PUBLIC ACCEPTANCE AND ADOPTION OF SHARED-RIDE SERVICES IN THE RIDE-HAILING INDUSTRY

by

Kimberly Lippke and Christian Noyce

A practicum submitted
in partial fulfillment of the requirements
for the degree of
Master of Science
(School for Environment and Sustainability)
in the University of Michigan
May 2020

Advisors:
Professor Michael R. Moore, School for Environment and Sustainability, University of Michigan
Dr. Dana Jackman, Economist, U.S. Environmental Protection Agency, Office of Transportation and Air Quality

Abstract

On-demand ride-hailing companies like Uber and Lyft, often referred to as transportation network companies (TNCs), now provide shared-ride services, such as UberPool or Lyft Shared. Shared-ride services match riders with similar origins and destinations together. Passengers benefit from these services by paying reduced fares for the additional time spent picking up and dropping off additional passengers. This study seeks to provide a deeper understanding of the social and behavioral considerations associated with travelers' acceptance of shared-rides and how those considerations factor into individuals' willingness to pay (WTP) for shared-ride services. We conducted a survey of TNC users through Qualtrics in February of 2020, which had 1609 respondents from ten major metropolitan areas across the United States. In addition to the survey, we also conducted one focus group in Detroit, Michigan which supplements our survey results with the narratives of actual TNC users. We found that (a) the average WTP is significantly less for a shared-ride than a solo-ride and that this average decreases at a decreasing rate with each additional passenger; (b) the average WTP for a commuter ride is less than a leisure ride, which could be due to feelings that ridesharing is unreliable and inconvenient in regard to fixed work schedules; (c) the average WTP for a leisure ride is higher than a commute ride, which could be due to the value that individuals place on not having to drink and drive and to avoid parking hassles, and; (d) the presence of an option that allows riders to be matched based on social preferences of "happy to chat", "quiet preferred", or "no preference" results in a decrease in WTP. This study revealed that although most interventions are viewed as positive additions to TNC services and that social and behavioral motivation for using shared-ride services are relevant, they matter less when compared to traditional factors, such as time and cost.

Acknowledgements

We are sincerely grateful for the guidance, expertise, and encouragement of our advisors, Professor Michael R. Moore of SEAS and Dr. Dana Jackman of the U.S. Environmental Protection Agency, Office of Transportation and Air Quality. Thank you for sharing your knowledge throughout all aspects of our study and for the many hours of writing assistance, technical editing, and language editing.

We would also like to thank the members of the U.S. Environmental Protection Agency Office of Transportation and Air Quality DC and Ann Arbor Offices, led by Sharyn Lie, for your input and recommendations in shaping our survey instrument and focus group discussion.

Thanks, as well to John DeCicco and Shelly Sherman from the University of Michigan Energy Institute (UMEI). We are grateful for your financial support and administrative assistance in reallocating a portion of UMEI's SPEED grant to our SEAS research project.

Table of Contents

1. Introduction

Transportation now generates more carbon dioxide emissions than any other United States (U.S.) economic sector, and, at the same time, new mobility options are rapidly changing transportation (EIA, 2017). On-demand ride-hailing companies like Uber and Lyft, often referred to as Transportation Network Companies (TNCs)[1], now provide on-demand mobility services that complement and compete with public transit, personal vehicle and non-motorized mobility options (Clewlow & Mishra, 2017; Rayle et al., 2016; Hall et al., 2018). Ride-hailing services using smartphones got their start in 2010, with Uber and Lyft both rolling out their ride-hailing apps in 2012 (Sperling, 2018). Within this relatively short period of time, these door-to-door service providers have expanded across most of the United States and have introduced new options to riders, such as shared-ride services. These shared-ride services, such as Lyft Shared (formerly Lyft Line) and UberPOOL, match riders with similar origins and destinations together (Lyft, 2018; Uber, 2020). These shared services enable dynamic ridesharing[2], meaning passengers can request pickups in real-time and can save 25% to 60% in fares if a rider chooses the shared option (Constine, 2017). Uber has claimed that requests for UberPOOL are around 20%, while Lyft says that 37% of users in cities with the Lyft Shared option request a Lyft Shared trip, however they have not clarified the rate of actual matches (Schaller, 2018). Despite the rapid growth and availability of these dynamic shared-ride services, the past decade has not seen any increase in vehicle occupancy rates in the United States. Research investigating requests and matches of shared services have found the actual numbers to be substantially lower than those stated by Uber and Lyft (Henao and Marshall, 2018; Schaller, 2018). According to the U.S. Census Bureau, only around 9.3% of commuters in the U.S. carpooled to work, compared to 76.4% who drove alone (McKenzie, 2015). Furthermore, the U.S. National Household Travel Survey reported the mileage-weighted vehicle occupancy factor of light vehicles[3] has remained at 1.67 between 2009 and 2017; and when considering only cars, the factor reduced from 1.55 to 1.54 (FHWA, 2018). This stability, even with technological

[1] Transportation network companies (TNCs) are rapidly expanding organizations that use digital technologies to connect passengers to drivers who use their personal vehicles to provide for-hire ride services (Texas A&M Transportation Institute, 2017).
[2] Dynamic ridesharing describes real-time matching between the driver and rider such that the shared-ride does not have to be arranged in advance. The matching is provided by algorithms that propose the best real-time match between riders in terms of time and location (Gargiulo et al., 2015).
[3] Light-duty vehicles (i.e. passenger cars) have a maximum gross vehicle weight rating < 8,500 lbs.

advancements in shared-ride services, suggests the U.S. population is not yet willing to embrace ridesharing.

Regardless of the seeming unwillingness of the U.S. population to adopt ridesharing services, there is a growing body of literature which indicates that ridesharing can provide numerous transportation, infrastructure, environmental, and societal benefits (Shaheen & Cohen, 2018; Martin & Shaheen, 2010; Chan & Shaheen; 2012). On an individual level, rideshare participants experience cost savings due to shared travel costs, travel time savings by utilizing high-occupancy vehicle (HOV) lanes[4], and in some cases, reduced commuter stress from not having to drive (Peterson, 2008; Shaheen et al., 2016). Another societal benefit of ridesharing is the potential development of social and cultural capital (Cameron et al., 2018)[5]. Cameron et al. (2018) found that both drivers and riders acquired benefits from informational and emotional resources, as well as cultural exchanges via interactions with each other and the app. Similarly, a study analyzing riders' tweets posted on Twitter[6] regarding UberPool and Lyft Shared found that while positive tweets were outnumbered by negative tweets, the most common tone was humorous, suggesting that sharing rides may be providing riders with a rich and interesting cultural and social experience due to chance encounters with strangers (Pratt et al., 2019).

Further research is needed to understand what will motivate individuals to opt for the shared-ride option when using ride-hailing services to effectively reduce vehicle miles traveled (VMT)[7]. Noland et al. (2006) and Sperling (2018) argue that enacting policies[8,9] to increase ridesharing, even mandating ridesharing, is the most effective strategy to reduce

[4] High-occupancy vehicle (HOV) lanes are one or more lanes of a roadway that have restrictions on use to encourage ridesharing, reduce vehicle miles traveled (VMT), remove congestion, and improve overall traffic operations (U.S. Department of Transportation, 2015).

[5] According to the author of this study, social capital is "one of the benefits you get from being in a network of people, whether that's cooperation, emotional support, information being shared, trust or reciprocity". Cultural capital is "about learning more about the environment you're in" (Cameron, 2019).

[6] The Economic and Social Research Council describes Twitter as a 'microblogging' system that allows an individual to send and receive short posts called tweets (ESRC, 2020).

[7] Vehicle miles traveled (VMT) per capita is calculated as the total annual miles of vehicle travel divided by the total population in a state or in an urbanized area (U.S. Department of Transportation, 2015).

[8] Restrictive policies such as driving bans and mandatory ridesharing would be effective at reducing fuel consumption (Noland, 2006).

[9] Policies that may encourage ridesharing include giving tax credits to mobility service providers for achieving average passenger occupancies of two or more for cars, reduce vehicle registration fees for car owners and mobility companies who use their vehicles for ridesharing, provide subsidies for low-income travelers using shared-ride services, and give shared-ride vehicles special parking and stopping privileges in congested areas (Sperling, 2018).

energy consumption besides prohibiting driving. Noland found that other strategies that may be easier to implement such as telecommuting and flexible work schedules provided small reductions in oil while educational campaigns encouraging public transport use were even less effective and potentially more costly to implement. Another environmental benefit of ridesharing is the potential reduction of greenhouse gas (GHG) emissions into the atmosphere. A common strategy to reduce GHG emissions from passenger vehicles is the reduction of per capita VMT. An examination of the effects of on-demand ride-hailing use on vehicle kilometers traveled (VKT) in Santiago, Chile, revealed that in more than 50% of simulated scenarios, VKT was reduced if mean occupancy rate was 2.9 pax/veh or higher (Tirachini & Gomez-Lobo, 2019). Similarly, Taylor et al. (2015) found that if ridesharing became dominant in the field of on-demand ride-hailing services, a reduction of VMT would result. Thus, the average occupancy rate among ride-hailing services is a key parameter that determines the impact on VKT/VMT. While some research suggests that ride-hailing leads to reductions in vehicle ownership (Clewlow and Mishra, 2017; Ward et al., 2019), fewer vehicles does not necessarily lead to fewer VMT, through sharing or any other means. In fact, much of the current literature shows that ride-hailing leads to increases in VMT (Clewlow and Mishra, 2017; Schaller, 2018; Ward et al., 2019; Wenzel et al., 2019). In this context, it highlights the need to understand what will motivate individuals to opt for the shared-ride option when using ride-hailing services to effectively reduce VMT.

There is some evidence that consumers are prepared to accept a cultural shift away from car ownership towards ridesharing. PricewaterhouseCoopers (2015) conducted research on consumer attitudes towards the sharing economy and found one-third of people surveyed indicated that the automotive industry yields too much waste, and 56% of people find it more affordable to rideshare than to own a personal vehicle. It is important to note that this study only surveyed consumers' willingness to use ride-hailing services (e.g., UberX, Lyft) or to share vehicles (e.g., corporate fleets, Zipcar) and did not specifically look at consumers' willingness to share these rides with additional passengers whom they don't know (e.g., UberPool, Lyft Shared). Studies that have examined why individuals are reluctant to share rides with people whom they don't know found many riders have a desire for personal space, a dislike of social situations, a distrust of others, and concerns about security and privacy (Tahmasseby et al, 2016, Morales Sarriera et al., 2017, Amirkiaee & Evangelopoulos, 2018). However, some users of shared-ride services have reported that while the social interactions between passengers are relevant, it is not as important as the traditional factors, such as time and cost (Morales Sarriera et al., 2017).

Motivated by the important role that ridesharing may play in reducing consumer costs, VMT, road congestion, GHG emissions, air pollution, and stormwater runoff and the currently limited use of ridesharing services in the U.S., this study seeks to provide a deeper understanding of the social and behavioral considerations associated with travelers' acceptance of shared-rides and how those considerations factor into individuals' willingness-to-pay (WTP)[10] for shared-ride services. To better grasp the social dimensions of dynamic ridesharing services, we designed a survey to explore how people with different socio-economic backgrounds, with different travel behaviors, and different attitudes towards travel use ridesharing services. Additionally, we aim to learn what types of interventions could make individuals more or less likely to use shared services in the future. To understand how these factors influence WTP for shared-rides, the survey includes scenarios in which respondents are asked the most they would be willing to pay for a ride based on a set of attributes. In addition to this survey, we also conducted one focus group in Detroit, Michigan which supplements our survey results with the narratives of actual TNC users.

This research expands upon the ride-hailing and shared-ride services literature in multiple ways. First, it will inform policy makers and TNC decision makers on what influences the likelihood of an individual choosing a shared-ride. Second, it will help TNC decision makers more competitively price their shared services to maximize revenue, minimize costs, increase shared-rides, and decrease transit pollution per capita. Third, it will provide insight into emerging complementary services TNCs may choose to provide such as conversation options.

The rest of the paper is organized as follows. Literature review and hypothesis development are presented in the next section. Survey instrument development, focus group design, data collection, and data analysis is presented in the research methodology section. Section 4 summarizes survey and focus group results. Section 5 is a discussion of our findings. The paper concludes with implications for researchers, TNC decision makers, and policy makers, as well as limitations and suggestions for future research.

[10] Willingness to pay can be shown to be a measure of preference satisfaction and hence a measure of welfare. If money is used as the standard to measure welfare, the measure of benefit is willingness to pay to secure that benefit (Bateman et al., 2002).

2. Literature Review and Hypotheses Development

Ridesharing is not a new concept. Chan and Shaheen (2012) categorized the evolution of ridesharing into five key phases: 1) World War II car-sharing clubs (1942-45); 2) major responses to energy crises (late 1960's to 1980); 3) early organized ridesharing schemes (1980-1997); 4) reliable ridesharing systems (1999-2004); and 5) technology-enabled ridematching (2004-present). TNCs, which fall into the technology-enabled ridematching category, were nonexistent in many markets before Uber launched in the U.S. in 2010 (Sperling, 2018). The rapid adoption of ride-hailing services posed significant challenges for transportation researchers, policymakers, and planners, as there was limited information and data about how these services affect transportation decisions and travel patterns (Clewlow & Mishra, 2017). However, a considerable body of research has recently emerged to shed light on the role of TNCs in urban transportation. The following review highlights key insights from both ride-hailing specific literature, as well as, earlier ride-sharing and carpooling literature. Our hypotheses formulation is based on the literature and are presented throughout this section.

2.1 Motivations and deterrents of ridesharing adoption

Understanding the motivations and barriers to ridesharing has been a topic of interest since the U.S. energy crisis in the late 1960's (Chan & Shaheen, 2012). Increasingly, ridesharing is being discussed by researchers and policy makers as a powerful strategy to reduce congestion, emissions, and fossil fuel dependency. Even so, the literature shows that for most individuals, the propensity to rideshare remains low (Merat et al., 2017).

Overall, ride-hailing users find TNC services to be beneficial to the mobility landscape, with 86% of users agreeing that they contribute to time savings and stress reduction when traveling (Smith, 2016). Time and cost have often been identified as the most relevant determinants of ridesharing adoption, but they can either promote or deter adoption depending on the situation (Amirkiaee & Evangelopoulos, 2018; Lavieri & Bhat, 2019). For example, fixed schedules and long wait times have been an important deterrent to traditional carpooling services (Chan & Shaheen, 2012). Although TNCs have increased the flexibility of ridesharing services, users still need to accept the potentially longer (and less reliable) travel times of a shared-ride due to the pick-up/drop-off of additional passengers (Pratt et al., 2019). On the flip side, the ability to use HOV lanes without paying

a toll fee (thus saving time and money) motivates drivers and passengers to casually share rides during the morning commute in the San Francisco Bay Area (Shaheen et al., 2016). This same study also found that riders' most important reasons for sharing a ride were to save time (27%) and save money (40%). In the case of shared ride-hailing services, riders are motivated by time savings relative to other modes (such as public transit and walking), and monetary savings relative to private rides (Morales Sarriera et al., 2017; Schwieterman and Smith, 2018). This leads to the formulation of the following hypotheses:

H_1 - The average willingness to pay will be less for a shared-ride than a solo ride.

H_2 - The average willingness to pay will decrease at a decreasing rate with each additional passenger.

H_3 - The average willingness to pay will decrease as additional travel time increases.

The impact of TNCs on other mobility options, specifically public transit and personal vehicle use, has been a recent topic of interest in the transportation research community. Under some circumstances, ride-hailing services can increase public transit ridership by better serving the first and last miles, improving the experience of riding transit services, or providing a ride home outside the hours of operation of public transit or when traveling by transit and/or walking to/from transit stops may be considered unsafe (Taylor et al., 2015; Circella et al., 2016). However, Clewlow and Mishra (2017) found that ride-hailing services were found to replace public transit use by 6%, and Henao and Marshall (2018) found that 34% of people used ride-hailing services in place of walking, biking, or public transit.

While the adoption of ride-hailing services has motivated some individuals in the U.S. to reduce the number of vehicles they own, most users have not. Clewlow and Mishra (2017) found that 91% of users have not reduced the number of vehicles they own and Ward et al. (2019) found that per-capita vehicle ownership in the U.S. decreased in urban areas on average by only 3%. Interviews conducted in London found different results, with 37% of the sample indicating that vehicle sharing impacted their decision to own a private vehicle (Le Vine & Polack, 2019). Of these 37%, the vast majority (83%) indicated that the impact resulted in a decision not to purchase a vehicle that would otherwise have been purchased. It should be noted that the Le Vine and Polack (2019) study focused on free-

floating carsharing[11], more similar to ZipCar than Uber and Lyft. However, evaluating time-cost comparisons and users' motivation to reduce vehicle ownership due to this type of mobility option could be useful in on-demand ride-sharing research. Overall, further research on the adoption of, use, and travel behavior impacts of ride-hailing and ridesharing is needed.

2.2 Socio-economic factors

Previous ride-hailing and carpooling literature investigated socioeconomic factors, such as gender, ethnicity, age and income, that influence the propensity to use ride-hailing services and shared-ride services. In solo ride-hailing services, there are no substantial differences in usage between gender or along racial lines (Smith, 2016). However, women are more likely than men to use ridesharing and carpool services (Golob & Brownstone, 1992; Buliung et al., 2009; Siddiqi, 2012; Delhomme & Gheorghiu, 2016). Despite this tendency of women to rideshare more than men, studies which focused on perceptions of the social aspects of on-demand ridesharing found that safety is a significant concern among women, with the most pronounced difference being female respondents felt intimidated by other passengers more than male respondents (Daziano, 2012; Bansal et al., 2016; Morales Sarriera et al., 2017; Sanguinetti et al., 2019).

Age is another significant factor in determining an individuals' willingness to use ride-hailing services and shared-ride services. The median age of adult ride-hailing users in the U.S. is younger than average, with one study finding 18-to-29-year-olds being seven times as likely to use these services as those age 65 and older (Smith, 2016; Rayle et al., 2014; Young & Farber, 2019). Carpooling has been found to increase with age up to around 55 years-old, beyond which very few people carpool (Buliung et al., 2009). Similarly, Circella et al. (2015) found that millennials were consistently more likely to report higher awareness, adoption and frequency of use of all shared mobility services, if compared to members of the older Generation X that live in the same regions. Overall, though, the user base of shared mobility services seems to be continuously increasing among all age groups (ITS America, 2015).

[11] Free-floating carsharing (FFCS) is a mobility service in which the user located a nearby available vehicle (via an app on a smartphone) and drives to their destination (paying on a per-minute basis), and subsequently ends the usage after the one-way trip (Le Vine & Polak, 2019).

One problem with the rapid expansion of shared mobility networks is that they are not accessible to every neighborhood and demographic. Barriers to access include low rates of smartphone ownership, with bank accounts, and credit cards among lower income demographics (Shaheen & Cohen, 2018). A 2017 FDIC survey found that 25% of U.S. households were either unbanked or underbanked,[12] and Pew Research (2019) found only 71% of individuals making less than $30,000 had access to a smartphone. Multiple studies have found that ride-hailing adopters tend to be more educated and have higher incomes than the rest of the population (Clewlow & Mishra, 2017; Alemi et al. 2018; Schaller, 2018). However, Tahmasseeby et al. (2016) found that low-income commuters were more willing to participate in ridesharing services, suggesting that low-income individuals may be willing to adopt on-demand ridesharing options if they are afforded the access.

2.3 Attitudes and preferences towards ridesharing

Despite the many benefits of ridesharing, there are numerous behavioral and psychological barriers to increased ridesharing. In this sense, an important obstacle to ridesharing adoption is the users' willingness to share rides with strangers. Recent studies have examined why individuals are reluctant to share rides with people whom they don't know. They found that many riders desire personal space, dislike social situations, distrust others, and have concerns about security and privacy (Chan & Shaheen, 2012; Tahmasseby et al, 2016, Morales Sarriera et al., 2017, Amirkiaee & Evangelopoulos, 2018). One study gauging interest in social interactions while sharing a ride revealed that most respondents disagreed that socialization is a benefit to ridesharing (Morales Sarriera et al., 2018). The same study found the major deterrents to using ridesharing services (UberPool, Lyft Shared) to be: 1) being paired with an unpleasant passenger; 2) uncertainty about the length of the trip; and 3) a preference for privacy. Similarly, a more recent study that investigated the social implications of sharing a vehicle with strangers through observation of online commentary about UberPool and Lyft Shared on Twitter found that most tweets were about other passengers and their behavior, and while humorous in tone, negative tweets outnumbered positive ones (Pratt et al., 2019). Conversely, some individuals have leveraged ridesharing services as a new way to network and make social connections, with

[12] Unbanked or underbanked means individuals either don't have a bank account, or have an account, but still use financial services outside the banking system like payday loans to make ends meet (FDIC, 2017).

one CBS report stating that 30% of users of ridesharing services reported making a useful social connection during the ride (Krueger, 2018; Sanguinetti et al., 2019). These positive interactions between passengers have made the idea of connecting social media accounts to ridesharing apps increasingly popular. In 2017, Uber filed a patent to pull Facebook data for UberPool rides in the hopes of improving the ridesharing experience (Ghosh, 2017). More recently, HERE Mobility launched its mobility app, SoMo, which is an app that allows people to collaborate and share their rides with their social circles, allowing for a convenient and cost-effective ride from point A to B (SmartCitiesWorld, 2019; SoMo, 2019). While the use of social media data to connect people with similar interests could increase the willingness of some people to adopt ridesharing, it could also introduce the potential for discrimination in the system, pushing others away from ridesharing and creating more barriers to adoption. Studies have found that a substantial number of drivers and riders harbor feelings of prejudice towards passengers of different social classes and races (Morales Sarriera et al., 2018; Middleton & Zhao, 2019). Without careful design of interventions to improve the social aspects of dynamic ridesharing, these services could reinforce prejudice and discrimination in society.

A potential way to encourage ridesharing is to increase compatibility by allowing users to create a profile on ride-hailing apps describing entertainment preferences (Sanguinetti et al., 2019). This feature could find commonalities between passengers regarding these preferences and provide mutually preferred travel environments. Compatibility could also be centered around how the user wants to spend their travel time. In 2019, Uber launched “Quiet Mode” for its Uber Black and Uber Black SUV services (Uber, 2019). This allows riders, for a premium fee, to choose between “quiet preferred” and “happy to chat”. Currently, these options don’t exist for ridesharing passengers, but it would be useful to understand their influence on ridesharing adoption. To determine the effect of Uber’s “Quiet Mode” option on ridesharing services, we’ve included a conversation option variable in the hypothetical scenario section of our survey. Based on individuals’ lack of interest in social connections, we formulated the following hypothesis:

H_4 - The willingness to pay for ride-hailing services will increase when a conversation option is available.

Additional studies have investigated disposition towards safety, convenience, environmentalism, and trip type. Concern about the safety of riding with TNC drivers has

been a challenge for ride-hailing services (Chaudhry et al., 2018). While there are driver screening criteria and driver rating systems in place, there is currently no way to rate other passengers in shared-rides. Passenger rating systems have been considered, however evidence of passenger-to-passenger discriminatory attitudes in the context of ridesharing raises concerns that passenger reviews could create equity issues (Middleton and Zhao, 2019). While riders consistently list safety as a ride-hailing concern, it's difficult to measure due to it being a qualitative variable that is cognitively built using multiple dimensions. To address the safety concerns of both drivers and riders, in 2019 both Uber and Lyft added a button that directly connects the user to emergency services (Uber, 2019; Lyft, 2019). To better understand how the availability of this button influences individuals' willingness to share rides, we included a Likert scale response addressing this question in the attitudinal portion of our survey. We predict that:

P_1 - The likelihood of taking a shared-ride will increase when an emergency button that automatically shares location data with emergency personnel is present in the ride-hailing app.

Convenience, efficiency, and reliability are critical qualities of a ride-hailing service and longer travel times with shared services is an ongoing challenge. Chan and Shaheen (2012) found that individuals often see the attractiveness of ridesharing but are disinclined to sacrifice the flexibility and convenience of the private automobile. However, difficulties finding parking and cost of parking are often cited as common reasons for choosing ride-hailing over personal vehicle use (Chaube et al., 2010; Tahmasseby et al., 2016; Clewlow & Mishra, 2017; Schaller, 2018). To promote the adoption of ridesharing many TNCs have introduced straight-line routing. Straight-line routing[13], such as Uber Express POOL and Lyft Shared Saver, instructs users to walk a short distance to a designated pick-up location; the rider benefits by a reduced fare and a more direct route once in the vehicle (Schaller, 2018; Lyft, 2018). Understanding how long individuals are willing to wait for a shared-ride and how far they are willing to walk for a reduction in travel time would be useful in the organization of ridesharing services and the design of policies aimed at increasing adoption rates.

Some research has examined the determinants of consumer's intention to use ride-hailing services, specifically if environmental concerns and/or awareness is a significant

[13] Straight-line routing is meant to minimize turns and thus minimize in-vehicle travel time and the uncertainties experienced with ridesharing options (Schaller, 2018).

factor in ride-sharing adoption. It is often assumed that individuals' who perceive themselves as environmentalists will be more likely to ride-share (Burkhardt & Millard-Ball, 2006). Chaude et al. (2010) found that 69% of survey respondents stated they consider environmental concerns to act as an incentive to ride-share. However, Amirkiaee & Evangelopoulos (2018) found that having sustainability concerns does not have a direct effect on individuals' attitudes towards ridesharing. Similarly, Wang et al. (2018) found that environmental awareness is positively associated with consumers' intention to use ridesharing services, but this effect is relatively small.

Ride-hailing purposes are mixed, with 20% of all trips being work-related and the other major trip purposes being social and recreational (Schaller, 2018). The most common trip purpose for ride-hailing is going to bars and parties (38%), with 33% percent stating their top reason for using TNC services over driving themselves is to avoid drinking and driving (Clewlow & Mishra, 2017). Overall, individuals seem to be less sensitive to the presence of strangers on a commute trip than on a leisure trip, but the sensitivity to time is opposite (Lavieri & Bhat, 2019). Further safety measures may need to be put in place to increase ridesharing adoption for leisure trips. Even though women tend to use ridesharing services more often than men, women have a lower tendency to rideshare during commuter trips (Lavieri & Bhat, 2019). Some argue this is because women are usually responsible for most household shopping and after-school activities, which are usually tied to their typical commute (Fan, 2017; Buddelmeyer et al., 2018). We formulated the following hypothesis related to WTP based on trip type:

H_5 - The average willingness to pay for a ride will be less for a commuter trip than a leisure trip.

3. Research Methodology

3.1 Survey Instrument Development

Before the survey instrument was created, we conducted a soft focus group with six EPA staff members who are regular TNC users. This approach provided information on some of the important characteristics and perceptions of ridesharing services by early adopters. Based on our literature review and soft focus group, we designed our survey to assess the social and behavioral considerations associated with travelers' acceptance of shared-rides and how those considerations factor into individuals' WTP for shared-ride services. The survey was divided into three sections 1) stated preference choice scenarios, 2) transportation preferences, and 3) demographic questions. The survey instrument is reproduced in full in Appendix A - Survey Instrument.

Each stated preference question presents a hypothetical trip scenario in a ride-hailing service. In each scenario, the respondent is asked to assume:

- The weather is nice, and the driving conditions are good;
- The vehicle picking them up is a new, high-quality midsize car, such as a Honda Accord;
- The driver has a five-star rating.

The respondent is asked to fill in the most they would be willing to pay to take the trip based on each unique set of trip characteristics. An opt-out option, presented as an "I would not take this trip" survey response, was included in each question, allowing the respondent to opt-out of ridesharing altogether. As summarized in Table 1, the stated preference scenarios were differentiated by the following attributes and their levels:

- Type of trip, either commute or leisure;
- The trip duration in minutes if no additional passengers join the trip was categorized into 8, 16, 24, or 30 minutes;
- The number of additional passengers that joined the trip (i.e. equivalent to 0, 1, 2, or 3);

- The additional travel time in minutes due to additional passenger(s) joining the trip was categorized into 5, 10, 15, or 20 minutes;
- The availability of a conversation option, which matches riders on their preferences of “happy to chat”, “quiet preferred” or “no preference”.

In the stated preference section, we formulated our scenarios based on Taguchi’s orthogonal array mixed-level design using Minitab 17 statistical software. We chose the orthogonal array technique to ensure the attributes of each scenario presented to respondents were entirely distinct from other scenarios, as well as to maximize the attribute coverage with a limited and proportional amount of combinations. We used an L16 design with 16 runs and 5 factors (3 of 5 factors with 4 levels, 2 of 5 factors with 2 levels): L16(4^3 2^2). Table 1 shows the list of factors and levels used in the stated preference section. To minimize respondent fatigue, each respondent was randomly given 10 of the 16 scenarios to answer in the stated preference section.

In most cases, the transportation preferences and demographic questions were structured as multiple-choice questions, and those focusing on ridesharing perceptions were structured as Likert scale questions, in which the respondent was asked to state their opinion (extremely important to not at all important or strongly agree to strongly disagree) about or assign a feeling to (extremely comfortable to extremely uncomfortable) statements focusing on ridesharing characteristics and interventions.

Table 1

Orthogonal array of trip characteristics for scenario development

Scenario	Trip Type	Trip Duration in Minutes (Solo-Ride)	Number of Additional Passengers	Additional Trip Time in Minutes (Shared-Ride)	Conversation Option Available
1	Commute	8	0	0	Yes
2	Commute	16	0	0	Yes
3	Leisure	24	0	0	No
4	Leisure	30	0	0	No
5	Leisure	8	1	10	No
6	Leisure	16	1	5	No
7	Commute	24	1	20	Yes
8	Commute	30	1	15	Yes
9	Commute	8	2	15	No
10	Commute	16	2	20	No
11	Leisure	24	2	5	Yes
12	Leisure	30	2	10	Yes
13	Leisure	8	3	20	Yes
14	Leisure	16	3	15	Yes
15	Commute	24	3	10	No
16	Commute	30	3	5	No

3.2 Survey Sample and Data Collection

The survey was conducted with individuals who self-identified as users of TNCs and who reside in metropolitan areas in the United States where UberPool and Lyft Shared are available. The sample included individuals who may or may not have used shared-ride services; however, all had the option of requesting a shared-ride due to their geographic location. The survey was administered to individuals 18 years of age or older and who reside in one of the following metropolitan areas: Atlanta; Boston; Chicago; Denver; Houston; Los Angeles; Miami; New York; San Francisco; or, Washington D.C.

To reach our targeted population, a survey created on Qualtrics (an online survey development service) was used, and respondents were recruited through Pollfish[14] (a survey distribution company that offers non-monetary incentives to individuals to complete surveys). There are limitations to using Pollfish to acquire survey respondents. First, because survey takers receive incentives for each survey they complete, they may complete surveys with less attention to detail than researchers would prefer. Second, since Pollfish is a mobile-first platform, respondents could have felt overwhelmed by the amount of text on their smartphone screen. Thus, data was assessed and modified to address those limitations. For example, respondents who appeared to have abandoned the survey midway through or who appeared to have provided unrealistic answers (e.g. Question: How many people live in your household? Answer: 99) were removed.

The survey was conducted between February 10 and February 23, 2020. In order to limit survey takers to only individuals who have had previous experience using TNC services, a screener question was first distributed to 5,398 individuals, of which 3,672 (68%) passed and were redirected to the Qualtrics survey. Of the 3,672 individuals who started the survey, 1,634 (44.5%) completed the survey. From the 1,634 completed surveys, 25 (1.5%) were eliminated for unrealistic responses. Details regarding what constitutes an unrealistic response are discussed in section 3.4 Data Cleaning. The final sample size used in the analysis was 1,609 respondents.

3.3 Focus Group

Qualitative survey methods are often used to understand travelers' perceptions, attitudes, and behaviors, frequently as a complement to quantitative surveys of public perceptions, attitudes, and behaviors (Grosvenor, 2000; Clifton & Handy, 2001). Consequently, to gain depth and insight into the experiences and perceptions of TNC users regarding ridesharing services, we conducted a focus group discussion in the Metro Detroit area. Our focus group data supplemented survey results with anecdotes, illustrations, and/or narratives.

[14] Pollfish uses the app-partnership model: the developers have control over respondent incentives specific to their individual apps. For example, an app for world news, a survey incentive might be a premium content article. For a fitness app, a free yoga class. In a game, an extra life. The publishers know what will motivate their users and prompt them to choose a survey when it is presented (Pollfish, 2019).

The popularity of Uber and Lyft services in Metro Detroit, as well as the availability of UberPool and Lyft Shared ride-hailing services, as well as its proximity to the University of Michigan make Detroit an ideal location to conduct the focus group. To assist in the recruitment process, we worked with Cypher Research, a marketing research focus group facility and field management service based in the Metro Detroit area. To participate in the focus group, participants were required to 1) be at least 18 years of age; 2) reside in Wayne County; 3) use TNC services at least once per month; and, 4) have never worked as a TNC driver. Cypher Research recruited ten participants with genders, ages, and ethnicities representative of Detroit. Eight attended the discussion. The discussion was conducted from 6 pm - 7 pm on March 9, 2020, at Cypher Research in Livonia, Michigan. Cypher Research provided a digital audio recording of the focus group discussion, which was transcribed into a text file using the online transcription Rev. The text file was coded and analyzed using MAXQDA, a software package for qualitative and mixed methods research. Full details of focus group methodology are provided in Appendix B - Focus Group Final Report.

3.4 Data Cleaning

After receiving the raw output from the administered survey, we identified faulty and questionable data. When possible, these types of data points were corrected. However, if an appropriate correction was not immediately apparent, we omitted the response. After considering descriptive statistics and graphs, we dropped observations in the top 1% of the WTP entered by our respondents.

Using fareestimate.com, we examined the actual fares of Uber and Lyft rides. Only a few actual fares had prices in the $100 to $200 range, which were long distance fares (e.g., to the airport or from city to city) and therefore not comparable to our stated preference scenarios. Because our scenarios never exceeded 45 minutes or included trips to an airport or to another city, we felt comfortable excluding any observation with a WTP over $500 (top 1% of the WTP data points). We applied the same 1% rule to the number of people in the household, excluding any households with more than 10 members. While we are reluctant to exclude any data from our analysis, we felt that a few respondents may have entered information quickly, without considering the parameters of the scenarios and survey, to quickly complete the survey and receive payment from Pollfish. Therefore, we feel justified in excluding the top 1% of data points from our analysis.

3.5 Economic Models

Employing linear mixed models (West, Welch, and Galecki, 2007), we crafted three models examining individuals' WTP for a hypothetical rideshare with varying attributes regarding the trip duration, the number of other passengers the trip may include, the type of trip, and then an option to converse with the other passengers. According to our literature review and in addition to weather, which we held constant, these are the core variables individuals consider when determining whether to take a ride-hailing service and WTP.

In our Core Model (1), the dependent variable is WillingnessToPay transformed by the natural log. In this equation, i is the individual and the vector $\overrightarrow{TripAttributes}$ includes the variables Trip Duration, NumberOfPassengers, Commute, and ConversationOption. The Betas, β, represent each associated coefficient to be estimated by the regression. The Epsilon term, ϵ, represents the random error component of the equations.

$$\ln(\text{WillingnessToPay})_i = \beta_o + \vec{\beta}_1(\overrightarrow{\boldsymbol{TripAttributes}})_i + \epsilon_i$$

Our Full Model (2), implements control measures for demographic variables and respondents' travel attitudes. The vector $\overrightarrow{Demographics}$ includes variables Age, Non-White, Income, DriversLicense, NumberOfVehiclesOwned, Female, and MetroArea (with an excluded category of NYC). The vector $\overrightarrow{TravelAttitudes}$ includes binary variables on how one regularly travels (Personal Vehicle, Public Transit, Micro Transit, Taxi, Ride-hailing, Walking or Jogging, Carpooling). $\overrightarrow{TravelAttitudes}$ also includes five point ordinal variables describing how important safety is during a ride, how important socializing is during a ride, how important the cost of a ride is, the ability to multitask during a ride, comfortability with regards to riding at night with an unknown passenger, the importance of one's environmental impact, the use of ride-hailing over a personal vehicle to connect to transit, and comfort level conversing with an unknown driver.

$$\ln(\text{WillingnessToPay})_{i,} = \beta_o + \vec{\beta}_1(\overrightarrow{\boldsymbol{TripAttributes}})_i + \vec{\beta}_2(\overrightarrow{\boldsymbol{Demographics}})_i + \vec{\beta}_3(\overrightarrow{TravelAttitudes})_i + \epsilon_i$$

Our Full Quadratic Model (3), includes all of the variables from Full Model (2) as well as quadratic variables of TripDuration squared and NumberofPassengers squared.

$$\ln(\text{WillingnessToPay})_i = \beta_o + \vec{\beta}_1(\overrightarrow{\boldsymbol{TripAttributes}})_i + \beta_2(\text{TripDuration}^2)_i + \beta_3 (\text{NumberOfPassengers}^2)_i + \vec{\beta}_4(\overrightarrow{\boldsymbol{Demographics}})_i + \vec{\beta}_5(\overrightarrow{TravelAttitudes})_i + \epsilon_i$$

These equations will inform the conclusions to our hypotheses regarding ridesharing services. We also examined these equations using no transformations on the dependent variable of WillingnessToPay, i.e., in levels rather than logarithms. Using STATA 16.0 statistical software, we ran multiple ordinary least squares (OLS) linear regression outputs of the cleaned data to examine which variables impact an individuals' WTP, as well as, the direction of the impact. An OLS regression is a statistical method that estimates the relationship between a dependent variable and other parameters by minimizing the sum of the squares that represent the difference between the observed dependent variable and those predicted by the linear function. We examined regressions with fixed effects, random effects, clustered analysis, and robust standard errors. After our completed analysis, we decided to highlight only the regressions with robust standard errors as the others did not significantly impact the error terms or fit.

4. Results

4.1 Survey Descriptive Statistics

Our objective was to include only “regular” users of ride-hailing services. As a consequence, respondents who answered “no” to the screener question “Do you use or have you ever used a ride-hailing service, such as Uber, Lyft or Via?”, were not redirected to the survey. After cleaning the survey data and removing outliers, we had 1609 usable survey responses. The following three sections present descriptive statistics for willingness to pay, travel attitudes and behaviors, and demographics. Figures 1 and 10 are histograms of respondents’ WTP across all stated preference scenarios. Table 2 shows the mean, median, and standard deviation for travel attitudes and behaviors numeric variables. Figures 2 through 9 illustrate respondents' choices for different categorical variables related to travel attitudes and demographics, which could impact travel behavior.

4.1.1 Willingness to Pay

The distribution of WTP is right skewed with the average WTP of $21.43 for a trip and a median WTP of $15 (Figure 1, Table 2). The average time of a solo-ride was 19 ½ minutes, with a shared-ride adding on average, 12 extra minutes. Approximately half of the scenarios were commute rides and half of the scenarios had the conversation option. The minimum amount an individual would pay was 50 cents, which is less than the average cost of public transit in the United States (Value Penguin, 2020). Some metropolitan areas, such as Los Angeles, offer discounted senior and disability public transit fares at $0.35 to $0.75, which could account for the low WTP of some individuals (Metro, 2020).

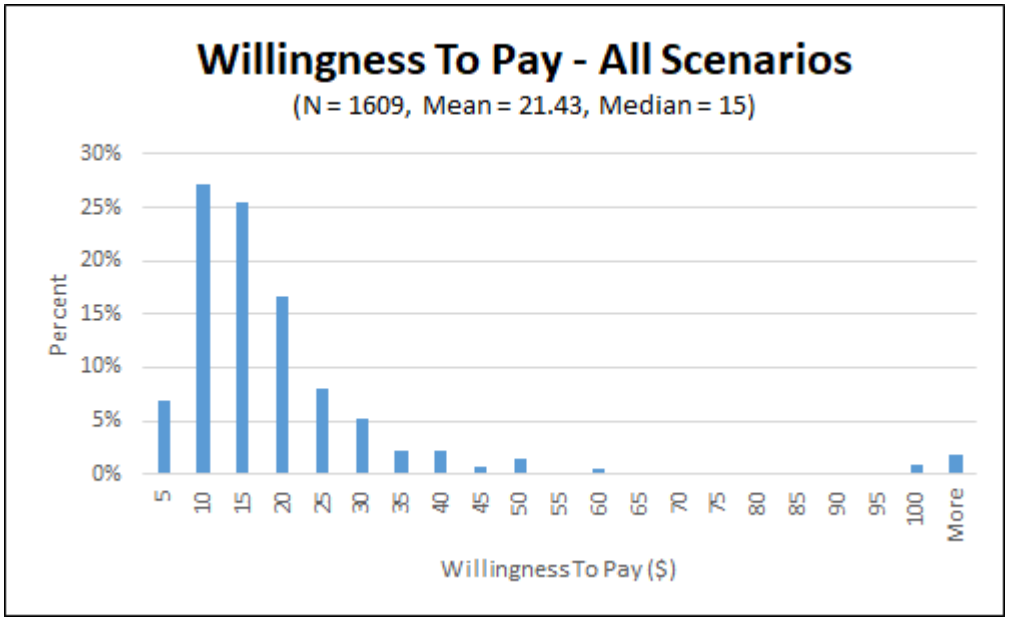

Figure 1. Histogram of Willingness to Pay - All Scenarios

4.1.2 Travel Attitudes and Behavior

On a five-point scale from strongly disagree to strongly agree, over half of respondents (68.6%) strongly agreed or somewhat agreed that they were frequent users of ride-hailing services. A majority (83.58%) also either strongly or somewhat agreed with the idea that ride-hailing saves time and stress during travel. A majority (83.04%) strongly agreed that it is easy to find shared-rides such as UberPool and LyftLine. While data was often skewed, we found a more even response distribution regarding TNCs collecting too much personal data about their customers. A plurality of respondents (33.13%) answered that they neither agree nor disagree with this statement.

Not surprisingly, safety ranked high in day to day travel with a majority of respondents rating it as extremely important. Environmental impact rated lower with a leftward skew, but a majority still felt it was either extremely important or very important. The importance of socializing in day to day travel was more evenly distributed between respondents with most believing it was slightly to moderately important. Cost on the other hand was a very important factor in the day to day travel with more than half our respondents indicating it was extremely important. Travel time was also a very or extremely important factor for our respondents. Privacy, while very important, had a bit less of a skew, suggesting a slightly more even spread for our respondents. A majority of respondents felt privacy was moderately important or very important.

Regarding comfort level with other passengers, more individuals were extremely comfortable with being picked up/dropped off at their work or school than at their home address. We also found quite a difference in comfort regarding riding in a car during the day with a passenger whom one does not know versus riding at night with a passenger one does not know. The average for nighttime sharing was on the border of “somewhat uncomfortable” and “neither comfortable nor uncomfortable,” while daytime sharing was “neither comfortable nor uncomfortable” and “somewhat comfortable.” In addition, most respondents were either “somewhat comfortable” or “neither comfortable nor uncomfortable” having a conversation with a driver or another passenger whom they did not know. Finally, when asked how the addition of an emergency button would impact a participant’s willingness to take a solo or shared-ride at night or during the day, a majority felt no matter the time of day or in the presence of another passenger, the option of an emergency button would somewhat or significantly increase their willingness to take said ride.

Due to the impacts straight line routing can have on shared TNC time, cost, miles, and emissions, we also asked how long our respondents would be willing to walk in order to partake in those benefits. The median answer was 5 minutes with a little less than 10% saying they would not be willing to walk to meet a driver.

Table 2. Descriptive Statistics - Travel Attitudes and Behavior (N = 1,609)

Question	Mean	Median	Std Dev
Willingness to Pay	21.43	15	35.53
Frequent ride-hailing user? (Strongly Agree = 5)	3.73	4	1.23
Ride-hailing saves time and stress during travel (Strongly Agree = 5)	4.2	4	0.86
Easy to find shared-rides such as UberPool/Lyft Shared (Strongly Agree = 5)	4.29	5	0.97
TNCs collect too much personal data about their customers (Strongly Agree = 5)	3.05	3	1.17
How important is safety in your day to day travel? (Extremely Important = 5)	4.64	5	0.67
How important is environmental impact in your day to day travel? (Extremely Important = 5)	3.67	4	1.08
How important is socializing in your day to day travel? (Extremely Important = 5)	2.73	3	1.38
How important is convenience in your day to day travel? (Extremely Important = 5)	4.36	5	0.79
How important is cost in your day to day travel? (Extremely Important = 5)	4.44	5	0.81
How important is travel time in your day to day travel? (Extremely Important = 5)	4.23	4	0.83
How important is privacy in your day to day travel? (Extremely Important = 5)	3.87	4	1.11
How comfortable are you being picked up or dropped off at your home address? (Extremely Comfortable = 5)	4.22	4	0.94
How comfortable are you being picked up or dropped off at your work or school? (Extremely Comfortable = 5)	4.33	5	0.87
How comfortable are you riding in the car during the day with another passenger whom you don't know? (Extremely Comfortable = 5)	3.46	4	1.16
How comfortable are you riding in the car during the night with another passenger whom you don't know? (Extremely Comfortable = 5)	2.95	3	1.33
How comfortable are you having a conversation with a driver whom you don't know? (Extremely Comfortable = 5)	3.7	4	1.03
How comfortable are you having a conversation with another passenger whom you don't know? (Extremely Comfortable = 5)	3.47	4	1.15
How would the addition of an emergency button change your willingness to take a solo-ride during the day? (Significantly Increase = 5)	4.16	4	0.87
How would the addition of an emergency button change your willingness to take a solo-ride during the night? (Significantly Increase = 5)	4.12	4	0.98
How would the addition of an emergency button change your willingness to take a shared-ride during the day? (Significantly Increase = 5)	3.9	4	0.94
How would the addition of an emergency button change your willingness to take a shared-ride during the night? (Significantly Increase = 5)	3.9	4	1.14
With nice weather, how long would you be willing to walk to meet a driver for a more direct route? (0, 3, 5, 7, 10, 15+ minutes)	5.68	5	3.58

Figure 2 shows that many of our respondents regularly use public transit, ride-hailing services, personal vehicles, and walk or jog in their day to day travel. We see that a majority of individuals use both personal vehicles (60%) and ride-hailing services (58%). When examining the use of multiple modes in daily travel, we see that about 30% of respondents regularly use both their personal vehicle and ride-hailing services, 32% of respondents regularly use a mix of public transit and ride-hailing services, and 15% of respondents regularly use a mix of public transit, ride-hailing services, and their personal vehicle.

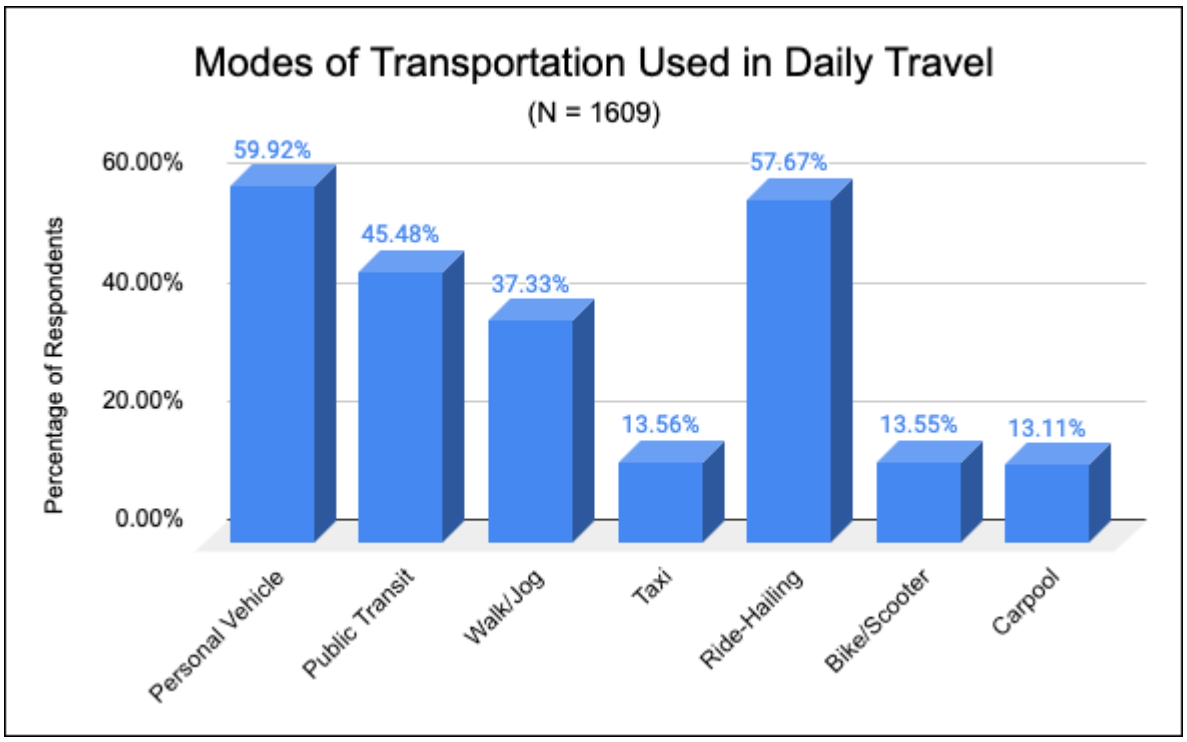

Figure 2. Modes of Transportation Used in Daily Travel

We specifically asked respondents the reasons they choose TNCs over driving a personal vehicle. As shown in Figure 3, most employ TNCs to avoid drinking and driving (57%), while many others use TNCs to avoid the cost (43%) and difficulties (46%) associated with parking. Others use ride-hailing services to multitask during travel (27%), to connect to public transit (21%), or because they do not have access to a vehicle or a driver's license (28%).

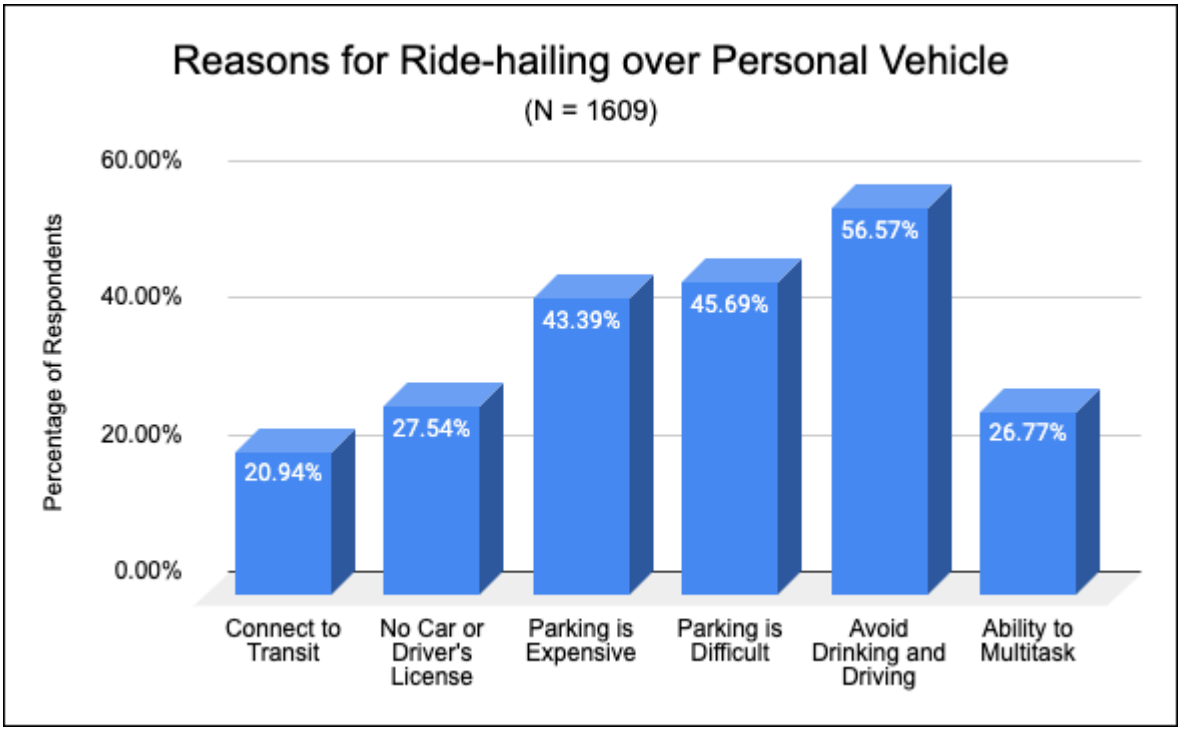

Figure 3. Reason for Ride-hailing over Personal Vehicle

4.1.3 Demographics

Figure 4 displays our survey demographics by metropolitan area. A large portion of our respondents were from Atlanta, Houston, New York City, and Chicago, with a small percentage of respondents from Denver, Los Angeles, Washington DC, Miami, and San Francisco, and very few respondents from Boston.

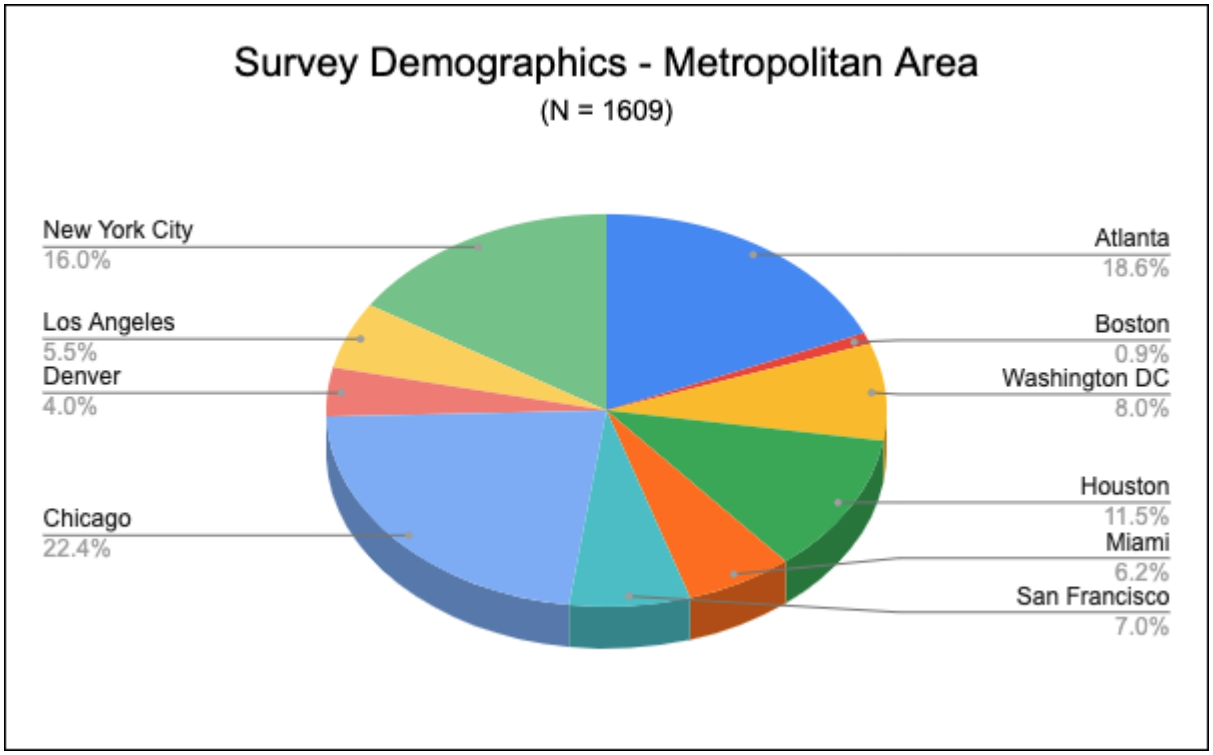

Figure 4. Survey Demographics - Metropolitan Area

Fifty-nine percent of respondents identified as female and a majority (60%) were between the ages of 18 and 34, with only .55% of respondents over the age of 65 (Figure 5). While this is not representative of the United States' metropolitan populations (Census.gov, 2017), it is expected as we limited our survey to existing TNC users, who tend to be younger, with the highest users between 18-29 years old. In addition, we sourced our respondents from Pollfish, which uses the app-partnership model for finding respondents. Thus, all respondents owned a smartphone, and though smartphone ownership varies greatly based on age, most are between 18 and 29 years of age (Pew Research Center, 2019).

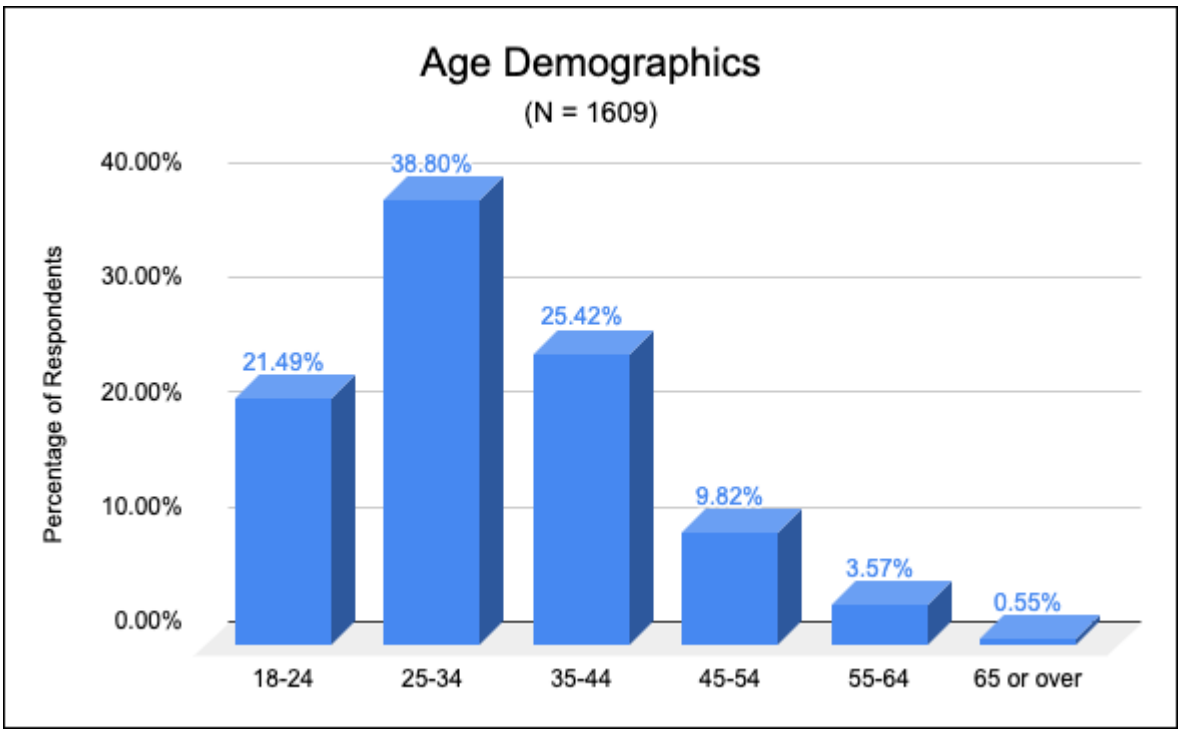

Figure 5. Age Demographics Distribution

Figure 6 shows respondents' race and ethnicity demographics. A majority (52.8%) of our respondents identified as white, meaning they checked only "white" and no other race or ethnicity when asked to "check all that apply.". Black or African American populations represented 27.6% of respondents and Hispanic and/or Latino populations represented 15.9% of respondents. The Black or African American representation in our survey is more than double the national population estimates (Census.gov, 2019) and may be due to our targeting of metropolitan areas, which tend to be more diverse in the United States than the general population. The Asian (7.2%), Native Alaskan or Native American (3.3%), and Native Hawaiian or Pacific Islander (.29%) respondent demographics are representative of national population estimates (Census.gov, 2019).

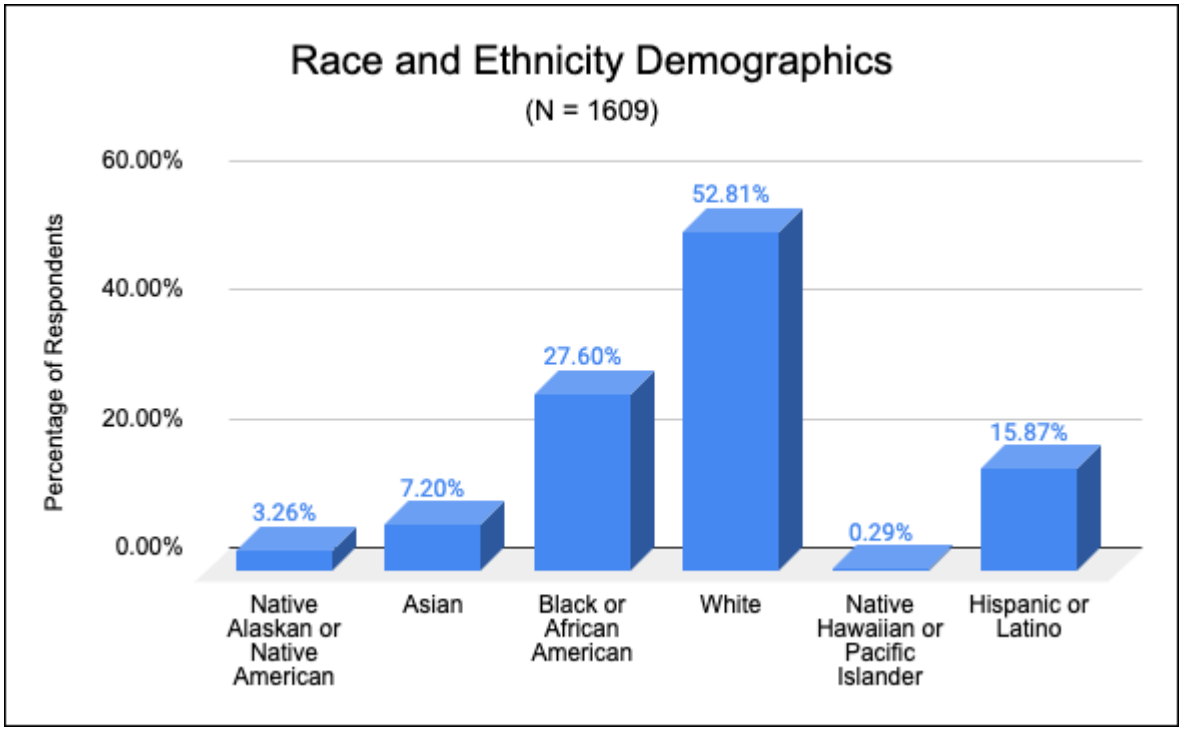

Figure 6. Race and Ethnicity Demographics Distribution

Figure 7 presents a visual of the educational attainment of respondents. A majority of respondents (61.1%) have some form of training or degree after high school, many have received a high school diploma or equivalent (36%), and few have less than a high school diploma (1.7%). Respondents have a higher percentage of high school graduates or post-secondary education than the national average (Census.gov, 2019), however this again could be attributed to the fact that we restricted our survey to existing TNC users which previous studies (e.g., Clewlow and Mishra, 2017; Schaller, 2018; and Alemi et al., 2018) have found to be more educated.

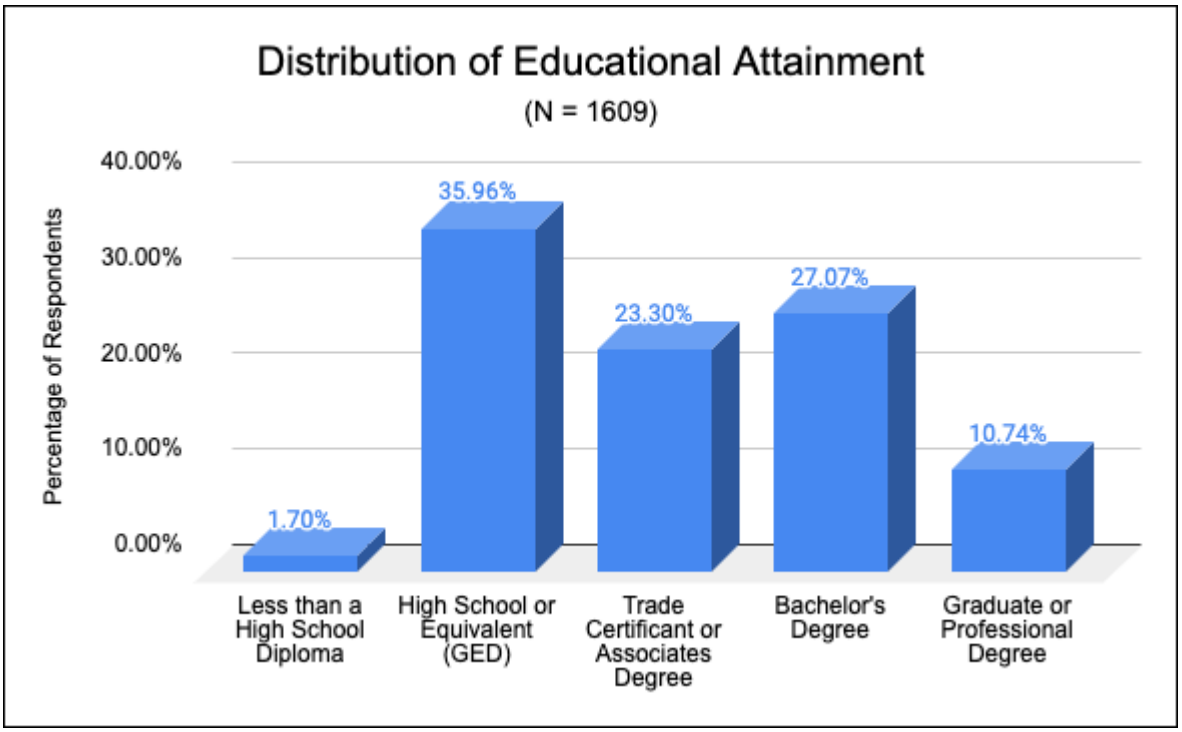

Figure 7. Educational Attainment Distribution

Figure 8 presents a distribution of household income across our respondents. Income was evenly split between households earning incomes under $50,000 and households earning incomes over $50,000. Other studies (e.g., Clewlow and Mishra, 2017; Schaller, 2018) typically find the highest rates of TNC usage among households that earn over $50,000 making the even split in incomes interesting. One potential reason for the higher percentage of incomes under $50,000 could be that Pollfish, from whom we sourced our respondents, provides financial incentives that may be more likely to entice lower income people to respond to our survey.

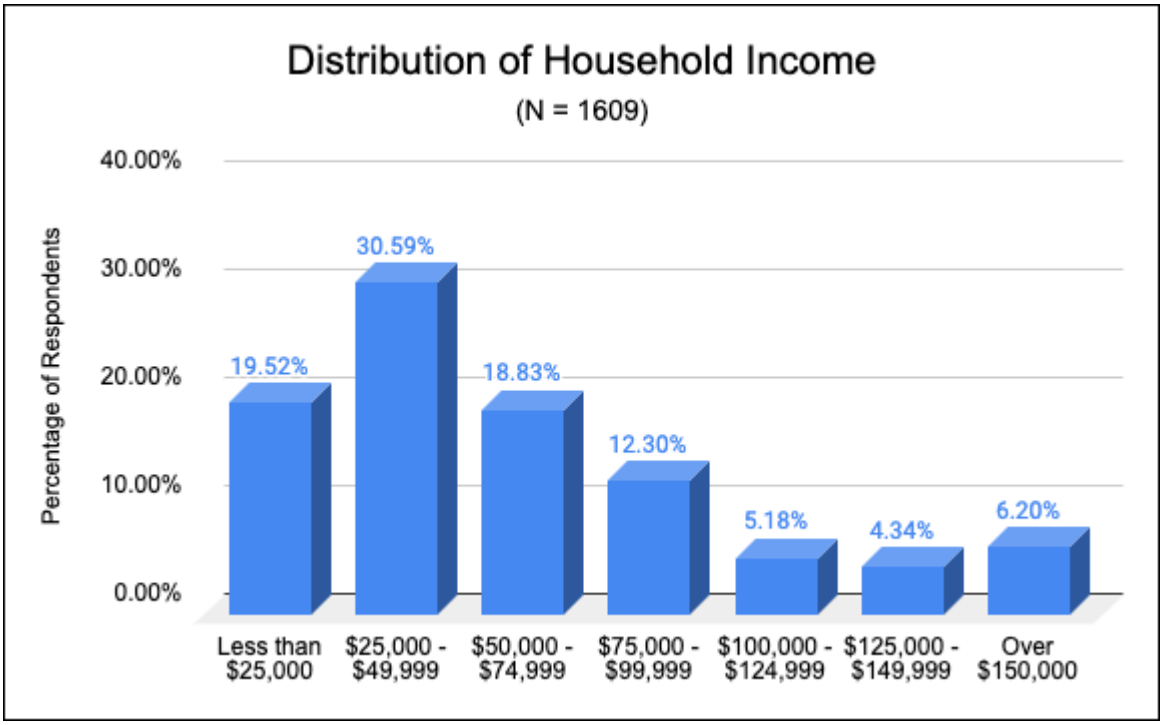

Figure 8. Household Income Distribution

A large majority (79%) of respondents had a driver's license and the average number of vehicles owned by a household was 1.3 (Figure 9). With the United States' car centric culture, the majority of households owning or leasing one or more vehicles is expected. Important to note is the 16.7% percent of respondents do not own a car. Not owning a car is highly related to TNC use across geographic groups. Those without a car in their household use TNCs 2.5 times more often than car owners in urban areas (Schaller, 2018).

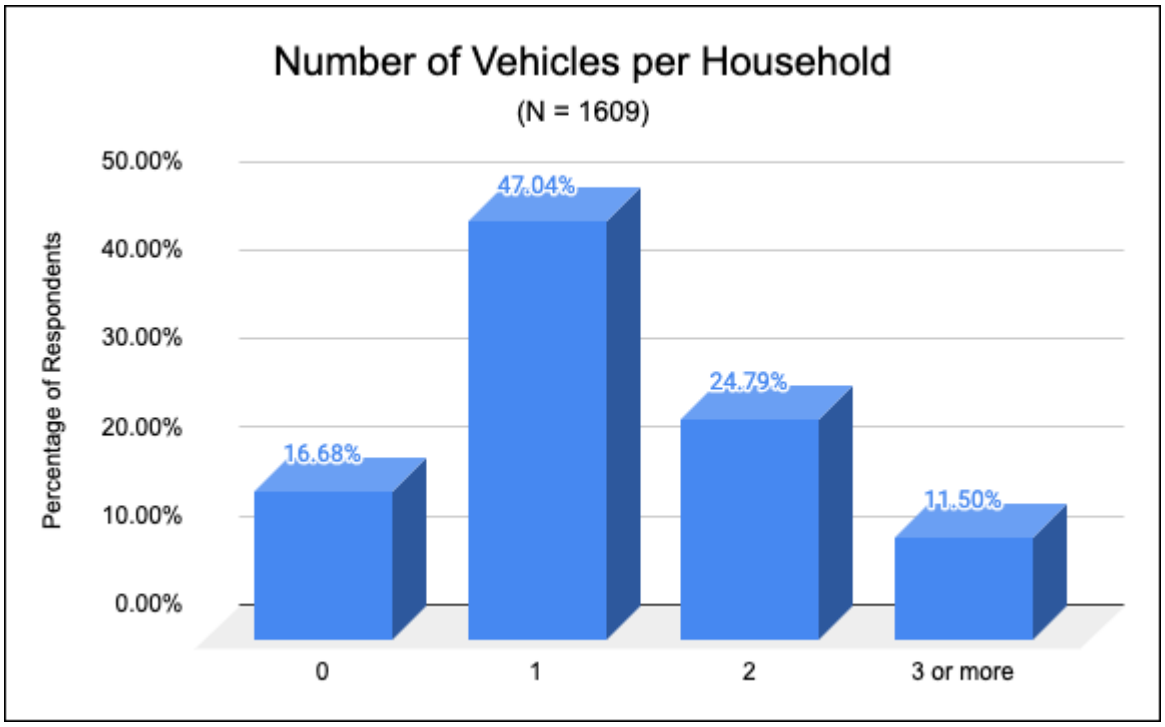

Figure 9. Number of Vehicles per Household

4.2 Regression Results

As discussed in section *4.1.1 Willingness to Pay*, the distribution of the raw data is right skewed (Figure 1). To approximate a normal distribution for estimating an OLS regression, we adjusted the data with a logarithmic transformation. Figure 10 shows the distribution of log WTP is roughly normal, therefore more appropriate for OLS. Thus, preferred regression results use log level WTP as described in the methods section (Table 3). However, we also show results where WTP is not logarithmically transformed and is in levels (Table 4), as results in levels are consistent with log results and offer more intuitive interpretations.

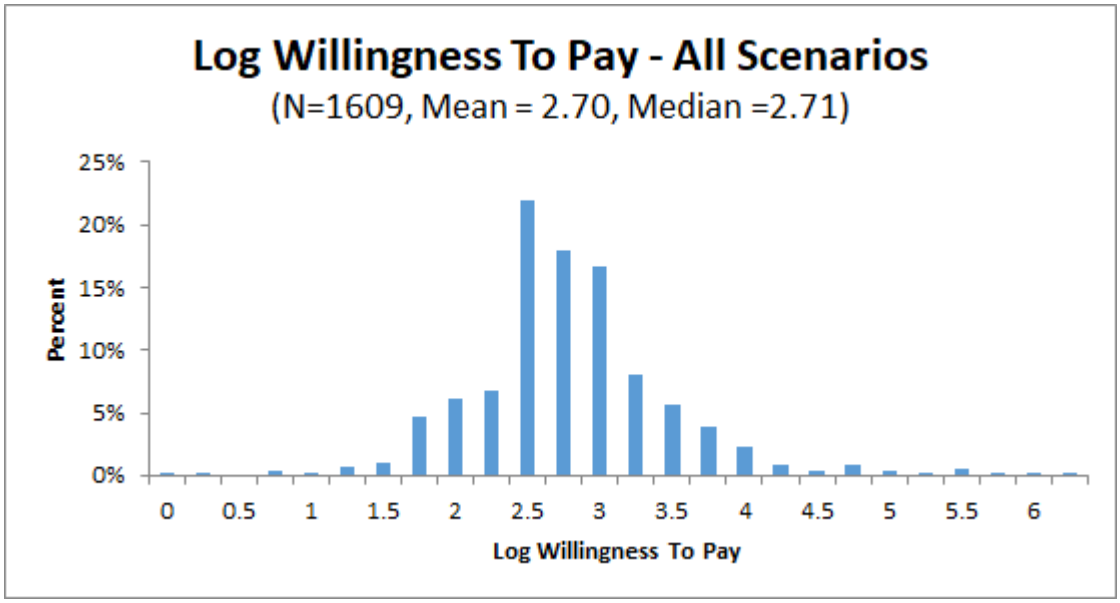

Figure 10. Histogram of Logarithmic Willingness to Pay - All Scenarios

Tables 3 and 4 summarize the results of our regression analyses. In Table 3, the log of the respondents' WTP is regressed across a number of variables with results described as percent change. Table 4 shows the regression described as unit change in dollars. Because most individuals communicate money in absolute terms and not percentage change, we use Table 4 to better convey our interpretations. For example, when examining the Full Quadratic Model (3) in Table 3, an increase from one income bracket to the next would lead to a 6.81% increase in WTP. When we look at the Full Quadratic Model (3) in Table 4, we see that an increase from one income bracket to the next would increase WTP by $1.94. Since the models are slightly different, an increase of 6.81% does not directly

correlate to a $1.94 increase, however, it does provide a solid communication tool for explaining results.

Table 3 presents the logarithmic regressions explaining WTP based on a number of variables for each of our three models. The first column, or Core Model (1), includes scenario variables of trip duration, number of passengers, type of trip, and whether or not the conversation option was available. The second column, Full Model (2), includes the trip scenario variables from Core Model (1), as well as, travel attitudes and demographic variables that influence an individual's WTP. The third column, Full Quadratic Model (3), includes all previous variables, along with duration of trip in minutes squared and number of passengers squared. All models estimate robust standard errors, with the Full Quadratic Model (3) providing the best fit with an R-squared value of .095.

From Table 3, we see a number of coefficient estimates that are significant at the .01 level, including those on: the duration of the ride-hailing trip in minutes, the number of passengers, when the trip is a commute, if there is a conversation option, the duration of the trip squared, and the number of passengers squared. Interestingly, as we move across the different model outputs given for the scenario option of commute, we see a reduction in the level of significance. The coefficient also changed from an approximate reduction of 8% to a reduction of 3.18%. This is most likely due to the addition of the quadratic terms in the third model. We also find a similar pattern when examining the conversation variable. The coefficient on the conversation variable was statistically significant at the .01 level but was not significant once the quadratic terms were included. The coefficient went from a reduction of approximately 4% to an increase of 1.15%. This suggests that the coefficients of the conversation and commute variables held a large portion of the quadratic terms' coefficients on the WTP variable. The inclusion of these quadratic terms of trip duration and number of passengers are significant and explain a portion of the coefficients of the commute and conversation terms in both Core Model (1) and Full Model (2).

From Table 4, we see that the estimated coefficients are statistically significant for both number of passengers and number of passengers squared. From the Full Quadratic Model (3) in Table 4, we see WTP would decrease by $2.74 with the addition of one additional passenger. With the addition of two extra passengers, we see WTP would decrease by $4.71 and with the addition of three extra passengers, we see WTP would decrease by $5.90.

We also see from Table 4's Full Model (2) the amount respondents are willing to pay changes based on the type of trip, with respondents WTP $1.88 less for commute trips than for leisure trips.

Statistically significant coefficients are also found in the demographic variables: age, income, and location in comparison to New York City. In Table 3, we see that the age and income coefficients are significant at the .01 level and do not change significantly between the Full Model (2) and the Full Quadratic Model (3). Thus, we can conclude that with an increase from one age bracket to the next, we see a significant reduction in WTP by approximately 4.04%. Further, with an increase from one income bracket to the next, we expect a 6.81% increase in WTP. When we examine the location's impact on WTP for ride-hailing services, we see significant differences in WTP in many cities when compared to New York City. In Boston and Miami, WTP for ride-hailing services is more than in New York City, and in the Bay Area, Atlanta, Houston, and Los Angeles, WTP is less than in New York City. The differences in WTP between cities may be due to a diversity of transportation system challenges when compared to New York City.

The final section of significant coefficients include variables for travel attitudes, such as how people get around in day to day travel (personal vehicle, bus, taxi, carpooling); how important safety, multitasking, socializing, and cost are regarding travel modes; and comfort levels regarding riding with an unknown passenger at night. We see that an individuals' regular mode of travel impacts WTP. For example, in the Full Quadratic Model (3) of Table 3, when the regular mode of travel is personal vehicle, WTP increases by 10.4% for ride-hailing services. An increase in WTP is also seen when the regular mode of travel is bike or scooter (7.09% increase), taxi (14.9% increase), or carpool (8.32% increase). Conversely, WTP decreases when regular mode of travel is public transit (8.34% decrease), walk or jog (6.51% decrease), and ride-hailing services (4.14% decrease).

We also see that the perceived importance of certain factors impacts WTP for ride-hailing services. As presented in the Full Quadratic Model (3) of Table 3, for each unit increase in the importance of socializing, there is an increase of 5.16% in WTP. In reverse, we found significance in the coefficients of some variables that results in a decrease in WTP. Examples include, for each unit increase in the importance of safety, there is a decrease of 3.98% in WTP; for each unit increase in the importance of cost, there is a decrease of 1.87% in WTP, and; for individuals who use ride-hailing services to be able to multitask, there is a 6.86% decrease in WTP. We also found significance in another variable: comfort level when riding at night with an unknown passenger. For each unit

increase in comfort regarding ride-hailing at night with an unknown passenger, there is an increase of 1.13% in WTP.

These regression results provide the foundation upon which we build our conclusions in the discussion section.

Table 3. Logarithmic Regressions for Explaining Willingness-to-Pay

VARIABLES	Core Model (1)	Full Model (2)	Full Quadratic Model (3)
Duration of Trip in Minutes	0.0162***	0.0161***	0.0446***
	(0.000764)	(0.000760)	(0.00560)
Number of Passengers	-0.0660***	-0.0698***	-0.202***
	(0.00675)	(0.00673)	(0.0222)
Commute	-0.0825***	-0.0835***	-0.0318*
	(0.0133)	(0.0132)	(0.0178)
Conversation	-0.0431***	-0.0403***	0.0115
	(0.0133)	(0.0133)	(0.0173)
Duration of Trip in Minutes, Squared			-0.000485***
			(0.000100)
Number of Passengers, Squared			0.0355***
			(0.00725)
Age		-0.0414***	-0.0404***
		(0.0108)	(0.0108)
Income		0.0691***	0.0681***
		(0.0109)	(0.0108)
Number of Vehicles Owned or Leased		0.00828	0.00811
		(0.00920)	(0.00918)
Commute Mode of Choice (CMC): Personal Vehicle		0.105***	0.104***
		(0.0168)	(0.0167)
CMC: Public Transit		-0.0834***	-0.0835***
		(0.0172)	(0.0172)
CMC: Micro Transit (Bike or Scooter)		0.0709***	0.0701***
		(0.0244)	(0.0244)

Table 3. Logarithmic Regressions for Explaining Willingness-to-Pay (Continued)

VARIABLES	Core Model (1)	Full Model (2)	Full Quadratic Model (3)
CMC: Taxi		0.149***	0.151***
		(0.0214)	(0.0214)
CMC: Ride-hailing		-0.0414***	-0.0389***
		(0.0153)	(0.0153)
CMC: Walking or Jogging		-0.0651***	-0.0389***
		(0.0157)	(0.0157)
CMC: Carpooling		0.0832***	0.0836***
		(0.0217)	(0.0216)
Importance Regarding Feelings of Safety During a Ride		-0.0398***	-0.0403***
		(0.0131)	(0.0131)
Importance of Socializing During a Ride		0.0518***	0.0516***
		(0.00557)	(0.00556)
Importance of Cost of a Ride		-0.0183*	-0.0187*
		(0.00994)	(0.00991)
The Ability to Multitask During a Ride		-0.0679***	-0.0686***
		(0.0161)	(0.0161)
Comfort Regarding Night Riding with an Unknown Passenger		0.0113*	0.0120*
		(0.00582)	(0.00580)
Location: Bay Area		-0.0945***	-0.0940***
		(0.0333)	(0.0332)
Location: Chicago		0.027	0.029
		(0.0219)	(0.0218)
Location: Atlanta		-0.0756***	-0.0754***
		(0.0218)	(0.0217)
Location: Washington DC		0.0173	0.0187
		(0.0265)	(0.0264)
Location: Miami		0.0838**	0.0856**
		(0.0380)	(0.0379)

Table 3. Logarithmic Regressions for Explaining Willingness-to-Pay (Continued)

VARIABLES	Core Model (1)	Full Model (2)	Full Quadratic Model (3)
Location: Houston		-0.0677***	-0.0659***
		(0.0257)	(0.0256)
Location: Denver		-0.0061	-0.00357
		(0.0276)	(0.0276)
Location: Los Angeles		-0.115***	-0.114***
		(0.0321)	(0.0320)
Location: Boston		0.152***	0.155***
		(0.0484)	(0.0487)
Female		0.0038	0.0041
		(0.0150)	(0.0150)
Importance of the Environmental Impact of Ride		0.00128	0.00203
		(0.00675)	(0.00672)
Use of Ride-hailing over Primary Mode to Connect to Public Transit		0.00476	0.0042
		(0.0193)	(0.0192)
Level of Comfort Conversing with an Unknown Driver		-0.00809	-0.00819
		(0.00778)	(0.00777)
Constant	2.404***	2.511***	2.161***
	(0.0207)	(0.0808)	(0.108)
Robust?	Yes	Yes	Yes
Observations	11,560	11,032	11,032
R-squared	0.041	0.09	0.095

Note: Robust standard errors in parentheses

Note: p-values = ***p<0.01, **p<0.05, *p<0.1

Table 4. Regressions in Levels for Explaining Willingness-to-Pay

VARIABLES	Core Model (1)	Full Model (2)	Full Quadratic Model (3)
Duration of Trip in Minutes	0.304***	0.299***	0.913***
	(0.0367)	(0.0361)	(0.271)
Number of Passengers	-1.231***	-1.442***	-3.128***
	(0.343)	(0.337)	(1.188)
Commute	-1.859***	-1.882***	-0.677
	(0.653)	(0.644)	(0.850)
Conversation	-0.0135	-0.208	0.964
	(0.665)	(0.656)	(0.899)
Duration of Trip in Minutes, Squared			-0.107**
			(0.00487)
Number of Passengers, Squared			0.387
			(0.370)
Age		-3.092***	-3.072***
		(0.479)	(0.478)
Income		1.954***	1.940***
		(0.544)	(0.545)
Number of Vehicles Owned or Leased		-2.106***	-2.112***
		(0.443)	(0.444)
Commute Mode of Choice (CMC): Personal Vehicle		4.633***	4.619***
		(0.882)	(0.881)
CMC: Public Transit		-3.524***	-3.526***
		(0.832)	(0.832)
CMC: Micro Transit (Bike or Scooter)		5.051***	5.042***
		(1.363)	(1.362)
CMC: Taxi		4.141***	4.171***
		(0.883)	(0.882)

Table 4. Regressions in Levels for Explaining Willingness-to-Pay (Continued)

VARIABLES	Core Model (1)	Full Model (2)	Full Quadratic Model (3)
CMC: Ride-hailing		-2.876***	-2.836***
		(0.774)	(0.776)
CMC: Walking or Jogging		-2.325***	-2.325***
		(0.774)	(0.773)
CMC: Carpooling		2.481**	2.480**
		(1.062)	(1.061)
Importance Regarding Feelings of Safety During a Ride		-4.081***	-4.092***
		(0.791)	(0.791)
Importance of Socializing During a Ride		2.622***	2.617***
		(0.249)	(0.249)
Importance of Cost of a Ride		-1.941***	-1.944***
		(0.486)	(0.486)
The Ability to Multitask During a Ride		-3.405***	-3.411***
		(0.830)	(0.831)
Comfort Regarding Night Riding with an Unknown Passenger		0.354	0.366
		(0.239)	(0.238)
Location: Bay Area		-0.53	-0.517
		(1.556)	(1.555)
Location: Chicago		4.269***	4.302***
		(1.081)	(1.081)
Location: Atlanta		-1.012	-1.009)
		(1.031)	(1.031)
Location: Washington DC		1.158	1.186
		(1.249)	(1.249)
Location: Miami		8.521***	8.551***
		(1.853)	(1.852)

Table 4. Regressions in Levels for Explaining Willingness-to-Pay (Continued)

VARIABLES	Core Model (1)	Full Model (2)	Full Quadratic Model (3)
Location: Houston		0.163	0.192
		(1.105)	(1.105)
Location: Denver		-0.743	-0.701
		(0.864)	(0.866)
Location: Los Angeles		0.102	0.127
		(1.728)	(1.728)
Location: Boston		0.0164	0.0708
		(1.143)	(1.149)
Female		-4.026***	-4.020***
		(0.759)	(0.759)
Importance of the Environmental Impact of Ride		1.431***	1.442***
		(0.313)	(0.313)
Use of Ride-hailing over Primary Mode to Connect to Public Transit		3.006***	2.996***
		(1.035)	(1.035)
Level of Comfort Conversing with an Unknown Driver		-1.315***	-1.318***
		(0.422)	(0.422)
Constant	15.53***	39.11***	31.32***
	(1.020)	(4.895)	(5.637)
Robust?	Yes	Yes	Yes
Observations	11,560	11,032	11,032
R-squared	0.006	0.067	0.068

Note: Robust standard errors in parentheses

Note: p-values = ***p<0.01, **p<0.05, *p<0.1

Figure 11 reveals the average WTP depends on how long the trip is in minutes. There is a clear difference between respondents' WTP for a solo-ride and WTP for a shared-ride. However, when considering only shared-rides, whether the additional passengers are one, two, or three, the differences in WTP are markedly less than between a shared-ride and a solo-ride.

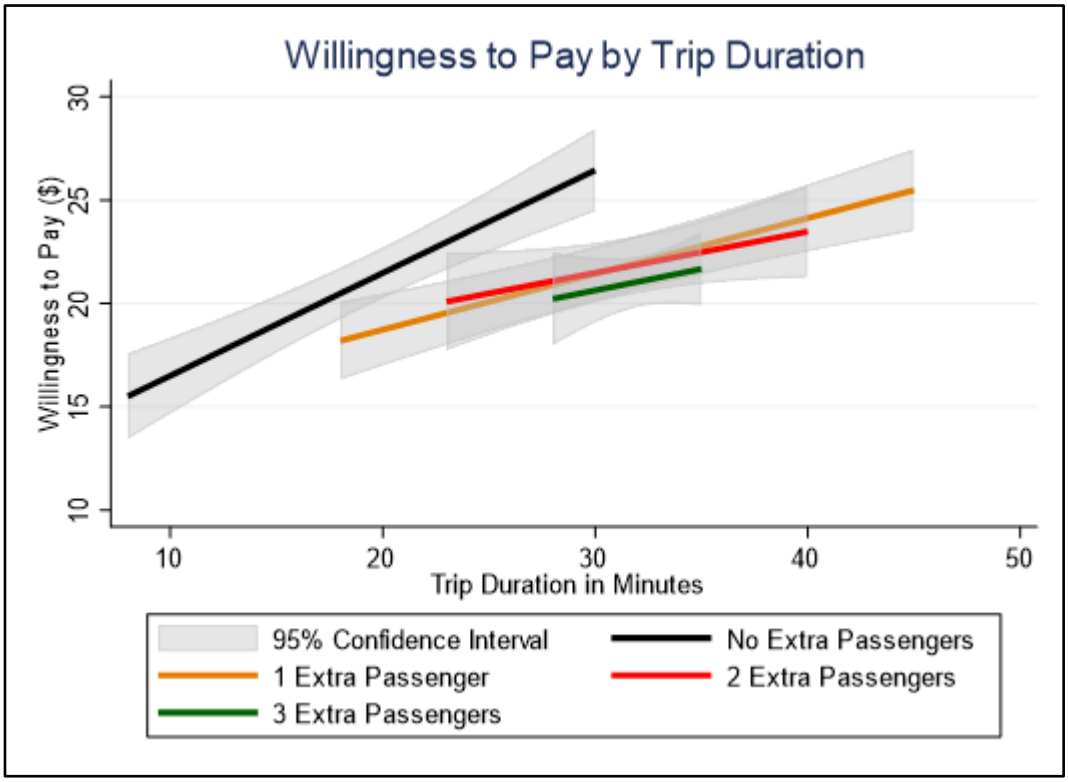

Figure 11. Willingness to Pay by Trip Duration

4.3 Focus Group Results

Six overarching themes emerged from the focus group discussion. The first theme represented individuals' motivations for using ride-hailing services over their primary mode of transportation. Two themes represented the main reasons for not adopting shared-ride services: minimal cost difference between solo and shared services and the inconveniences associated with inaccurate travel duration estimates. The final three themes linked the real and perceived (dis)comforts and risks associated with shared-ride services and the intervention strategies aimed at mitigating these risks: straight-line routing; social interaction (dis)comforts; and safety concerns. Full details of focus group results are provided in Appendix B - Focus Group Final Report.

4.3.1 Motivations for using ride-hailing services

Most participants expressed that going out to bars and restaurants was their main reason for using ride-hailing services over their primary mode of transportation, which in this group was a personal vehicle.

> P1 (Female): *"I usually use it on the weekends with my friends when I want to go out to the bars and stuff."*

When asked if anyone in the group had ever used shared ride-hailing services, such as Uber Pool or Lyft Shared, only two group members acknowledged that they had. Interestingly, both individuals noted that they first used shared services when travelling out of town and each described opposite experiences.

> P5 (Female): *"We just figured it would be cool if we met somebody, but actually they didn't pick anybody up, so it's cheaper. We just use it every time now, because a lot of times they don't pick anybody up."*

> P7 (Male): "*...what should have been a 35-minute Lyft ride turned into about an hour and fifteen-minute Lyft ride…..So, it was more like a one-and-done, I'll just pay the more money and be done with it."*

4.3.2 Cost Difference and Inconvenience

Most participants stated the main reason for not selecting the shared option was because the cost difference is not enough to justify the additional time spent traveling.

> P3 (Male): *"I always see the option, and like the price difference is usually not enough for me to spend 45 minutes with a stranger."*

When the conversation turned to factors that may increase individuals' motivation to adopt shared-ride services, most participants reiterated the significance of cost which suggests they would be willing to use shared-ride services if the price difference between solo-rides and shared-rides was significant.

> P3 (Male): *"Cost would probably be the number one thing."*

> P2 (Male): *"Money always motivates people."*

Cost difference was followed closely by the inconveniences associated with a distrust of the travel time estimates of shared-rides. Multiple participants noted that they didn't feel comfortable taking a shared-ride to work because they couldn't run the risk of being late. This suggests that individuals' may be more willing to take a shared-ride for leisure purposes than commute purposes due to the uncertainty of travel time associated with shared-rides.

> P4 (Male): *"(time) more than double. I'm an impatient guy, so I don't want to be driving around picking everybody up…. You can't be late for work."*

> P6 (Female): *"I take an Uber twice a week for work, so I can't imagine stopping and picking folks up when I have to be to work at 8 am."*

Similar to cost, when the conversation turned to factors that may increase individuals' motivation to adopt shared-ride services, participants mentioned that more accurate travel time estimates or knowing the route before selecting the shared-ride is important.

P8 (Female): *"Maybe having the option of seeing ahead of time that this (ride) would be picking up this (person) and seeing the next pickup."*

4.3.3 Straight-Line Routing

Straight-line routing[15] inspired the most dialogue between participants. Most participants were interested in and voiced positive reactions to the straight-line routing option and stated they'd be willing to walk 5-10 minutes to meet a driver. However, their willingness to walk was dependent on gender, the time of day, and location. In general, female participants voiced safety concerns about walking at night or in unfamiliar areas. Male participants focused more on the benefit of the time-saving aspect of straight-line routing and the usefulness of this option during concerts/sporting events.

P4 (Male): *"If it's two blocks and it's going to save me twenty minutes in traffic? Sure, I'll meet you down the road."*

P6 (Female): *"If it's nighttime and you want me to walk a block to find you, I don't know about that. But in the daytime, I'll whatever"*

P7 (Male): *I think that's (straight line routing) a prime candidate…. because at the end of those things (events) everybody just wants to get the hell out of there. I don't care if I'm sharing with people at that point."*

4.3.4 Social Interactions

In a post-discussion questionnaire, none of the participants listed "to socialize" as a reason for using TNC services and few ranked "Socialization" as an important attribute when considering TNC use. During the discussion most participants seemed to view the social interactions associated with TNCs with either indifferent or positive attitudes. The dynamic changes depending on whether it is a solo ride or a shared-ride. The majority of participants

[15] Straight-line routing connects riders in the same area who want to travel to similar destinations. Riders are asked to walk a short distance to be picked up at a common location. They also would be dropped off at a common site that would be a short walk from their final destinations (Uber Express Pool, 2020).

noted they feel more comfortable socializing with the driver than other passengers because the driver has gone through a hiring process while other passengers are complete unknowns.

P8 (Female): *“I usually am quiet, unless they want to talk, and then I talk. But if they don’t want to talk, then I’m not talking.”*

P2 (Male): *“I'm more willing to talk to a driver than a random stranger.”*

To increase comfort among its users, Uber Black has recently launched “Quiet Mode” allowing passengers to choose before selecting a ride whether or not they would like to talk, whether they don't want to talk or whether they don't have a preference. Most participants view this option with either indifferent or positive attitudes. No one mentioned that it would personally increase their willingness to share rides, however, one participant mentioned she thought it might increase adoption for people with social anxiety.

P6 (Female): *“There are some people that get so anxious about taking an Uber or Lyft that they never have because of talking.”*

4.3.5 Safety

To address the safety concerns of users, many TNCs now offer access to emergency services. All participants viewed the built-in emergency button in the App as a benefit but noted the presence of the button wouldn’t increase their adoption of shared-rides. However, even with both Uber and Lyft having in-app emergency buttons, only one participant knew that the button existed.

P3 (Male): *“It wouldn’t hurt to have it (emergency button).”*

P5 (Female): *“It would be a good thing (emergency button) for them to advertise.”*

One way to address the safety concerns of passengers using shared-ride services is to allow users to create a ride-hailing profile that provides basic information to additional passengers. Most participants viewed the option of creating a general ride-hailing profile as

a beneficial service with a photo being the most important profile attribute. Other notable profile attributes were age and gender. Many female respondents stated that they would feel more comfortable sharing a ride with other women, but no one specifically stated that they wouldn't take a shared-ride with a man. One male participant stated that his wife wouldn't take a ride with a group of men. At this point in the discussion, a brief side conversation broke off regarding all participants' lack of comfort with unaccompanied minors riding in TNCs.

> P6 (Female): *"(a photo and age) ...so you know who's getting in the car. It's a 25 to 35-year-old man……. not some random person jumping in."*

> P5 (Female): *"I would be comfortable showing that (picture) to them. I don't want them to know a bunch of stuff about me."*

5. Discussion

Our research seeks to understand what will motivate individuals to opt for the shared-ride option when using ride-hailing services. While there is some work on understanding why individuals are reluctant to share rides with people whom they don't know (e.g., Tahmasseby et al, 2016, Morales Sarriera et al., 2017, Amirkiaee & Evangelopoulos, 2018), there is little work on how social and behavioral considerations factor into individuals' WTP for shared-ride services. On a broader level, there is some progress in understanding the factors that motivate individuals to use ride-hailing services in general (Chan & Shaheen, 2012; Smith, 2016), as well as the factors that motivate individuals to use carpooling services in general (Peterson, 2008; Shaheen et al., 2016). However, research has not been targeted to understand on-demand ridesharing services. Our study investigates the social and behavioral considerations associated with travelers' acceptance of shared-rides and how those considerations factor into individuals' WTP for shared-ride services. Additionally, we examined the perceptions of TNC users regarding various intervention strategies aimed at increasing the adoption of shared services in the future. We contribute to the existing body of research regarding the motivations and deterrents of on-demand ridesharing adoption.

Our results provide support for most of our hypothesized relationships. Our discussion is structured from the specific to the general: expanding and transitioning from the narrow confines of specific interventions aimed at increasing shared-ride adoption to a more general WTP for shared-ride services compared to solo-ride services.

P_1 examined how the presence of an in-app emergency button - that when pushed automatically shares location data with emergency personnel - would influence an individual's willingness to take a shared-ride. Past studies (Popuri et al., 2011; Kuppam et al., 1999) suggest that safety is very important to ride-hailing users. Thus, we predicted the presence of the emergency button would alleviate some of the safety concerns associated with ridesharing thereby leading to an increase in willingness to take a shared-ride. As expected, our respondents generally rated safety as "extremely important." In addition, the more important safety is to an individual, the less they are willing to pay for the ride, reinforcing the notion that safety concerns depress willingness to take a shared ride. However, respondents reported that their willingness to take ride-hailing services increased, but only somewhat, with the addition of the emergency button. When we probed deeper into this question during our focus group, we found that while individuals view the presence of

the emergency button as beneficial, focus group participants stated that the emergency button would not increase their willingness to use shared-services. Altogether, these results suggest that while the perceived safety of the travel environment is an important factor, the presence of an emergency button does not mitigate the safety risk to the extent that it will increase adoption rates of shared-rides.

Our fourth hypothesis, H_4, examined whether matching riders based on their social preferences of “happy to chat”, “quiet preferred”, or “no preference” would influence their WTP. Previous research finds most passengers don’t perceive socialization as a benefit to ridesharing, with major deterrents to ridesharing being a dislike of social situations and a preference for privacy (Morales Sarriera et al., 2018; Chan & Shaheen, 2012; Tahmasseby et al, 2016). Thus, by allowing individuals to avoid socializing if desired or match with social passengers if desired, we predicted the conversation option would increase WTP. In stark contrast, our survey results indicate that the relationship between matching riders based on their conversation preferences and WTP is significant, however, the presence of the conversation option results in a 4.03% decrease in WTP (See Table 2, Full Model). This decrease in WTP was a surprise. However, our research results diverge from those of previous studies in other ways. Respondents to our survey generally perceive socialization in day to day travel as “moderately important.” In addition, those individuals who view socialization with higher importance result in a 5.16% increase in WTP (See Table 2, Full Quadratic Model). Finally, respondent’s reported comfort level in having a conversation with drivers and other passengers whom they don’t know revealed the median response to be somewhat comfortable.

Our focus group results aligned with the findings of our survey, as most participants viewed the social interactions associated with shared-rides with either indifferent or positive attitudes and indicated the conversation option would not increase their willingness to take a shared-ride. When we probed deeper into the conversation piece, many in the focus group alluded to a dislike of the conversation option because they didn’t want to appear rude by choosing “quiet preferred” or pressured to talk by choosing “happy to chat”, noting that it really depends on the situation, who the other passengers are, and what mood they are in at the time. The feelings of not wanting to be perceived in a certain way or behave in a certain way based on their conversation choice may indicate why WTP decreases when the conversation option is present. A possible explanation for the differences between our survey responses regarding the importance of socialization and past research is that we didn’t define socialization. It is possible that some respondents who ranked the importance

of socialization in day to day travel as high were referring to the importance of spending time on their social media accounts, not physical interactions with other humans.

Previous studies have identified potential design features that could help mitigate the perceived safety risks of shared-ride services, including the creation of rider or passenger profiles (Tahmasseby et al., 2015; Sanguinetti et al., 2019). While we did not include specific questions to measure individuals' perceptions of these features, we did include Likert-style questions to gauge the comfort levels of individuals' when riding with an unknown passenger. Our results found the median response to be "somewhat comfortable" when riding with an unknown passenger during the day and "neither comfortable nor uncomfortable" when riding with an unknown passenger at night. Similar to Morales Sarriera et al. (2017), our focus group discussion revealed a difference between genders when discussing issues of safety and passenger profiles. While most participants viewed the option of creating a general ride-hailing profile as a beneficial service, the female participants controlled the discussion, highlighting safety concerns and noting that seeing a photo and knowing the age and gender of other passengers would make them feel more comfortable during the ride. While many of the focus group participants stated they would feel comfortable providing their photo, age, and gender for other riders to view, they did not feel comfortable linking their social media accounts to their passenger profiles for fear of providing too much personal information. Our research confirms the findings from past studies that people are uneasy sharing a ride with strangers and suggests the implementation of passenger profiles may make individuals more likely to take shared-rides in the future.

Hypothesis H_5, which stated that the average WTP for a ride will be less for a commuter trip than a leisure trip, is supported by our study. Our results indicate that passengers are willing to pay $1.88 less for commuter trips than their leisure trips (See Table 4, Full Model). Lavieri and Bhat (2019) found while individuals are less sensitive to the presence of strangers on a commute trip than on a leisure trip, the sensitivity to time is the opposite. Similar studies have found an unwillingness to share rides for daily commuting to work and school due to feelings that ridesharing is unreliable and inconvenient (Popui et al., 2011; Chaube et al., 2010). Our focus group results align with the previous research as most participants stated they are not comfortable taking a shared-ride to get to work out of concern they will be late due to inaccurate travel time estimates. Our results also found that an individuals' primary mode of transportation impacts their WTP. Individuals who primarily travel by personal vehicle, bike/scooter, taxi or carpool are willing to pay more for TNC

services, while individuals who take public transit, walk/jog, or use TNC services are willing to pay less for TNC services. One possible explanation for frequent TNC users to have a lower WTP is they use ride-hailing services for commute trips, which have a lower WTP than leisure trips. Another possible explanation is that with regular use the rider associates ride-hailing more with public transit than a private ride resulting in a decrease in WTP. We find the higher WTP for TNC services among carpool users surprising. Shaheen et al. (2016) found the most important reasons for carpooling to work was to save money (33%), save time (15%), and convenience (20%). A possible explanation is that TNCs offer more flexibility than carpool schemes, increasing the convenience factor, which may justify the increase in WTP among regular carpool users.

As previously discussed, minimizing in-vehicle time and the uncertainties experienced with shared-ride services are critical to increasing the adoption, especially regarding commuter travel. A White Paper by Schaller Consulting (2018) highlights the need to examine the effectiveness of straight-line routing in increasing the adoption of shared-services. To better understand how far individuals are willing to walk for a reduction in travel time and more accurate trip duration estimates we included straight-line routing questions into both our survey and focus group discussion. Our survey results found individuals were willing to walk five minutes in nice weather to meet a driver for a more direct route. Similarly, our focus group discussion revealed that most participants were willing to walk five to ten minutes in nice weather to meet a driver. However, the distance was dependent on if they felt comfortable and safe walking to/from the pick-up/drop-off points. Previous studies have found a majority of casual carpool users walk to/from the pick-up/drop-off locations (Shaheen et al., 2016; Oliphant, 2008). Our findings suggest straight-line routing could be effective for commuters if costs were perceived to be low and pick-up/drop-off locations were strategically placed in densely populated, walkable neighborhoods. Future research should examine WTP for straight-line routing for both commuter and leisure trips.

Hypothesis H_3, which stated that the average WTP will decrease as additional travel time increases, holding all else constant, is not supported by our study. While contrary to our expectation, these results are not unexpected as longer trips incur higher travel costs per mile and minute. We found that for every extra minute of travel time, there would be an increase in WTP at a decreasing rate. Even when separating out the extra time required for a shared trip, there was still an increase in WTP. However, we found that the WTP per minute decreased as the duration of the trip increased. This suggests high fixed costs expected from these services and low variable costs of operation, meaning a short ride will

not be proportionally cheaper to a longer ride. From the Full Quadratic Model (3) in Table 4, for every 1-minute increase in trip duration, there is an increase of $0.91 in WTP, with a correction by the number of minutes squared multiplied by the coefficient -.0107. For example, the average WTP for a 10-minute ride is approximately $8.10, but for a 20-minute ride, the average WTP is approximately $14.20.

The relationship between travel time and WTP for a ride sets the foundation for TNCs to offer discounts and encourage certain behaviors that maximize profits. It suggests that a traveler's time is valuable and changes over time. The first minute is more valuable than every minute afterwards. While an economic framework would normally associate the large upfront costs to TNCs fixed costs, we could reverse that framework and associate it with the household's transaction costs. For example, TNCs are willing to pay the operational, variable costs of the service to get from point A to point B, however, the household is also willing to pay the fixed costs associated with the trip because it is more advantageous to their time than the transfer costs associated with switching services (bus to bus or shared-ride to bus). This area of thought can be expanded on more thoroughly by examining transfer costs associated with mode shifting. We see the cost of transfer is large from Schwieterman and Smith (2018), who found a single bus transfer increased travel time by 18-19 minutes in Chicago. From our analysis we see that avoiding transfer costs is advantageous to individuals as they are willing to pay a high fixed cost to avoid multimodal travel.

Hypothesis H_2**,** that the average WTP would decrease at a decreasing rate with each additional passenger, is confirmed based on our results from both Tables 3 and 4. For example, the Full Quadratic Model (3) in Table 4 shows that with an additional passenger we would see a reduction of WTP of $2.74, assuming all else held constant. With two additional passengers, we would see a decrease in WTP of $4.71. The Number of Passengers and the Number of Passengers Squared coefficients suggest significance at the .01 level in Table 3. The shift in significance between Table 3 and Table 4 in the variable Number of Passengers Squared is likely due to the change in accuracy of the regression caused by the transformation from a logged WTP to WTP in levels. The confirmation of this hypothesis is likely due to factors that make multi-passenger rides unappealing, such as increased trip duration, interactions with unknown passengers, and a lack of personal space.

The results from H_2 and the WTP predictions that accompany it are important for ridesharing services to understand when setting prices for their shared services. Currently,

Uber and Lyft do not have high rates of adoption for their shared services. A possible explanation is that the discount offered is not high enough when compared to solo-ride services (Schaller, 2018; Henao and Marshall, 2019). The discount should vary depending on the trip, its attributes, and the number of individuals, however, when examining current discounts for a range of real-life potential trips in Denver and Los Angeles, suggests the discount rarely exceeds $2.50, with an average between $1.00 - $2.00 (estimatefares.com, 2020). This suggests a majority of ride-hailing users will continue to opt for the solo-ride options. The minimal discounts between solo- and shared-rides may also explain why TNCs see people selecting shared-rides, but either cancelling or not showing up, leaving the other shared-ride passenger riding alone, inadvertently adding more time to their otherwise more direct route.

Hypothesis H_1 states that the average WTP would be less for a shared-ride than a solo ride. Results from Tables 3 and 4 confirm that this is true, suggesting that individuals see disadvantages to shared-rides, but are willing to take those rides if the fare is appropriate. Currently, the fares offered by TNCs for shared-rides do not reflect the discounts required by riders, therefore we see a lack of adoption of shared-ride services. Increasing discounts for shared-rides and increasing the costs associated with single passenger travel is one way to increase adoption of shared services. Shared-rides should maximize revenue flowing to TNCs, as well as to TNC drivers, by maximizing the number of passengers per vehicle mile traveled. However, this currently does not seem to be the case as drivers avoid shared-rides. Drivers have expressed frustrations regarding the lack of profitability of shared-rides, the poor tips typically associated with shared-rides, the high percentage of ride fares that go towards the company instead of the driver, and the poor driver ratings due to waiting for additional passengers who do not show up or cancel rides (Koebler, 2016). A restructuring of TNCs financial formulas to include larger discounts for shared-rides, as well as increased revenue sharing with drivers and clear expectations laid out for passengers etiquette, could increase adoption of shared services by both drivers and passengers.

6. Conclusion

Because the use of TNC services is becoming increasingly popular, and urban populations continue to grow, on-demand ridesharing is an opportunity for individuals to travel from place to place and at the same time reduce VMT, road congestion, GHG emissions, air pollution, and stormwater runoff. However, the aforementioned environmental benefits depend on shared-ride services becoming the dominant choice in TNC services.

This study provided a deeper understanding of the social and behavioral considerations associated with travelers' acceptance of shared-rides and how those considerations factor into individuals' WTP for shared-ride services. Additionally, we learned what types of interventions could make individuals more or less likely to use shared services in the future.

Of the more significant findings, our survey revealed (a) the average WTP is significantly less ($2.74/ first additional passenger) for a shared-ride than a solo-ride and that this average decreases at a decreasing rate with each additional passenger; (b) the average WTP for a commuter ride is less than a leisure ride, which could be due to feelings that ridesharing is unreliable and inconvenient in regards to fixed work schedules; (c) the average WTP for a leisure ride is higher than a commute ride, which could be due to individuals WTP more for the benefit of not having to drink and drive and to avoid parking hassles, and; (d) the presence of an option that allows riders' to be matched based on social preferences of "happy to chat", "quiet preferred", or "no preference" results in a decrease in WTP of 4.03%.

This study revealed that although most interventions are viewed as positive additions to TNC services and that social and behavioral motivation for using shared-ride services are relevant, they matter less when compared to traditional factors, such as time and cost.

Limitations to this study include the lack of information and investigation into surge pricing and wait times. Future studies should include data on the level and timing of surge pricing and how that influences individuals' perceptions of shared-services and WTP for shared-services. Another limitation is our chosen WTP elicitation technique. While open-ended WTP questions are useful for eliciting an average WTP, respondents often find them difficult to answer, resulting in skewed or missing values for WTP. Future studies should use a dichotomous choice approach to form broad intervals around respondents' WTP as a comparison. Finally, additional focus groups should be conducted to provide additional

insight into individuals' perceived risks and benefits of shared-ride services and the potential effectiveness of mitigation initiatives.

As a final remark, dynamic ridesharing will become an increasingly common mode of transportation dependent upon social comfortability as well as comparative monetary cost and travel time. An understanding of the ways in which shared-ride passengers perceive these social rides and accompanied interactions, as well as the value they place on such rides, will be valuable information for policy makers and TNC strategists alike. The results discussed here can be a starting point for future study and modification of ridesharing services.

Literature Cited

Amirkiaee, S.Y., Evangelopoulos, N. 2018. Why do people rideshare? An experimental study. Transportation Research Part F (55), 9-24. https://doi.org/10.1016/j.trf.2018.02.025.

Bansal, P., Kockelman, K. M., Singh, A., 2016. Assessing public opinions of and interest in new vehicle technologies: An Austin perspective. Transportation Research Part C: Emerging Technologies. https://doi.org/10.1016/j.trc.2016.01.019.

Bateman, I., Carson, R., Day, B., Hanemann, M., Hanley, N., Hett, T., Jones-Lee, M., Loomes, G., Mourato, S., Ozdemiroglu, E., Pearce, D., Sugden, R., Swanson, J., 2002. Economic Valuation with Stated Preference Techniques: A Manual. Department for Transport. 1-17. Edward Elgar Publishing.

Buddelmeyer, H., Hamermesh, D.S., Wooden, M., 2018. The stress cost of children on moms and dads. European Economic Review (109), 148-161. https://doi.org/10.1016/j.euroecorev.2016.12.012.

Buliung, R.N., Soltys, K., Habel, C., Lanyon, R., 2009. Driving Factors Behind Successful Carpool Formation and Use. Transportation Research Record: Journal of the Transportation Research Board (2118), 31-38. https://dx.doi.org/10.3141/2118-05.

Burkhardt, J., Millard-Ball, A., 2006. Who is attracted to Carsharing? Journal of the Transportation Research Board. https://doi.org/10.1177/0361198106198600113.

Cameron, L., 2019. Why Ridesharing Reaps Unexpected Benefits. University of Pennsylvania, Wharton. Retrieved from https://knowledge.wharton.upenn.edu/article/ridesharing-culture-benefits/.

Cameron, L., Kameswaran, V., Dillahunt, T.R., 2018. Support for Social and Cultural Capital Development in Real-time Ridesharing Services. Retrieved from http://www.tawannadillahunt.com/wp-content/uploads/2012/12/pn3094-kameswaranA.pdf.

Chan, N. D., Shaheen, S. A., 2012. Ridesharing in North America: Past, Present, and Future. Transport Reviews, 1647. https://doi.org/10.1080/01441647.2011.621557.

Chaudhry, B., Yasar, A. U. H., El-Amine, S.,Shakshuki, E., 2018. Passenger Safety in Ride-Sharing Services. Procedia Computer Science (130), 1044–1050. https://doi.org/10.1016/j.procs.2018.04.146.

Circella, G., Tiedeman, K., Handy, S., 2016. What Affects U.S. Passenger Travel? Current Trends and Future Perspectives. UC Davis: National Center for Sustainable Transportation. Retrieved from https://escholarship.org/uc/item/2w16b8bf.

Clewlow, R. R., Mishra, G. S., 2017. Disruptive Transportation: The Adoption, Utilization, and Impacts of Ride-Hailing in the United States. Institute of Transportation Studies, University of California, Davis, Research Report UCD-ITS-RR-17-07. Retrieved from https://itspubs.ucdavis.edu/wp-content/themes/ucdavis/pubs/download_pdf.php?id=2752.

Clifton, K., Handy, S., 2003. Qualitative Methods in Travel Behaviour Research. Transport Survey Quality and Innovation. Retrieved from http://www.des.ucdavis.edu/faculty/handy/Qualitative_paper.pdf.

Constine, J., 2017. Uber “Express POOL” offers the cheapest fare if you walk a little. *Tech Crunch*. Retrieved from https://techcrunch.com/2017/11/10/uber-express-pool/.

Daziano, R. A., 2012. Taking account of the role of safety on vehicle choice using a new generation of discrete choice models. Safety Science, 50(1), 103–112. https://doi.org/10.1016/j.ssci.2011.07.007.

Delhomme, P., Gheorghiu, A., 2016. Comparing French Carpoolers and Non Carpoolers: Which Factors Contribute the most to Carpooling? Transportation Research Part D: Transport and Environment (42) 1-15. https://doi.org/10.1016/j.trd.2015.10.014.

Economic and Social Research Council (ESRC), 2020. What is Twitter and why you should use it? Retrieved from https://esrc.ukri.org/research/impact-toolkit/social-media/twitter/what-is-twitter/.

Energy Information Administration (EIA), 2017. Power sector carbon dioxide emissions fall below transportation sector emissions. *Today in Energy*. Retrieved from https://www.eia.gov/todayinenergy/detail.php?id=34192.

Estimatefares.com, 2020. Estimate Fares. Retrieved from estimatefares.com.

Fan, Y., 2017. Household structure and gender differences in travel time: spouse/partner presence, parenthood, and breadwinner status. Transportation (44), 271–291. https://doi.org/10.1007/s11116-015-9637-7.
Federal Deposit Insurance Corporation (FDIC), 2017. FDIC National Survey of Unbanked and Underbanked Households. Retrieved from https://www.fdic.gov/householdsurvey/2017/2017execsumm.pdf.
Federal Highway Administration, 2018. Summary of Travel Trends: 2017 National Household Travel Survey (Publication Number FHWA-PL-18-019). Retrieved from https://nhts.ornl.gov/assets/2017_nhts_summary_travel_trends.pdf.
Gargiulo, E., Giannantonio, R., Guercio, E., Borean, C., Zenezini, G., 2015. Dynamic ride sharing service: are users ready to adopt it? Procedia Manufacturing (3), 777-784. Retrieved from https://www.researchgate.net/publication/280641112_Dynamic_Ride_Sharing_Service_Are_Users_Ready_to_Adopt_it.
Ghosh, S., 2017. Uber wants to use Facebook data to show what you have in common with other UberPool passengers. Business Insider. Retrieved from https://www.businessinsider.com/uber-has-patented-mining-social-data-for-uberpool-2017-2
Golob, T. F., Brownstone, D., 1992. The effectiveness of ridesharing incentives in Southern models of commuting. Regional Science and Urban Economics, 22, 5–24. https://doi.org/https://doi.org/10.1016/0166-0462(92)90023-T.
Grosvenor, T., 2000. Qualitative Research in the Transport Sector. TRB Transportation Research Circular E-C008: Transport Surveys: Raising the Standard. Retrieved from http://onlinepubs.trb.org/onlinepubs/circulars/ec008/workshop_k.pdf.
Hall, J.D., Palsson, C., Price, J., 2018. Is Uber a substitute or complement for public transit? Journal of Urban Economics (108), 36-50. https://doi.org.proxy.lib.umich.edu/10.1016/j.jue.2018.09.003
Henao, A., Marshall, W., 2019. The impact of ride-hailing on vehicle miles traveled. Transportation (46), 2173-2194. https://doi-org.proxy.lib.umich.edu/10.1007/s11116-018-9923-2.
Homem de Almeida Correia, G., Abreu e Silva, J., Viegas, M., 2013. Using latent attitudinal variables estimated through a structural equations model for understanding carpooling propensity. Transportation Planning and Technology. http://dx.doi.org/10.1080/03081060.2013.830894.
ITS America, 2015. Rise of the Real-Time Traveler. Retrieved from https://static1.squarespace.com/static/596fb16003596e0fa70a232f/t/59c57104e9bfdfecd2609a44/1506111749327/Rise+of+the+Real-Time+Traveler_+ITS+America+Report.pdf.
Koebler, Jason. 2016. Why Everyone Hates UberPOOL: Shared ridesharing is bad, in part, because people are unreliable and unpredictable. *Vice*. Retreived from https://www.vice.com/en_us/article/4xaa5d/why-drivers-and-riders-hate-uberpool-and-lyft-line.
Krueger, A., 2018. Is Ride Share the New LinkedIn? The New York Times. Retrieved from https://www.nytimes.com/2018/07/05/nyregion/ride-share-uber-via-lyft-connections.html.
Kuppam, A., Pendyala, R., Rahman, S., 1999. Analysis of the Role of Traveler Attitudes and Perceptions in Explaining Mode-Choice Behavior. Transportation Research Record, 1676 (1), 68–76. https://doi.org/10.3141/1676-09.
Le Vine, S., Polak, J., 2019. The impact of free-floating carsharing on car ownership: Early-stage findings from London. Transport Policy (75), 119-127. https://doi-org.proxy.lib.umich.edu/10.1016/j.tranpol.2017.02.004.
Lyft, 2018. About Shared rides. Retrieved from https://help.lyft.com/hc/en-us/articles/115013078848-About-Shared-rides.
Lyft, 2019. Safety. https://www.lyft.com/safety.
McKenzie, B., 2015. Who Drives to Work? Commuting by Automobile in the United States: 2013. U.S. Department of Commerce. Retrieved from https://www.census.gov/content/dam/Census/library/publications/2015/acs/acs-32.pdf
Merat, N., Madigan, R., Nordhoff, S., 2017. Human Factors, User Requirements, and User Acceptance or Ride-Sharing in Automated Vehicles. International Transport Forum. Retrieved From https://www.itf-oecd.org/human-factors-user-requirements-and-user-acceptance-ride-sharing-automated-vehicles.

Metro. 2020. Retrieved from https://www.metro.net/riding/fares/.
Middleton, S., Zhao, J., 2019. Discriminatory Attitudes Between Ridesharing Passengers. Transportation. https://doi-org.proxy.lib.umich.edu/10.1007/s11116-019-10020-y.
Morales Sarriera, J., Esovar Alvarez, G., Blynn, K., Alesbury, A., Scully, T., Zhao, J., 2017. To share or not to share: Investigating the social aspects of dynamic ridesharing. Journal of the Transportation Research Board 2605, 109-117. https://doi.org/10.3141/2605-11.
Noland, R.B., Cowart, E.A., Fulton, L.M., 2006. Travel demand policies for saving oil during a supply emergency. Energy Policy, 34 (17), 2994-3005. https://doi.org.proxy.lib.umich.edu/10.1016/j.enpol.2005.05.013.
Oliphant, M., 2008. The Native Slugs of Northern Virginia: A Profile of Slugging in the Washington DC Region. Major Paper for Master of Sciences in Urban and Regional Planning. Virginia Polytechnic Institute and State University. Retrieved from https://toolsofchange.com/userfiles/Slugging_Report_Oliphant(2).pdf.
Peterson, M., 2008. Does Carpooling To/From Work Reduce Stress? Kennesaw State University: Dissertations, Theses and Capstone Projects. Retrieved from https://digitalcommons.kennesaw.edu/cgi/viewcontent.cgi?article=1013&context=etd.
Pew Research Center, 2019. Mobile Fact Sheet. Retrieved from https://www.pewresearch.org/internet/fact-sheet/mobile/.
Pollfish, 2019. How the Pollfish methodology works. Retrieved from https://resources.pollfish.com/pollfish-school/how-the-pollfish-methodology-works/.
Pollfish, 2020. About Pollfish. Retrieved from https://www.pollfish.com/about/.
Popuri, Y., Proussaloglou, K., Ayvalik, C., Koppelman, F., Lee, A., 2011. Importance of traveler attitudes in the choice of public transportation to work: findings from the Regional Transportation Authority Attitudinal Survey. Transportation, 38 (4), 643-661. https://doi-org.proxy.lib.umich.edu/10.1007/s11116-011-9336-y.
Pratt, A., Morris, E.A., Zhou, Y., Khan, S., Chowdhury, M., 2019. What do riders tweet about the people they meet? Analyzing online commentary about UberPool and Lyft Shared/Lyft Line. Transportation Research Part F 62, 459-472. Retrieved from https://doi.org/10.1016/j.trf.2019.01.015.
PricewaterhouseCoopers, 2015. Customer intelligence series: The sharing economy. Retrieved from https://www.pwc.fr/fr/assets/files/pdf/2015/05/pwc_etude_sharing_economy.pdf.
Rayle, L., Dai, D., Chan, N., Cervero, R., Shaheen, S., 2016. Just a better taxi? A survey-based comparison of taxis, transit, and ridesourcing services in San Francisco. Transportation Policy 45 (2016), 168-178. Retrieved from https://doi.org/10.1016/j.tranpol.2015.10.004.
Rayle, L., Shaheen, S., Chan, N., Dai, D., Cervero, R., 2014. App-Based, On-Demand Ride Services: Comparing Taxi and Ridesourcing Trips and User Characteristics in San Francisco. University of California Transportation Center, Berkeley. Retrieved from http://innovativemobility.org/wpcontent/uploads/2015/01/RidesourcingWhitePaper_Nov2014Update.pdf.
Reynolds, P., 2019. The Most and Least Affordable Cities for Public Transit. Value Penguin. Retrieved from https://www.valuepenguin.com/most-and-least-affordable-cities-commuting.
Sanguinetti, A., Kurani, K., & Ferguson, B., 2019. Is It OK to Get in a Car with a Stranger? Risks and Benefits of Ride-pooling in Shared Automated Vehicles. UC Office of the President ITS Reports. https://doi.org/10.7922/G27M064Z.
Schaller, B., 2018. The New Automobility: Lyft, Uber and the Future of American Cities. Schaller Consulting. Retrieved from http://www.schallerconsult.com/rideservices/automobility.pdf.
Shaheen, S., Chan, N., Gaynor, T., 2016. Casual carpooling in the San Francisco Bay Area: Understanding user characteristics, behaviors, and motivations. Transport Policy, 51. https://doi.org/10.1016/j.tranpol.2016.01.003.
Shaheen, S., Cohen, A., 2018. UC Office of the President Shared Mobility Policy Briefs: Definitions, Impacts, and Recommendations. Retrieved from https://doi.org/10.7922/G27S7KX6.
Siddiqi, Z., 2012. Dynamic Ridesharing: Understanding the Role of Gender and Technology. MS Thesis. University of Toronto. Retrieved from https://tspace.library.utoronto.ca/bitstream/1807/33529/11/Siddiqi_Zarar_201211_MSc_thesis.pdf.

SmartCitiesWorld, 2019. SoMo taps social connections as the future of mobility. Retrieved from https://www.smartcitiesworld.net/news/news/somo-taps-social-connections-as-the-future-of-mobility--3721

Smith, A., 2016. Shared, Collaborative and On Demand: The New Digital Economy. Pew Research Center. Retrieved from https://www.pewresearch.org/wpcontent/uploads/sites/9/2016/05/PI_2016.05.19_Sharing-Economy_FINAL.pdf.

SoMo, 2019. Making Mobility Social. Retrieved from https://somo.com/#home.

Sperling, D., 2018. Three Revolutions: Steering Automated, Shared, and Electric Vehicles to a Better Future: 58-62. *Island Press*.

Tahmasseby, S., Kattan, L., Barbour, B., 2016. Propensity to participate in a peer-to-peer social-network-based carpooling system. Journal of Advance Transportation, 50 (2), 240-254. https://doi.org/10.1002/atr.1326.

Taylor, B., Chin, R., Crotty, M., Dill, J., Hoel, L., Manville, M., Polzin, S., 2015. Special Report 319: Between Public and Private Mobility: Examining the Rise of Technology-Enabled Transportation Services. Transportation Research Board: Committee for Review of Innovative Urban Mobility Services. Retrieved from http://docshare02.docshare.tips/files/29670/296707674.pdf.

Texas A&M Transportation Institute, 2017. Policy Implications of Transportation Network Companies: Final Report. *Transportation Policy Research Center.* Retrieved from https://static.tti.tamu.edu/tti.tamu.edu/documents/PRC-17-70-F.pdf.

Tirachini, A., Gomez-Lobo, A., 2019. Does ride-hailing increase or decrease vehicle kilometers traveled (VKT)? A simulation approach for Santiago de Chile, International Journal of Sustainable Transportation, 14 (3), 187-204. https://doi.org.proxy.lib.umich.edu/10.1080/15568318.2018.1539146.

Uber, 2019. Uber Newsroom: Uber's Emergency Button. https://www.uber.com/newsroom/emergencybutton/.

Uber, 2019. Uber Newsroom: Introducing an Enhanced Uber Black Experience. Retrieved from https://www.uber.com/newsroom/introducing-an-enhanced-uber-black-experience/.

Uber, 2020. UberPool: How UberPool works. Retrieved from https://www.uber.com/us/en/ride/uberpool/.

Uber, 2020. Uber Express Pool. Retrieved from https://www.uber.com/us/en/ride/express-pool/.

United States Census Bureau, 2017. Patterns of Metropolitan and Micropolitan Population Change: 2000 to 2010. Retrieved from https://www.census.gov/library/publications/2012/dec/c2010sr-01.html.

United States Census Bureau, 2019. Quick Facts. People. Retrieved from https://www.census.gov/quickfacts/fact/table/US/PST045219#PST045219.

United States Department of Transportation (USDOT), 2015. High-Occupancy Vehicle Lanes. Retrieved from https://www.transportation.gov/mission/health/High-Occupancy-Vehicle-Lanes.

United States Department of Transportation (USDOT), 2015. VMT Per Capita. Retrieved from https://www.transportation.gov/mission/health/vmt-capita.

Ward, J., Michalek, J., Azevedo, I., Samaras, C., Ferreira, P., 2019. Effects of on-demand ridesourcing on vehicle ownership, fuel consumption, vehicle miles traveled, and emissions per capita in the U.S. States. Transportation Research Part C: Emerging Technologies 108: 289-301. https://doi.org/10.1016/j.trc.2019.07.026.

Wenzel, T., Rames, C., Kontou, E., Henao, A., 2019. Travel and energy implications of ridesourcing service in Austin, Texas. Transportation Research Part D: Transport and Environment 70: 18-34. https://doi.org/10.1016/j.trd.2019.03.005.

West, B., Welch, K., Galecki, A., 2007. Linear Mixed Models: A Practical Guide Using Statistical Software.

Young, M., & Farber, S. (2019). The who, why, and when of Uber and other ride-hailing trips: An examination of a large sample household travel survey. Transportation Research Part A: Policy and Practice, 119. https://doi.org/10.1016/j.tra.2018.11.018.

Appendix A - Survey Instrument

Screening Question:

Do you use or have you ever used a ride-hailing service, such as Uber, Lyft or Via?

- ❏ Yes [CONTINUE TO SURVEY]
- ❏ No [TERMINATE]

Warm-Up Question:

Please answer the following questions by marking the box that best describes the degree to which you agree or disagree with each of the following statements regarding ride-hailing services, such as Uber, Lyft, or Via.

	Strongly Agree	Somewhat Agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree	Prefer not to answer
I consider myself a frequent user of ride-hailing services.	○	○	○	○	○	○
I think ride-hailing services save time and stress during travel.	○	○	○	○	○	○
It is easy to find a shared-ride, such as UberPool or LyftLine, in my city.	○	○	○	○	○	○
I think ride-hailing services collect too much personal data and information about their customers.	○	○	○	○	○	○

Part 1: Transportation Scenario Questions
[Respondents were randomly given 10 of the 16 stated preference questions]

You can assume:

- The weather is nice and the driving conditions are good.
- The vehicle picking you up is a new, high-quality midsize car, such as a Honda Accord.
- Your driver has a five-star rating.

Remember:

- The conversation option, if available, matches riders on their preferences "happy to chat", "quiet preferred" or "no preference".

Q1

Type of trip	Commute
If solo ride, the trip duration would be	8 minutes
Number of additional passengers	0
Additional travel time for the shared-ride	+ 0 minutes
Total trip duration	8 minutes
Conversation option available	Yes

- ❑ What is the most you would be willing to pay to take this trip? _____
- ❑ I would not take this trip.

Q2

Type of trip	Leisure
If solo ride, the trip duration would be	30 minutes
Number of additional passengers	2
Additional travel time for the shared-ride	+ 10 minutes
Total trip duration	40 minutes
Conversation option available	No

- ❑ What is the most you would be willing to pay to take this trip? _____
- ❑ I would not take this trip.

Q3

Type of trip	Commute
If solo ride, the trip duration would be	24 minutes
Number of additional passengers	1
Additional travel time for the shared-ride	+ 20 minutes
Total trip duration	44 minutes
Conversation option available	Yes

- ❑ What is the most you would be willing to pay to take this trip? _____
- ❑ I would not take this trip.

Q4

Type of trip	Leisure
If solo ride, the trip duration would be	16 minutes
Number of additional passengers	3
Additional travel time for the shared-ride	+ 15 minutes
Total trip duration	31 minutes
Conversation option available	Yes

- ❑ What is the most you would be willing to pay to take this trip? _____
- ❑ I would not take this trip.

Q5

Type of trip	Commute
If solo ride, the trip duration would be	8 minutes
Number of additional passengers	2
Additional travel time for the shared-ride	+ 15 minutes
Total trip duration	23 minutes
Conversation option available	No

- ❑ What is the most you would be willing to pay to take this trip? _____
- ❑ I would not take this trip.

Q6

Type of trip	Leisure
If solo ride, the trip duration would be	24 minutes
Number of additional passengers	2
Additional travel time for the shared-ride	+ 5 minutes
Total trip duration	29 minutes
Conversation option available	Yes

- ❑ What is the most you would be willing to pay to take this trip? _____
- ❑ I would not take this trip.

Q7

Type of trip	Leisure
If solo ride, the trip duration would be	30 minutes
Number of additional passengers	0
Additional travel time for the shared-ride	+ 0 minutes
Total trip duration	30 minutes
Conversation option available	No

- ❑ What is the most you would be willing to pay to take this trip? _____
- ❑ I would not take this trip.

Q8

Type of trip	Commute
If solo ride, the trip duration would be	30 minutes
Number of additional passengers	3
Additional travel time for the shared-ride	+ 5 minutes
Total trip duration	35 minutes
Conversation option available	No

- ❑ What is the most you would be willing to pay to take this trip? _____
- ❑ I would not take this trip.

Q9

Type of trip	Commute
If solo ride, the trip duration would be	16 minutes
Number of additional passengers	0
Additional travel time for the shared-ride	+ 0 minutes
Total trip duration	16 minutes
Conversation option available	Yes

- ❑ What is the most you would be willing to pay to take this trip? _____
- ❑ I would not take this trip.

Q10

Type of trip	Leisure
If solo ride, the trip duration would be	8 minutes
Number of additional passengers	1
Additional travel time for the shared-ride	+ 10 minutes
Total trip duration	18 minutes
Conversation option available	No

- ❑ What is the most you would be willing to pay to take this trip? _____
- ❑ I would not take this trip.

Q11

Type of trip	Commute
If solo ride, the trip duration would be	30 minutes
Number of additional passengers	1
Additional travel time for the shared-ride	+ 15 minutes
Total trip duration	45 minutes
Conversation option available	Yes

- ❑ What is the most you would be willing to pay to take this trip? _____
- ❑ I would not take this trip.

Q12

Type of trip	Leisure
If solo ride, the trip duration would be	8 minutes
Number of additional passengers	3
Additional travel time for the shared-ride	+ 20 minutes
Total trip duration	28 minutes
Conversation option available	Yes

- ❑ What is the most you would be willing to pay to take this trip? _____
- ❑ I would not take this trip.

Q13

Type of trip	Commute
If solo ride, the trip duration would be	24 minutes
Number of additional passengers	3
Additional travel time for the shared-ride	+ 10 minutes
Total trip duration	34 minutes
Conversation option available	No

- ❏ What is the most you would be willing to pay to take this trip? _____
- ❏ I would not take this trip.

Q14

Type of trip	Leisure
If solo ride, the trip duration would be	24 minutes
Number of additional passengers	0
Additional travel time for the shared-ride	+ 0 minutes
Total trip duration	24 minutes
Conversation option available	No

- ❏ What is the most you would be willing to pay to take this trip? _____
- ❏ I would not take this trip.

Q15

Type of trip	Leisure
If solo ride, the trip duration would be	16 minutes
Number of additional passengers	1
Additional travel time for the shared-ride	+ 5 minutes
Total trip duration	21 minutes
Conversation option available	No

- ❏ What is the most you would be willing to pay to take this trip? _____
- ❏ I would not take this trip.

Q16

Type of trip	Commute
If solo ride, the trip duration would be	16 minutes
Number of additional passengers	2
Additional travel time for the shared-ride	+ 20 minutes
Total trip duration	36 minutes
Conversation option available	No

- ❏ What is the most you would be willing to pay to take this trip? _____
- ❏ I would not take this trip.

Part II: General Questions About Transportation Preferences

Q1 Which of the following modes of transportation do you rely on to get around in your daily life? (Check all that apply)

- ❏ Personal Motorized Vehicle (car, truck, motorcycle)
- ❏ Public Transit
- ❏ Bicycle / Scooter / E-bike
- ❏ Taxi / Cab
- ❏ Ride-hailing (Lyft, Uber, Via)
- ❏ Walk / Jog
- ❏ Carpool / Vanpool
- ❏ Other _____

Q2 Rate how important the following are to you in your day to day travel:

	Extremely important	Very important	Moderately important	Slightly important	Not at all important
Safety	○	○	○	○	○
Environmental Impact	○	○	○	○	○
Socializing	○	○	○	○	○
Convenience	○	○	○	○	○
Cost	○	○	○	○	○
Travel Time	○	○	○	○	○
Privacy	○	○	○	○	○

Q3 For what reasons have you chosen a ride-hailing service over driving a personal motorized vehicle? (Check all that apply)

- ❑ To avoid drinking and driving
- ❑ To connect to public transit
- ❑ Parking is difficult to find
- ❑ Parking is expensive
- ❑ To be able to multitask
- ❑ Do not have a driver's license or access to a car
- ❑ Other _____

Q4 In regard to ride-hailing, straight line routing asks riders to walk a short distance to a designated pick-up location. In return, the rider benefits by traveling a more direct route for a cheaper price.

Assuming it is nice weather, how far would you be willing to walk to meet a driver for a more direct route?

- ❑ 3 minutes
- ❑ 5 minutes
- ❑ 7 minutes
- ❑ 10 minutes
- ❑ 15 minutes or more
- ❑ I would not walk to meet a driver

Q5 When taking a ride-hailing service, please note your comfort level regarding the following.

	Extremely comfortable	Somewhat comfortable	Neither comfortable no uncomfortable	Somewhat uncomfortable	Extremely uncomfortable
Being picked-up or dropped-off at your home address.	○	○	○	○	○
Being picked-up or dropped-off at your work or school.	○	○	○	○	○
Riding in the car during the day with another passenger whom you don't know.	○	○	○	○	○
Riding in the car during the night with another passenger whom you don't know.	○	○	○	○	○
Having a conversation with a driver whom you don't know.	○	○	○	○	○
Having a conversation with another passenger whom you don't know.	○	○	○	○	○

Q6 Some ride-hailing companies have added a 911 button in the App for passengers to use in emergency situations. If pushed, the button automatically shares location data with emergency personnel.

How would the addition of this button change your willingness to take the following rides?

Some ride-hailing companies have added a 911 button in the App for passengers to use in emergency situations. If pushed, the button automatically shares location data with emergency personnel.

How would the addition of this button change your willingness to take the following rides?

	Significantly increase my willingness	Somewhat increase my willingness	No change in my willingness	Somewhat decrease my willingness	Significantly decrease my willingness
A solo-ride during the day.	○	○	○	○	○
A solo-ride at night.	○	○	○	○	○
A shared-ride during the day.	○	○	○	○	○
A shared-ride at night.	○	○	○	○	○

Part III: Household Questions

Q1 To which gender do you most identify?

- ❑ Male
- ❑ Female
- ❑ Nonbinary/Gender nonconforming
- ❑ Prefer not to answer

Q2 What is your age?

- ❑ 18 - 24
- ❑ 25 - 34
- ❑ 35 - 44
- ❑ 45 - 54
- ❑ 55 - 64
- ❑ 65 or over
- ❑ Prefer not to answer

Q3 How would you describe yourself? (Check all that apply)

- ❑ American Indian or Alaska Native
- ❑ Asian
- ❑ Black or African American
- ❑ Native Hawaiian or Pacific Islander
- ❑ White
- ❑ Hispanic or Latino
- ❑ Other _____
- ❑ Prefer not to answer

Q4 What is the highest degree or level of education you have completed?

- ❑ Less than high school degree
- ❑ High school or equivalent (e.g., GED)
- ❑ Trade school certificate or associate degree
- ❑ Bachelor's degree
- ❑ Graduate or professional degree
- ❑ Prefer not to answer

Q5 Which of the following categories best describes your employment status?

- ❑ Employed, full-time
- ❑ Employed, part-time
- ❑ Self-employed
- ❑ Not employed, looking for work
- ❑ Not employed, not looking for work
- ❑ Student
- ❑ Retired
- ❑ Not able to work
- ❑ Prefer not to answer

Q6 Which category best represents your annual household income in the past (2019) year?

- ❑ Less than $25,000
- ❑ $25,000 - $49,999
- ❑ $50,000 - $74,999
- ❑ $75,000 - $99,999
- ❑ $100,000 - $124,999
- ❑ $125,000 - $149,999
- ❑ Over $150,000
- ❑ Prefer not to answer

Q7 Do you have a valid driver's license?

- ❑ Yes
- ❑ No
- ❑ Prefer not to answer

Q8 How many motor vehicles (cars, trucks, SUVs, vans) does your household own or lease?

- ❑ 0
- ❑ 1
- ❑ 2
- ❑ 3 or more
- ❑ Prefer not to answer

Appendix B - Focus Group Final Report

Consumer Preferences and Attitudes Towards On-Demand Ride-Sharing Services

Findings from One Focus Group with Frequent Users of On-demand Ride-hailing Services

Conducted March 9, 2020

Location: Cypher Research, Livonia, Michigan

Final Report

Kimberly Lippke, University of Michigan
Christian Noyce, University of Michigan

Table of Contents

Executive Summary

Student researchers from the University of Michigan conducted research to investigate the social and behavioral considerations associated with travelers' acceptance of Transportation Network Companies (TNCs) shared-ride services and how those considerations factor into individuals' willingness to pay (WTP) for such services. The aim of the focus group is to help understand travelers' perceptions, attitudes, and behaviors, and to act as a complement to the primary method of research - an online stated-preference survey.

Researchers conducted one focus group with eight participants on March 9th, 2020 at Cypher Research located in Livonia, Michigan. It was the intention of researchers to conduct two additional focus groups, however due to the COVID-19 outbreak in the United States, The Michigan Department of Health and Human Services issued Executive Order 2020-21. This order temporarily restricted gatherings and prohibited in-person work that was not necessary to sustain or protect life, forcing researchers to abandon additional focus group plans.

Key Findings:

- A majority expressed that going out to bars and restaurants was their main reason for using ride-hailing services over their primary mode of transportation.
- The main reason for not using the shared option is because the cost difference is not enough to justify the additional time.
- Most participants stated that they would be willing to use shared-ride services if the price difference between solo-rides and shared-rides was significant.
- Participants view cost, convenience, and time as the most important attributes when selecting both a solo and a shared TNC ride.
- Most participants are not comfortable taking a shared-ride to get to work out of concern they will be late.
- Most participants were open to utilizing the straight-line routing option if they felt comfortable and safe walking to/from the pick-up/drop-off points.
- Participants viewed the social interactions associated with shared-rides with either indifferent or positive attitudes. However, social interactions are not perceived as an important attribute when choosing to take a TNC ride.
- Current strategies, such as allowing riders to choose their conversation option before taking the TNC ride, the availability of an emergency button, and the option to set a private pick-up/drop-off location were all perceived as positive additions to the Apps by the participants. However, participants did not indicate that these improvements would increase their willingness to take a shared-ride.
- Most participants viewed the option of creating a general ride-hailing profile as a beneficial service, noting they would like to see a photo and know the age and gender of other riders. Many participants also noted they would feel comfortable providing this information for other riders to view.

2. Introduction

Transportation generates more carbon dioxide emissions than any other United States (U.S.) economic sector, and, at the same time, new mobility options are rapidly changing transportation. On-demand ride-hailing companies like Uber and Lyft often referred to as Transportation Network Companies (TNCs), now provide on-demand mobility services that complement and compete with public transit, personal vehicle and non-motorized mobility options. Within this relatively short period of time, TNCs have expanded across most of the urban United States and have introduced new options to riders, such as shared-ride services. These shared-ride services match riders with similar origins and destinations together. Riders can save 25% to 60% in fares if they choose the shared option. However, despite the rapid growth and availability of these dynamic shared-ride services, the past decade has not seen any increase in vehicle occupancy rates in the U.S. Some researchers argue that enacting policies to increase ride-sharing could be one of the most effective strategies to increase occupancy and reduce energy consumption besides pricing or prohibiting driving. Therefore, further research is needed to understand what will motivate individuals to opt for the shared-ride option when using ride-hailing services.

To gain depth and insight into the experiences and perceptions of TNC users regarding shared-ride services we conducted a focus group discussion in the Metro Detroit area. Specifically, the focus group will generate insight into the lived experience of TNC users. Information acquired in the focus group revealed specific attributes of interest in regard to solo and shared-ride services; language and terminology used by the population of interest, and new ideas not present in the existing literature.

3. Methodology and Participant Profile

3.1 Instrument Development

Before the focus group instrument was created, we conducted a soft-focus group discussion with EPA staff members in Washington DC who are regular TNC users. This approach provided information on some of the important characteristics and perceptions of ridesharing services by frequent users. Based on our review of the existing research regarding current and prospective intervention strategies aimed at increasing shared-ride adoption, in addition to the soft-focus group, we designed our discussion questions to evaluate 1) consumer preferences and attitudes toward solo and shared ride-hailing services, 2) real and perceived (in)conveniences, (dis)comforts, and risks associated with solo and shared ride-hailing services, and 3) societal and individual benefits associated with solo and shared ride-hailing services. The discussion was divided into three categories of questions 1) general questions pertaining to individuals' use of and perceptions towards on-demand ride-hailing services, 2) questions specific to shared-ride services based on the literature, and 3) intervention strategies aimed at mitigating the real and perceived risks/barriers of shared-ride services. Details of the discussion questions are provided in Appendix A.

3.2 Site Selection

The popularity of Uber and Lyft services in Metro Detroit, as well as the availability of UberPool and Lyft Shared ride-hailing services, as well as the close proximity of Detroit to the University of Michigan made Detroit an ideal location to conduct the focus group.

3.3 Participant Selection

Participants were recruited purposively. To assist in the recruitment process, we worked with Cypher Research, a marketing research focus group facility and field management service based in the Metro Detroit area. To participate in the focus group, participants were required to 1) be at least 18 years of age; 2) reside in Wayne County; 3) use TNC services at least once per month; and, 4) have never worked as a TNC driver. It took one week for Cypher Research to recruit ten participants with representative genders, ages, and ethnicities of Detroit. Full details of the focus group recruiting screener are provided in Appendix B.

3.4 Focus Group

One focus group was conducted from 6 pm - 7 pm on March 9, 2020, at Cypher Research in Livonia, Michigan. It was the intention of researchers to conduct two additional focus groups, however due to the COVID-19 outbreak in the United States, The Michigan Department of Health and Human Services issued Executive Order 2020-21. This order temporarily restricted gatherings and prohibited in-person work that was not necessary to sustain or protect life, forcing researchers to abandon additional focus group plans.

Cypher Research provided a digital audio recording of the focus group discussion, which was transcribed into a text file using the online transcription Rev. The text file was coded and analyzed using MAXQDA, a software package for qualitative and mixed methods research.

3.5 Group Composition

Eight of the ten recruited individuals participated in the focus group. Figure 1 summarizes the group's composition based on the following key areas: gender, ethnicity, age, participants' primary mode of travel, number of personal vehicles owned/leased, and how often (per month) participants used TNCs. Important to note in the "Primary Mode of Travel" chart is that all participants who stated Public Transportation as their primary mode also stated that Uber/Lyft was an equivalent primary mode of travel.

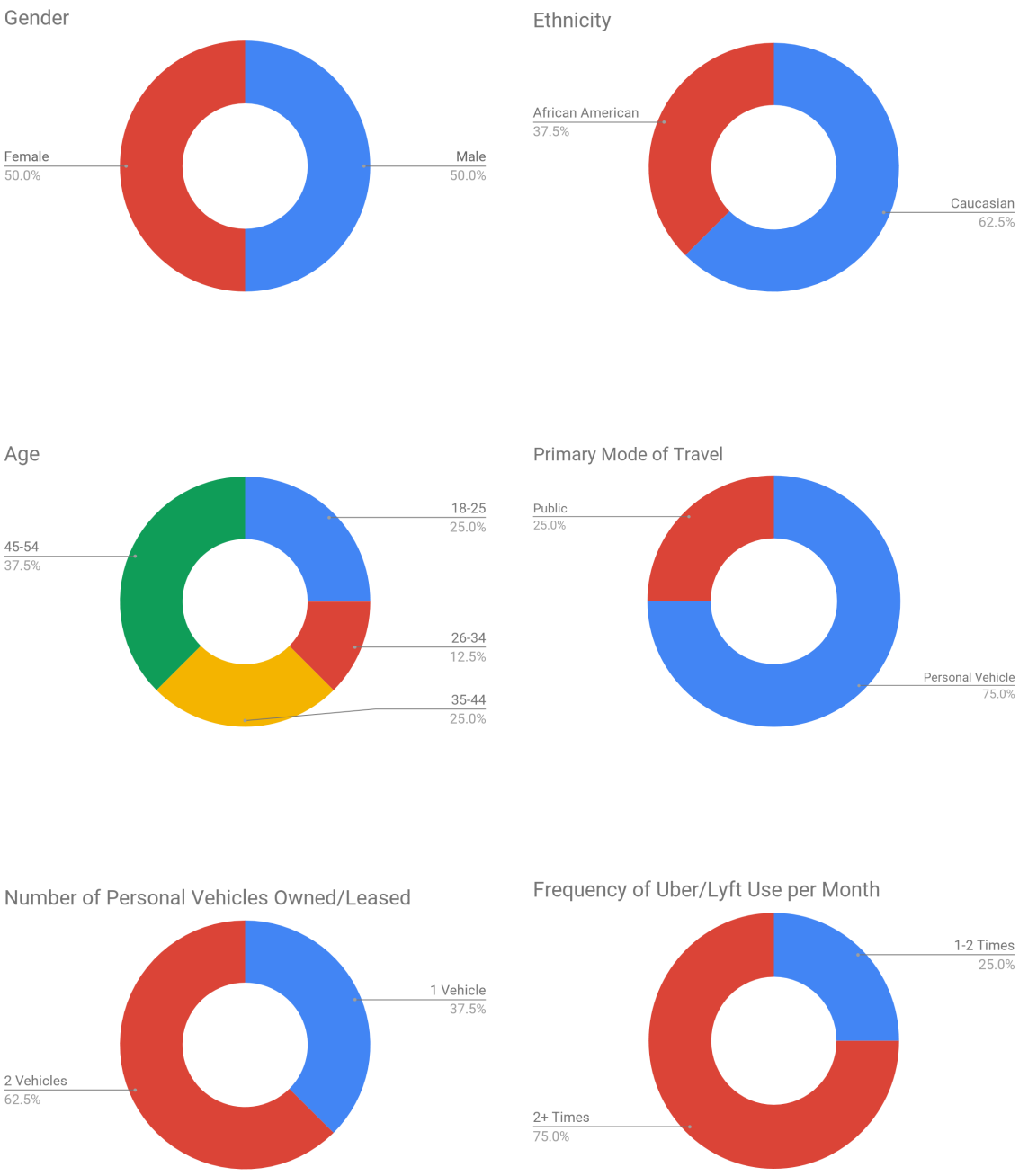

Figure 1. Group Composition

4. Discussion Results

4.1 Purpose of Ride-hailing Services

Question(s): How often do you use Uber and Lyft and for what purposes do you choose to take these services?

Summary: The group began with a discussion of how often and for what purposes they use ride-hailing services. Most participants expressed that going out to bars and restaurants was their main reason for using ride-hailing services over their primary mode of transportation, which in this group was a personal vehicle. Other notable reasons for utilizing ride-hailing options were traveling to the airport, commuting to work, and to avoid parking downtown.

> ***"****I usually use it on the weekends with my friends when I want to go out to the bars and stuff."* (Female participant)
>
> *"I use it probably five to six times a month, usually airport, or going out to dinner/bars."* (Male participant)

4.2 Current Users of Shared-Ride Services

Question(s): Has anybody in the room used either Uber Pool or Lyft Shared before? Why did you choose the UberPool/Lyft Shared over the solo option?

Summary: Most participants (6 of 8) have never used TNC's shared-ride services and those who had described different reasoning for choosing the shared option and opposite experiences.

> *"We just figured it would be cool if we met somebody, but actually they didn't pick anybody up, so it's cheaper. We just use it every time now, because a lot of times they don't pick anybody up."* (Female participant)
>
> *"...what should have been a 35-minute Lyft ride turned into about an hour and fifteen-minute Lyft ride…..So, it was more like a one-and-done, I'll just pay the more money and be done with it."* (Male participant)

4.3 Problems with Shared-Ride Services

Question(s): What's the reasoning behind why you choose the solo ride over the shared-ride option?

Summary: Most participants stated the main reason for not selecting the shared option was because the cost difference is not enough to justify the additional time, followed closely by

the uncertainty of travel time connected to shared-rides. Multiple participants noted that they didn't feel comfortable taking a shared-ride to work because they couldn't run the risk of being late due to travel time uncertainty.

> *"I always see the option, and like the price difference is usually not enough for me to spend 45 minutes with a stranger."* (Male respondent)
>
> *"(time) more than double(s). I'm an impatient guy, so I don't want to be driving around picking everybody up…. You can't be late for work."* (Male respondent)
>
> *"I take an Uber twice a week for work, so I can't imagine stopping and picking folks up when I have to be to work at 8 am."* (Female respondent)

4.4 Increasing Adoption of Shared-Ride Services

Question(s): Can you think of any attributes or additions to Uber Pool or Lyft Shared that may motivate you to take shared-rides in the future?

Summary: Most participants stated that they would be willing to use shared-ride services if the price difference between solo-rides and shared-rides was significant. A few participants mentioned that more accurate travel time estimates or knowing the route before selecting the shared-ride would be helpful. The conversation repeatedly returned to the cost difference between solo and shared-rides not being large enough to motivate people to choose the shared option. At the end of the discussion, many participants reiterated that they would be more willing to take a shared-ride for leisure purposes than commute purposes due to the uncertainty of travel time associated with shared-rides.

> *"Cost would probably be the number one thing."* (Male participant)
>
> *"Money always motivates people."* (Male participant)
>
> *"Maybe having the option of seeing ahead of time that this (ride) would be picking up this (person) and seeing the next pickup."* (Female participant)
>
> *"But again….as far as work goes, I have to be at work in 15 minutes, you got to go."* (Male participant)

4.5 Straight Line Routing

Question(s): Under what conditions, if any, would you be willing to walk to meet your Uber or Lyft driver? How long in minutes would you be willing to walk to meet these other passengers and drivers?

Summary: Straight-line routing connects riders in the same area who want to travel to similar destinations. Riders are asked to walk a short distance to be picked up at a common location. They also would be dropped off at a common site that would be a short walk from their final destinations.

Interesting to note is that straight-line routing inspired the most dialogue between participants. Most participants were interested in and voiced positive reactions to the straight-line routing option and stated they'd be willing to walk 5-10 minutes to meet a driver. However, their willingness to walk was dependent on gender, the time of day, and location. In general, female participants voiced safety concerns about walking at night or in unfamiliar areas. Male participants focused more on the benefit of the time-saving aspect of straight-line routing and the usefulness of this option during concerts/sporting events. All participants agreed that they wouldn't want to walk in bad weather.

> *"If it's two blocks and it's going to save me twenty minutes in traffic? Sure I'll meet you down the road."* (Male participant)
>
> *"If it's nighttime and you want me to walk a block to find you, I don't know about that. But in the daytime, I'll whatever"* (Female participant)
>
> *"You don't want to walk where you're secluded."* (Female participant)
>
> *"I think five minutes is probably my max, just because the savings is not that much. If it was more savings, I would walk a little bit further. You don't want to get too far from where you know things are."* (Female participant)
>
> *I think that's (straight line routing) a prime candidate….because at the end of those things (events) everybody just wants to get the hell out of there. I don't care if I'm sharing with people at that point."* (Male participant)
>
> *"If it's like a massive concert venue or an event, I'll walk 10 minutes versus if it's not that type of scenario, maybe five."* (Male participant)

4.6 Social Interactions

Question(s): How do you typically like to spend your time while traveling from point A to point B? Do you feel like Uber and Lyft allow you to engage in the activities that you like doing when going from Point A to Point B? Does this (social interactions) dynamic change if you were in a shared-ride versus solo-ride?

Summary: When asked how participants liked to spend their travel time many male participants stated they like to talk to others to make the time go by faster. Many female participants stated they prefer to listen to music/podcasts or check emails/social media. Overall, most participants viewed the social interactions associated with shared-rides with

either indifference or positive attitudes. The dynamic changed depending on whether it is a solo ride or a shared-ride. The majority of participants noted they feel more comfortable socializing with the driver than other passengers because the driver has gone through a hiring process while other passengers are complete unknowns.

> *"That would be kind of cool to meet people if you guys are all going to the same place."* (Female participant)
>
> *"I usually am quiet, unless they want to talk, and then I talk. But if they don't want to talk, then I'm not talking."* (Female participant)
>
> *"I'm more comfortable if they are talking, than just silent to me. So, I'll try to engage in a conversation, personally."* (Male participant)
>
> "*I'm more willing to talk to a driver than a random stranger."* (Male participant)

4.7 Conversation Option

Question(s): There has been discussion (Uber) about allowing passengers to choose before selecting a ride whether or not they would like to talk, whether they don't want to talk or whether they don't have a preference.

What are your thoughts on having the ability to choose your conversation preferences before getting into Uber or Lyft?

Summary: Most participants viewed the option to choose their conversation preferences before getting into Uber or Lyft with either indifference or positive attitudes. No one mentioned that it would personally increase their willingness to share rides, however, one participant mentioned she thought it might increase adoption for people with social anxiety.

> *"I don't care either way."* (Male participant)
>
> *"I think the (conversation) option being there is a good thing."* (Female participant)
>
> *"There are some people that get so anxious about taking an Uber or Lyft that they never have because of talking."* (Female participant)

4.8 Privacy Option / Emergency Button

Question(s): "Privacy" options have been discussed to allow users the option to enter pick-up and drop-off locations near their actual origin and destination. This would prevent the ride-hailing driver and other passengers from knowing your exact origin and destination locations.

What are your thoughts on the privacy option? What are your thoughts on an emergency button being available in the app? Who knew that emergency buttons were currently available in both the Uber and Lyft Apps?

Summary: All participants viewed the ability to enter a pick-up or drop-off location that is different from their actual origin/destination as a beneficial service, however, no one mentioned that the option would increase their willingness to share rides. Overall, people seemed more concerned with additional passengers knowing their locations than drivers. We received a similar response regarding the emergency button. All participants viewed the built-in emergency button in the App as a benefit but noted the presence of the button wouldn't increase their adoption of shared-rides. However, even with both Uber and Lyft having in-app emergency buttons, only one participant knew that the button existed.

> *"It does really make a difference. I mean, you don't know these people. Most people are good, but you can't assume that for everybody."* (Female participant)
>
> *"You have a little bit of information on the driver, you don't necessarily have any information on the passengers."* (Female respondent)
>
> *"It wouldn't hurt to have it (emergency button).*" (Male participant)
>
> *"It would be a good thing (emergency button) for them to advertise."* (Female participant)

4.9 Ride-hailing Profiles

Question(s): How would the option you create a ride-hailing profile influence your motivation to share rides? What sort of attributes do you think would be beneficial to go into a passenger profile?

Summary: Most participants viewed the option of creating a general ride-hailing profile as a beneficial service with a photo being the most important profile attribute. Other notable profile attributes were age and gender. Many female respondents stated that they would feel more comfortable sharing a ride with other women, but no one specifically stated that they wouldn't take a shared-ride with a man. One male participant stated that his wife wouldn't take a ride with a group of men. At this point in the discussion, a brief side conversation broke off regarding all participants' lack of comfort with unaccompanied minors riding in TNCs.

> *"I would be comfortable showing that (picture) to them. I don't want them to know a bunch of stuff about me."* (Female participant)
>
> *"(a photo and age) ...so you know who's getting in the car. It's a 25 to 35-year-old*

man……. not some random person jumping in." (Female participant)

"I don't want to ride with no children. I want to ride with mature people. That way, I'd be able to talk to them." (Male participant)

"My wife would agree on that. She wouldn't get in a car with a bunch of guys. She just would not do that." (Male participant)

5. Post Discussion Survey Results

At the end of the discussion hour, participants were asked to fill out a short questionnaire. Details of the questionnaire can be found in Appendix C. The questionnaire asked about the main purposes of using ride-hailing services over primary modes of transportation, as well as asked participants to rank the level of importance of different attributes.

5.1 Purpose of Ride-hailing Services

The majority of participants stated that one of the main reasons they choose TNC's over their primary mode of transportation is to avoid drinking and driving. This is consistent with the focus group discussion where most people noted they used TNC services to go to bars/restaurants. Many participants also noted that they use TNCs because parking is expensive and difficult to find. None of the participants used TNCs as a tool for socialization or because they viewed the ride as faster than their primary mode.

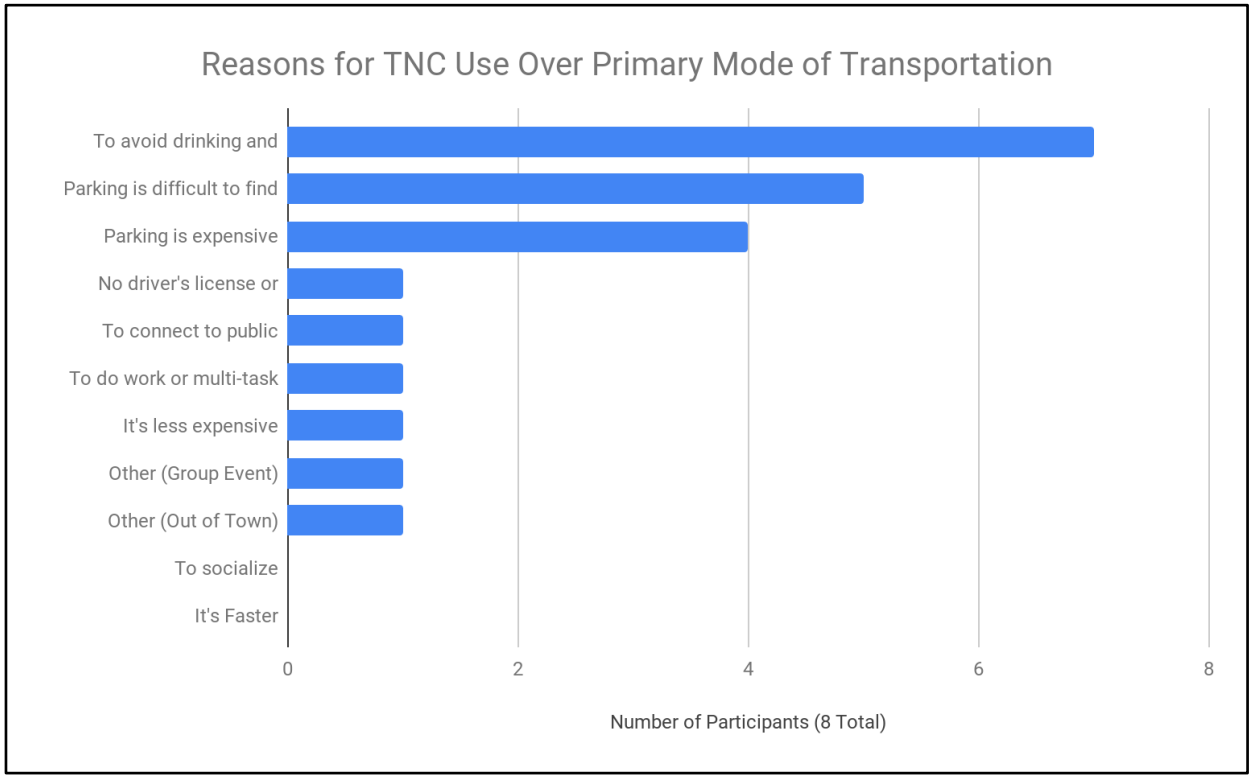

Figure 2. Reasons for TNC Use Over Primary Mode of Transportation

5.2 Attribute Importance - Primary Mode, Solo Services, Shared Services

The column chart below shows how participants ranked the importance of the following attributes when considering their primary mode of travel, taking a solo-ride, and taking a shared-ride: convenience, environmental concerns, ease/cost of parking, physical safety, the security of personal information, cost, time, socialization, and personal space. Consistent with the focus group discussion, cost, convenience, and time were the attributes ranked as most important in all three travel categories. Conversely, environmental concerns and socialization ranked least important across all three travel categories.

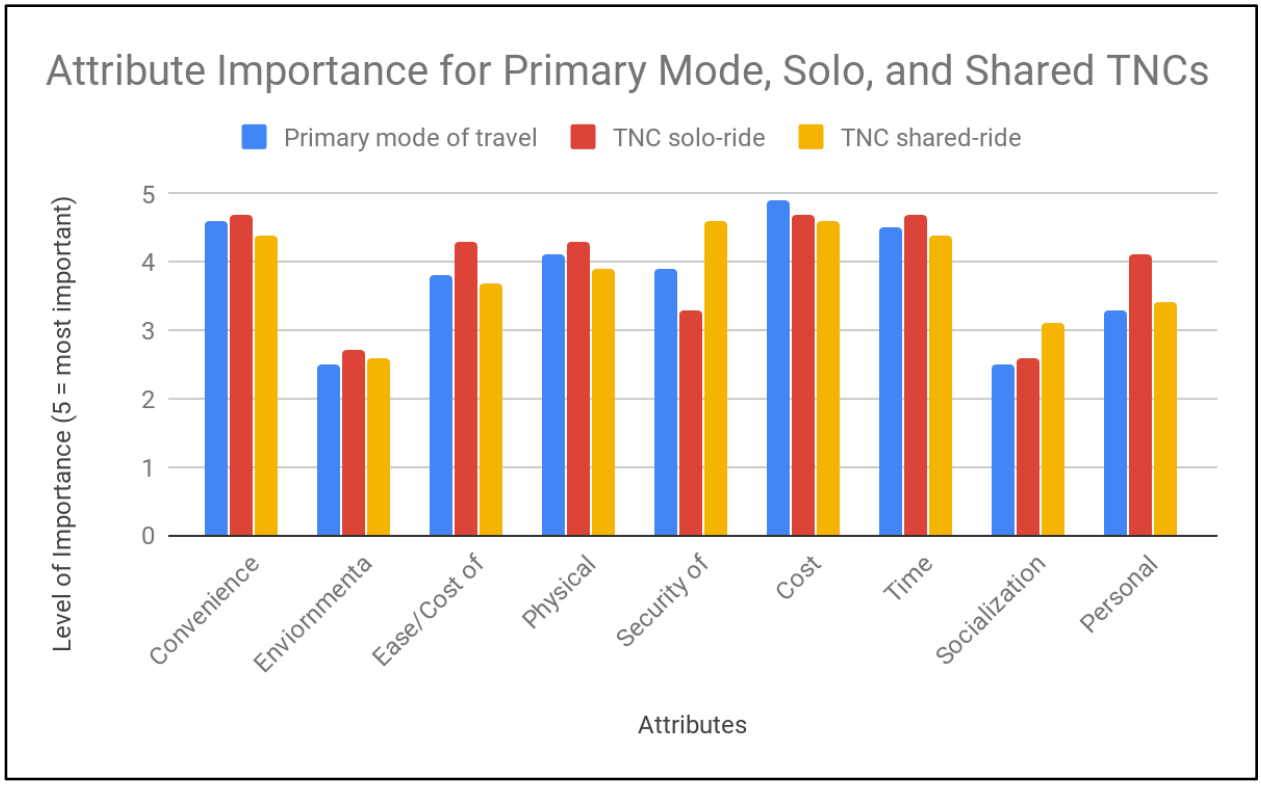

Figure 3. Attribute Importance for Primary Mode, Solo, and Shared TNCs

6. Summary of Findings

A wide variety of topics were discussed in this focus group about solo and shared Transportation Network Company (TNC) services held with a group of frequent TNC users in the Metro Detroit area. Topics included; purposes for using these services; perceived problems with these services; attributes that may increase the adoption of shared-ride services; and opinions about current strategies aimed at improving the adoption of shared-ride services. Some of the findings were:

- A majority expressed that going out to bars and restaurants was their main reason for using ride-hailing services over their primary mode of transportation.
- The main reason for not using the shared option is because the cost difference is not enough to justify the additional time.
- Most participants stated that they would be willing to use shared-ride services if the price difference between solo-rides and shared-rides was significant.
- Participants view cost, convenience, and time as the most important attributes when selecting both a solo and a shared TNC ride.
- Most participants are not comfortable taking a shared-ride to get to work out of concern they will be late.
- Most participants were open to utilizing the straight-line routing option if they felt comfortable and safe walking to/from the pick-up/drop-off points.
- Participants viewed the social interactions associated with shared-rides with either indifferent or positive attitudes. However, social interactions are not perceived as an important attribute when choosing to take a TNC ride.
- Current strategies, such as allowing riders to choose their conversation option before taking the TNC ride, the availability of an emergency button, and the option to set a private pick-up/drop-off location were all perceived as positive additions to the Apps by the participants. However, participants did not indicate that these improvements would increase their willingness to take a shared-ride.
- Most participants viewed the option of creating a general ride-hailing profile as a beneficial service, noting they would like to see a photo and know the age and gender of other riders. Many participants also noted they would feel comfortable providing this information for other riders to view.

7. Limitations

- The focus group was moderated by the researchers; therefore, we cannot guarantee the impartiality of the discussion.
- Rider experiences may vary from city to city depending on the built environment and population. For example, the city of Detroit is 139 square miles, with an estimated population of 677,116, and limited public transit options. The New York City borough of Manhattan is 22.8 square miles, with an estimated population of 1.629 million, and multiple mass transit options. Therefore, it is plausible that the results of the focus group could vary greatly between cities in the United States.
- The analysis was based on information gathered from one focus group of eight participants. Qualitative methods research suggests that in order to identify all themes, as well as, the most prevalent themes, three to six focus groups are ideal.
- Information from focus groups is not applicable to the general population. The selection of participants is not random and instead is purposive with the intent to gather a group with specific desired attributes.

8. Recommendations

From the findings of this focus group, the following recommendations could help increase the adoption of the shared-ride options in on-demand ride-hailing apps such as Uber and Lyft.

- Increase the cost of solo-rides so the savings associated with the shared-rides are perceived as significant. To justify the increase, TNC's could adapt their marketing strategies to portray the act of taking a solo-ride as a luxury, similar to hiring a private car.
- Time is second only to cost as the most important attribute to individuals when deciding on a mode of travel. TNCs need to work on creating more accurate estimations of total trip durations of shared-ride services and communicating those estimates reliably.
- TNCs should ensure that pick-up and drop-off locations and walking routes for straight-line routing services such as Uber Express Pool and Lyft Shared Saver are located in well-lit, high-traffic areas to address the safety concerns of users.
- Advertising straight-line routing options at concert venues, festivals, or at sporting events may increase adoption during these events as demand for TNCs is often high during these events and people are more willing to walk a short distance to avoid traffic.
- Allow users to create a personal profile for ridesharing so they feel more comfortable riding in a car with additional passengers whom they don't know. Example: A profile picture, age bracket, and gender.

If future research is affordable, the following areas should be explored.

- How much of a price difference between solo-rides and shared-rides do consumers perceive as significant enough to opt for the shared-ride?
- If trip duration estimates were accurate, what time range would passengers view as acceptable?
- Do consumers have concerns about discrimination regarding passenger profiles?

9. Appendices

Appendix A - Focus Group Questions

1. Could you briefly (30 seconds or less) share with us how often and for what purposes you take ride-hailing services such as Uber and Lyft?

2. Uber and Lyft both offer shared options in Metro Detroit. The concept of the shared option is that passengers pay a reduced price for sharing the ride with others and the driver is able to pick up and drop-off additional passengers during the ride.

   Has anyone ever used these shared-ride services?

   For those of you who have, could you share with us how often you use them and your primary reason for using them?

3. For everyone: What are your primary reasons for NOT selecting the shared option?

4. What do you think would motivate you to choose the shared option over the solo ride option?

5. Under what conditions, if any, would you be willing to walk to meet an Uber or Lyft driver?

6. “Express Pool,” which connects riders in the same area who want to travel to similar destinations. Riders are asked to walk a short distance to be picked up at a common location. They also would be dropped off at a common site that would be a short walk from their final destinations.

   What do you think about this option?

   How long in minutes, if at all, would you be willing to walk to meet a driver in order to have a more direct (faster) route to your destination?

7. How do you prefer to spend your travel time?

   Do you feel Uber and Lyft allow you to engage in these activities?

   Do you feel shared-rides and solo rides are different in this aspect?

8. ”Privacy” options have been discussed to allow users the option to enter pick-up and drop-off locations near their actual origin and destination. This would prevent the ride-hailing driver and other passengers from knowing your exact origin and destination locations.

   How do you feel about this option?

   Do your feelings change if it is a solo or shared-ride?

9. How would the option to create a ride-hailing profile influence your motivation to share rides?

   Which types of attributes would you most prefer to have in a ride-hailing profile?

   What do you think about the option of linking your ride-hailing App to your social media accounts, such as Facebook, Instagram, Tik Tok?

10. There has been discussion (Uber) about allowing passengers to choose before selecting a ride whether or not they would like to talk, whether they don't want to talk or whether they don't have a preference.

    What are your thoughts on having the ability to choose your conversation preferences before getting into Uber or Lyft?

Appendix B - Recruiting Screener

1. Are you 18 years of age or older?

Yes	( )	[Continue]
No	( )	[**TERMINATE**]

2. How often do you take an Uber or Lyft?

I've never taken an Uber or Lyft	( )	[**TERMINATE**]
Once or twice per year	( )	[**TERMINATE**]
Once or twice a month	( )	[Continue]
More than twice per month	( )	[Continue]

3. Have you ever worked as a driver for Uber or Lyft?

Yes	( )	[**TERMINATE**]
No	( )	[Continue]

4. What county do you live in?

Wayne	( )	[Continue]
Other	( )	[**TERMINATE**]

5. To which gender do you most identify?

Male	( )
Female	( )
Nonbinary/Gender nonconforming	( )

RECRUITER: IDEAL TO HAVE AN EVEN MIX OF GENDERS

5. As part of a random sample, we need to include races representative of Wayne County. Please indicate your race. Note all that apply.

American Indian or Alaska Native	( )
Asian	( )
Black or African American	( )
Native Hawaiian or Pacific Islander	( )
White	( )
Hispanic or Latino/Latina	( )
Other (Please specify)	_____

RECRUITER: WHITE, BLACK OR AFRICAN AMERICAN AND HISPANIC OR LATINO/LATINA ARE THE MOST COMMON RACES IN WAYNE COUNTY.

6. Into which age group do you fall?

18 - 24	( )
25 - 34	( )
35 - 44	( )
45 - 54	( )
65 or over	( )

RECRUITER: IDEAL TO HAVE AN EVEN MIX OF AGES

7. Can you tell me a story about a recent experience you had while riding in an Uber or Lyft?

RECRUITER: USE THIS QUESTION TO IDENTIFY ARTICULATE RESPONDENTS THAT ARE EASY TO UNDERSTAND. ANSWERS MUST BE INTERESTING, THOUGHTFUL AND WELL-EXPRESSED. IT IS EXTREMELY IMPORTANT THAT RESPONDENTS IN THIS STUDY ARE ARTICULATE. IF RESPONDENT DOES NOT GIVE A TWO TO THREE SENTENCE, UNPROMOTED ANSWER, YOU MUST TERMINATE.

Appendix C - Focus Group Questionnaire

1. How many motor vehicles does your household own or lease?

☐ 0 ☐ 1 ☐ 2 ☐ 3 or more

2. What is your primary mode of transportation (use the most)?

☐ Personal vehicle

☐ Public transportation

☐ Walking or Biking

☐ Uber or Lyft

☐Other _____

3. What are the main reasons you choose Uber or Lyft over your primary mode of transportation? **(Check all that apply)**

☐ Do not have a driver's license or access to a vehicle

☐ To connect to public transit

☐ To avoid drinking and driving

☐ Parking is expensive

☐ Parking is difficult to find

☐ To be able to do work or multi-task

☐ To socialize with the driver or other passengers

☐ It's less expensive than my primary mode

☐ It's faster than my primary mode

☐ Other _____

4. On a scale of 1 - 5, 1 being the least important, how important are the following attributes to you when considering your **PRIMARY MODE** of travel?

	Least → Most				
Convenience	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Environmental Concerns	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Ease/Cost of Parking	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Physical Safety	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Security of Personal Info	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Cost	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Time	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Socialization	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Personal Space	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Other _____	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

5. On a scale of 1 - 5, 1 being the least important, how important are the following attributes to you when taking a **SOLO RIDE** with Uber or Lyft?

	Least → Most				
Convenience	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Environmental Concerns	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Ease/Cost of Parking	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Physical Safety	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Security of Personal Info	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Cost	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Time	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Socialization	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Personal Space	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Other _____	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

6. On a scale of 1 - 5, 1 being the least important, how important are the following attributes to you when taking a **SHARED-RIDE** with Uber or Lyft?

	Least → Most				
Convenience	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Environmental Concerns	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Ease/Cost of Parking	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Physical Safety	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Security of Personal Info	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Cost	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Time	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Socialization	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Personal Space	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5
Other _____	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5

Optional: If there is anything else you would like to share with us regarding your experiences with Uber or Lyft, please share in the space below.