehicle Crashes in 4 US Cities: An Interrupted Time-Series Analysis. American Journal of Epidemiology, 187(2), 224–232. [PubMed: 28633356]

Moulton BE, Peterson A, Haddix D & Drew L (2010). National Survey of Drinking and Driving Attitudes and Behaviors: 2008 DOT HS 811 343

Murray-Tuite P, Anderson JC, Lahkar P, & Hancock K (2019). Travel choices in alcohol−related situations in Virginia. Transportation, 1–44.

Scagnolari S Walker JL & Maggi R (2015). Young drivers' night-time mobility preferences and attitudes towards alcohol consumption: A hybrid choice model. Accident Analysis and Prevention, 83, 74–89. [PubMed: 26221792]

Thorhauge M, Swait J, & Cherchi E, (2020). Breaking the Habit: Measuring the impact of inertia on departure time choices for commuting trips. Transportation Research Part A: Practice and Policy.

Turrisi R & Jaccard J (1992). Cognitive and attitudinal factors in the analysis of alternatives to drunk driving. J Study Alcohol, 53, 405–414.

U.S. Census Bureau. (n.d.) Metropolitan and Micropolitan. Retrieved from https://www.census.gov/programs-surveys/metro-micro.html.

U.S. Department of Agriculture Economic Research Service. (2019). Rural-Urban Continuum Codes. Retrieved from https://www.ers.usda.gov/data-products/rural-urban-continuum-codes.aspx#.UYJuVEpZRvY.

U.S. Department of Housing and Urban Development. (2018). United States Postal Service ZIP Code Crosswalk Files. Retrieved from https://www.huduser.gov/portal/datasets/usps_crosswalk.html.

Valeri E & Cherchi E (2016). Does habitual behavior affect the choice of alternative fuel vehicles? Int. J. Sustain. Transp. 10, 825–835.

Walk Score®. (2014). Walk Score Methodology. Retrieved from http://www.walkscore.com/methodology.shtml

Walker J (2001). Extended Discrete Choice Models: Integrated Framework, Flexible Error Structures, and Latent Variables. Environ. Eng. Massachusetts Institute of Technology. https://doi.org/http://transp-or.epfl.ch/courses/dca2012/WalkerPhD.pdf

Walker J & Ben-Akiva M (2002). Generalized random utility model. Math. Soc. Sci. 43, 303–343.

Williams PA (1989). The influence of residential accessibility on household trip-making. Socio-Economic Planning Sciences, 23(6), 373–385.

- Mode specific travel attitudes were predictive for travel behavior after drinking
- Perceived level of service increased the utility of ride and taxi
- Perceptions of arrest risk impacted choice through travel attitudes
- Not everyone assessed their mode options the same way
- Younger participants appear more willing to consider alternatives to driving

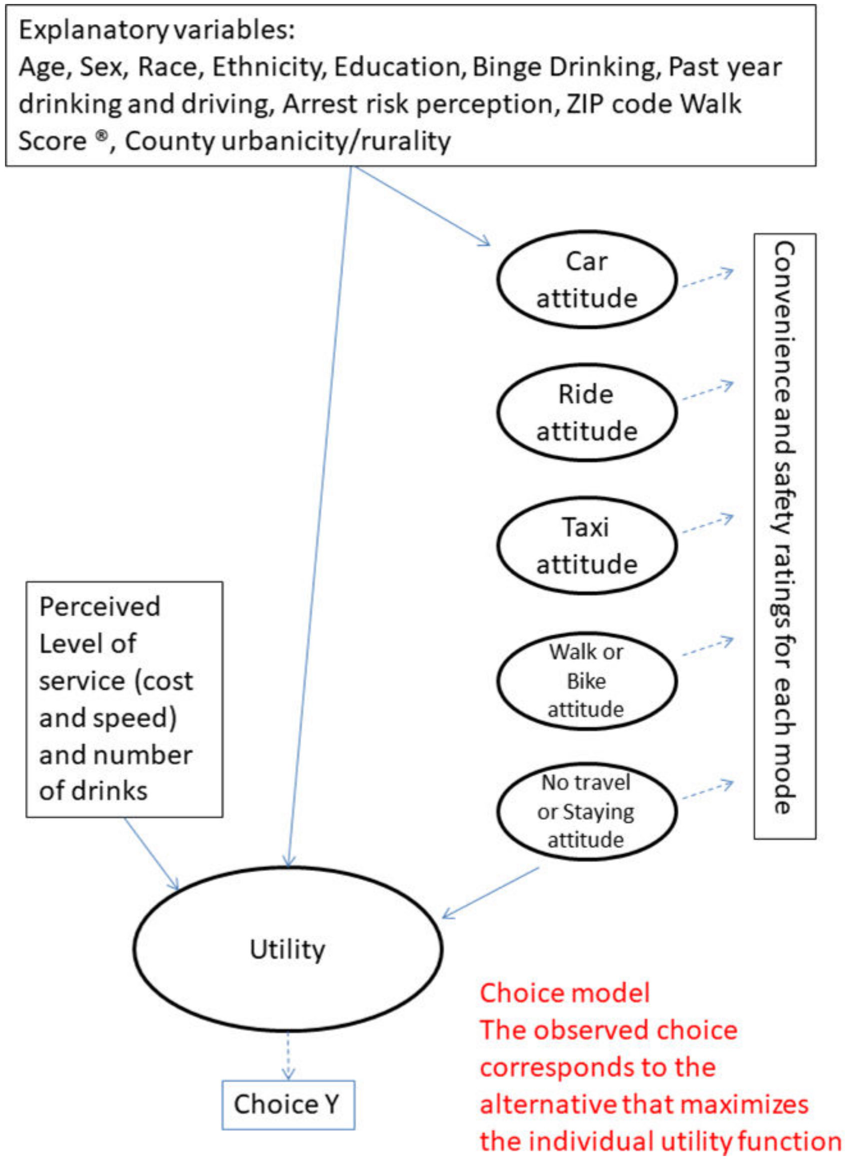

Figure 1.
Hybrid choice framework

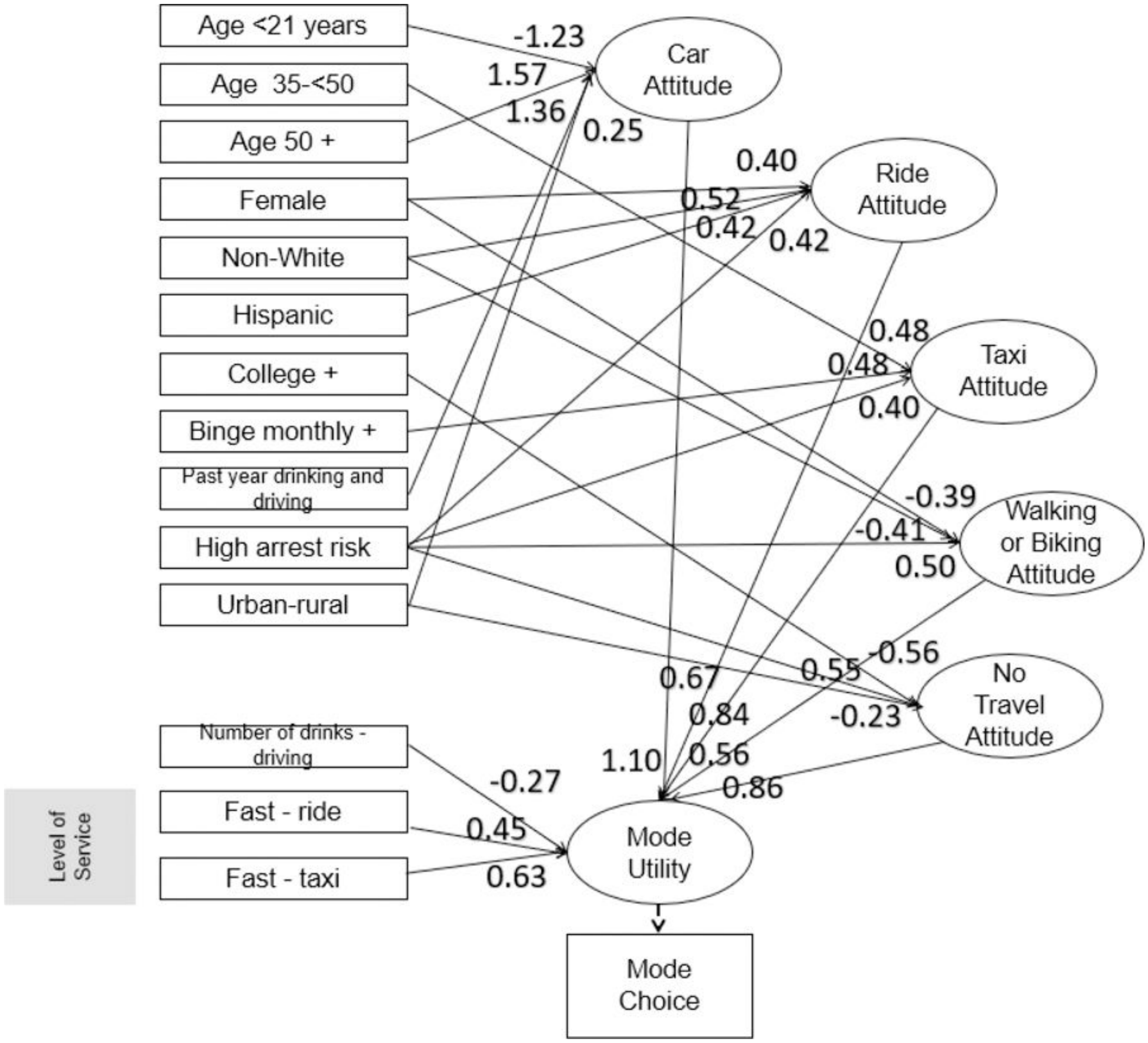

Figure 2.

Results significant with 95% confidence from the Hybrid Choice Model of travel behavior for a recent drinking occasion, California 2012

Table 1.

Participant and travel characteristics by travel choice home for last drinking occasion, California Roadside Survey 2012 (N = 580)

	Driving (n=249)		Ride (n=183)		Taxi (n=31)		Walking or biking (n=26)		No travel (n=91)		Overall (N=580)	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Female	98	39.36	83	45.36	11	35.48	8	30.77	39	42.86	239	41.21
Age												
<21	23	9.24	26	14.21	4	12.90	3	11.54	15	16.48	71	12.24
21–34	138	55.42	110	60.11	20	64.52	16	61.54	50	54.95	334	57.59
35–49	56	22.49	36	19.67	5	16.13	4	15.38	19	20.88	120	20.69
50+	32	12.85	11	6.01	2	6.45	3	11.54	7	7.69	55	9.48
Race												
White	145	58.23	103	56.28	21	67.74	17	65.38	48	52.75	334	57.59
white non-Hispanic	111	44.58	64	34.97	15	48.39	12	46.15	29	31.87	231	39.83
Black	26	10.44	7	3.83	1	3.23	1	3.85	8	8.79	43	7.41
Asian	26	10.44	17	9.29	4	12.90	2	7.69	15	16.48	64	11.03
Other	52	20.88	56	30.60	5	16.13	6	23.08	20	21.98	139	23.97
Hispanic/Latino	84	33.73	88	48.09	10	32.26	10	38.46	39	42.86	231	39.83
College +	85	34.14	50	27.32	9	29.03	5	19.23	19	20.88	168	28.97
Binge drinking												
Never	118	47.39	89	48.63	11	35.48	9	34.62	43	47.25	270	46.55
<Monthly	89	35.74	64	34.97	12	38.71	12	46.15	28	30.77	205	35.34
Monthly+	42	16.87	30	16.39	8	25.81	5	19.23	20	21.98	105	18.10
Past year drinking and driving	26	10.44	8	4.37	1	3.23	0	0	5	5.49	40	6.90
Perception of high arrest likelihood	142	57.03	120	65.57	20	64.52	17	65.38	66	72.53	365	62.93
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Residential Walk Score®	44.12	15.91	40.68	15.28	44.29	18.22	15.28	17.16	43.37	13.79	42.85	15.61
County urbanicity/rurality[(a)]	1.82	1.02	1.84	0.99	1.97	1.14	0.99	1.08	1.59	0.79	1.80	0.99
Number of alternatives available	5.41	1.38	5.44	1.31	5.61	1.05	1.31	2.03	5.76	0.82	5.46	1.32

	Driving (n=249)		Ride (n=183)		Taxi (n=31)		Walking or biking (n=26)		No travel (n=91)		Overall (N=580)	
	n	%	n	%	n	%	n	%	n	%	n	%
Number of drinks	1.79	1.52	2.34	2.11	3.50	2.70	2.74	2.03	2.60	4.02	2.22	2.37
Perceptions of mode chosen												
Fast*	3.56	0.69	3.51	0.66	3.19	0.79	2.79	0.93	3.62	0.75		
Inexpensive*	3.42	0.78	3.59	0.68	2.74	1.06	3.46	0.93	3.58	0.74		
Convenient*	3.49	0.78	3.67	0.57	3.48	0.77	3.50	0.81	3.72	0.60		
Safe*	3.19	0.83	3.75	0.48	3.58	0.72	3.21	0.78	3.76	0.50		

NOTES:

Walk Score® ranges 0–100 where a higher score indicates better walkability.

(a) County urbanicity/rurality ranges 1–4 where a higher score indicates more rural.

* Likert variables ranging 1–4 where a higher score indicates less expensive, faster, more convenient, and safer.