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Advancing Social Equity and Congestion Relief: Understanding the Travel Needs of Underserved Populations That Rely on Transportation Network Companies in the San Francisco Bay Area

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16. Abstract

Transportation Network Companies (TNCs) enable travelers to order and pay for rides on-demand using an online application that connects them with drivers using their personal vehicles. While these modes present opportunities to increase individual mobility and access, they also can worsen congestion and increase vehicle emissions. Researchers explored factors impacting the willingness to use pooled TNCs and identified strategies/policies that could be employed to reduce congestion from TNC use. Researchers conducted a literature review, interviews with TNC experts, semi-structured interviews with lower-income, non-White TNC users, and small group discussions with lower-income, non-White TNC users. This research resulted in several key findings including the importance of travel time in the decision to pool, greater focus on meeting the needs of people with disabilities, key operational and safety drawbacks of public transportation (e.g., delayed vehicles, harassment onboard), and the importance of personal safety in transportation decision-making. These findings informed several policy options to better understand how TNC benefits can be maximized while minimizing their negative externalities, such as congestion and vehicle emissions.

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Executive Summary

Transportation Network Companies (TNCs) enable travelers to order and pay for rides on-demand using an online application that connects them with drivers using their personal vehicles. While these modes present opportunities to increase individual mobility and access, they also can worsen congestion and increase vehicle emissions. Better understanding these services could help to maximize potential benefits and minimize negative externalities. Increasing TNC user pooling, where users with different origins and destinations along a common route are picked up and dropped off by the same vehicle, is one strategy toward this end. This study builds off key insights from year one of this study, *Understanding Curb Management and Targeted Incentive Policies to Increase Transportation Network Company Pooling and Public Transit Linkages* (Shaheen, 2021).

This research explores the factors impacting the willingness and propensity to use pooled TNCs and identifies strategies/policies that could be employed to reduce TNC congestion. As part of this study, researchers: 1) reviewed literature on TNCs, transportation equity, and methodological approaches;2) conducted interviews with two experts in TNCs; 3) performed semi-structured interviews with 19 lower-income or non-White TNC users; and 4) hosted two small group discussions with eight lower-income or non-White TNC users. Insights from the first-year study (Shaheen, 2021) and expert interviews informed our human subjects protocols for TNC user engagement. This study aimed to explore the needs of underserved populations (e.g., lower-income, people of color) who use TNCs at least once per week.

From March 2022 to June 2022, the research team recruited 27 TNC users to engage in semi-structured interviews and small group discussions about their TNC experiences. These engagements explored users' general transportation behavior, the key factors influencing their decision-making, and their willingness to use higher-occupancy modes, such as pooled TNCs and public transit.

This research resulted in four key findings:

1. **Pooling Interest:** The research revealed that cost savings were the primary motivation for using pooled services, yet this was not enough of a reason to choose pooled rides. Most participants, regardless of income, reported needing to weigh the cost savings against the added time when choosing pooled rides. Participants frequently reported using TNCs when they were running late and suggested that saving money through pooling was not the most important aspect of making their decision to ride-hail in this case. Operational strategies that improve the reliability of estimated arrival times of pooled rides or reduce the travel time of pooled rides could be particularly effective in encouraging more users to share rides with other passengers.
2. **Consideration of Other Modes:** All participants reported using multiple transportation modes in addition to TNCs. Public transit was the most often mode used by research participants, and most reported a desire and willingness to use public transit more if there was more reliable, frequent transit service, including enough rides and capacity, as well as improved cleanliness. Operational improvements to public transit could have an impact on travel behavior and encourage more individuals to use TNCs to connect with public transit or replace TNCs with transit trips altogether.
3. **TNCs for People with Disabilities**: The transportation needs and challenges of people with disabilities remains a vastly understudied topic as noted in expert interviews. Improvements to these services for a variety of disabilities (e.g., cognitive impairments) can increase the overall mobility of people with disabilities, particularly for those who cannot drive due to their disability.

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4. **Safety Concerns:** Safety concerns across all transportation modes were an often-discussed topic throughout each engagement. The concerns were generally about transmission of COVID-19, dangerous driving, and harassment or violence and were most pronounced among younger women; the lesbian, gay, bisexual, transgender, and queer plus (LGBTQ+) community; and Black/African American participants. Adding additional in-app safety features could help address feelings of safety during TNC trips.

Finally, this report highlights four related policy options:

1. **Data Sharing:** Sharing of data between key private and public stakeholders could allow for a more effective and efficient transportation system.
2. **Operational Improvements:** Advancing improvements that could enhance the reliability, availability, and safety of public transit service, pooling, and micromobility represent notable opportunities for shifting travel behavior that require further study.
3. **Personal Safety Strategies:** Expanding upon and educating about existing technological - safety features (e.g., emergency assist button, location tracking with trusted friends) could help alleviate some barriers to use of TNCs.
4. **Addressing the Needs of People with Disabilities:** Making transportation more accessible and accommodating to people with a variety of disabilities (e.g., cognitive impairments) could increase the mobility and access to opportunities among this population.

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Introduction

Transportation network companies (TNCs) are changing the way people travel by providing dynamic, on-demand mobility that can supplement public transit and personal-vehicle use. Early research suggests that TNCs have the potential to expand access and mobility for underserved communities. Yet aspects of the way TNCs operate have come under scrutiny as pricing algorithms and the choices of human drivers resulted in a number of inequities and biases in cost and service levels across various socio-demographic groups (e.g., minorities, women, people with disabilities). TNC use among all socio-demographic populations could also contribute to increased vehicle miles traveled (VMT), congestion, and/or greenhouse gas (GHG) emissions. Well-designed policy strategies are needed to balance the objectives of increasing mobility and accessibility for underserved communities while simultaneously mitigating the potential adverse impacts of increased TNC usage through policies, such as pooling and first-mile and last-mile connections.

The objectives of this research are to: 1) understand the factors impacting the willingness and propensity to use pooled TNCs among low-income, people of color; 2) identify strategies/policies that could be employed to reduce congestion from TNC users, such as practices that could be employed to encourage pooling and first-/last- mile connections to public transit; and 3) assess innovative and more context sensitive research methods for understanding the transportation needs of underserved populations.

Common Terms and Definitions

Transportation network companies (TNCs) allow travelers to order and pay for rides on-demand using an online-enabled application that connects them with drivers using their personal vehicles.

Pooling refers to users with different origins and destinations along a common route being picked up and dropped off by the same vehicle.

Ride-hailing entails hiring a personal driver to take a passenger to their destination.

Micromobility refers to low-speed, light-weight transportation vehicles such as bicycles or scooters.

This research also builds on our Year 1 NICR project: *Congestion Using New Mobility Platforms: Understanding Curb Management and Targeted Incentive Policies to Increase Pooling* and takes it a step further by uncovering the travel needs of underserved communities (that rely heavily on TNCs) and advancing transportation equity while providing strategies to addressing congestion (Shaheen et al., 2021). Researchers conducted narrative research, which allows researchers to probe in-depth responses that are not possible through traditional survey techniques. This method helps collect in-depth data on individual's views, values, and perspectives, as well as their priorities for change around a topic area. The intent of the group discussions was not to rank priorities per se but to seek a deeper understanding of issues as participants understand them and build critical group understanding.

This report includes six sections:

1. **Methodological Approaches**: A description of each of the research methods employed by researchers (literature review, expert interviews, semi-structured interviews, and small group discussions)
2. **Literature Review**: An overview of background information, research, and literature on relevant topic areas including TNCs, pooled rides, transportation equity, and narrative research approaches
3. **Expert Interviews**: A summary of interviews conducted with two experts

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4. **Results**: The key findings from the semi-structured interviews and small group discussions with TNC users
5. **Key Takeaways and Policy Options**: A discussion of possible policy approaches to encourage pooled TNC trips and TNC connections to and from public transit
6. **Conclusions**: A summary of key takeaways from the study

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Methodology

The research team employed a mixed-methods approach including: 1) literature review, 2) expert interviews, 3) semi-structured interviews with TNC users, and 4) small group discussions with TNC users.

Literature Review

Researchers reviewed journal articles and reports on a variety of topics including: TNCs, ride-hailing, shared ride services, pooled ride-hailing, transportation equity, and TNC equity. As in year one of this study (Shaheen et al., 2021), the review was narrowed to specifically target those articles that focused on issues of equity within TNC and pooling. The literature review also considered literature related to the methodology. Topics researched include narrative research, discourse analysis, content analysis, ATLAS.ti, and the application of these methods to transportation research or practice. Effort was made to include as much of the relevant literature as possible; however, some research may have been inadvertently missed due to the increased interest in TNCs and shared mobility among researchers.

Expert Interviews

To supplement the literature review, we conducted two expert interviews from January 2022 to March 2022. These interviews sought to fill gaps within the literature, particularly to better understand TNCs and social equity. Researchers conducted interviews with ride-hailing experts. Each interview lasted for approximately 50 minutes and was conducted following a pre-arranged set of questions, which we adjusted for the specific expertise of the interviewee. The expert interview protocols are provided in Appendix A.

Two ride-hailing experts from the public, private, and non-profit sectors were interviewed for insights on current TNC practices. The research team conducted the interviews virtually between January 2022 and March 2022. We followed the expert interview protocol for each interview; specific details in the questions were modified to reflect each expert's organization and interactions with ride-hailing services. The subject areas covered include: 1) current state of the industry, 2) social equity, 3) opportunities, 4) challenges, and 5) best practices. These interviews provided important background for developing the semi-structured interview and small group discussion protocols.

Semi-Structured Interviews with TNC Users

The goal of the semi-structured interviews was to better understand the role of TNCs in meeting traditionally underserved populations transportation needs. Participants were recruited via Craigslist Advertisements targeting the San Francisco Bay Area between March 2022 and June 2022. The ad included a brief description of the purpose of the project, what to expect if chosen to participate, compensation offered, researcher contact information, and a link to a Qualtrics screening survey. The screener (or eligibility) survey allowed interested persons to provide some information about themselves, allowing researchers to determine their eligibility and provide contact information to researchers. In the screener survey, the research team specifically asked about frequency of TNC use and pooling; access to Zoom teleconferencing and a webcam; and demographic information including household income, race and ethnicity, and zip code. Eligible participants were identified as non-White individuals using TNCs at least once per week with a household income of less than $70,000 annually and access to a web camera. The screening survey can be found in Appendix B.
We identified and contacted each person who met these criteria to identify their interest in continuing with the study. Nineteen individuals agreed to participate and were sent surveys asking them additional questions on

their demographics and travel behavior. The demographic survey is provided in Appendix C. Following the completion of the demographic survey, participants scheduled a one-hour video call for the interview at a time and date convenient for them. Upon completion of the interview and survey, participants received a $75 Visa gift card. Interviews were conducted virtually between March 2022 and May 2022. We scheduled interviews on a rolling basis. Nineteen participants completed the study, although 30 were recruited. The research team conducted the interviews virtually due to concerns over COVID-19.

The interviews followed a semi-structured format, with researchers following a question protocol yet having flexibility to explore in greater depth ideas shared by participants. Interviewers asked questions about: 1) general transportation needs, 2) use of and perceptions around TNCs, and 3) their attitudes toward pooling. Each interview lasted between 40 minutes to one hour in length. We recorded, transcribed, and coded each interview based on the generic coding method presented in Saldana (2013). The interview guide can be found in Appendix D.

Small Group Discussions with TNC Users

The small group discussions followed a similar procedure as the semi-structured interviews. Participants were recruited via Craigslist Advertisements targeting the San Francisco Bay Area in May 2022. The ad included a brief description of the project purpose, what to expect if chosen to participate, compensation offered, researcher contact information, and a link to the Qualtrics screening survey. The screener survey allowed interested persons to provide some information about themselves, allowing researchers to determine their eligibility and their contact information. The screener survey specifically asked about frequency of TNC use and pooling, access to Zoom teleconferencing and a webcam, and demographic information including household income, race and ethnicity, and zip code. Eligible participants were identified as non-White individuals using TNCs at least once per week with a household income of less than $70,000 annually and access to a web camera. The screening survey can be found in Appendix B.

We contacted all eligible participants based upon their availability for the small group discussion within a two-week period. Based on responses, the study team scheduled the small group discussions for the days and times that maximized the number of participants available to participate. Participants confirmed their availability and willingness to participate in the small group discussion and were sent the same demographic survey as the semi-structured interview participants as shown in Appendix C.

The research team conducted two small group discussions in early-June 2022. There were a total of six and two participants per each small group discussion, respectively, each lasting 2.5 hours. This was a smaller turnout than the nine and seven confirmed participants. We asked the small group discussion participants the same questions as the interview subjects. The small group discussion participants were encouraged to engage with one another throughout the session. We recorded, transcribed, and coded each small group discussion based on the generic coding method presented in Saldana (2013). Upon completion of the interview and survey, participants were given a $75 Visa gift card. The small group discussion guide is provided in Appendix D.

Study Limitations

The sample size of this study was small and makes drawing generalizable conclusions challenging. To offer more conclusive insights, future studies should engage more participants, recognizing the time investment necessary of these narrative methods. The small sample size is the result of numerous challenges including the COVID pandemic, disingenuous participant eligibility information and interest submitted through the online

recruitment ad, eligible participants opting to stop participating after being selected, and significant time commitment on behalf of the researchers required to coordinate and engage with each participant, as well as transcribe, code, and analyze these engagements. These are unavoidable challenges that led to many lessons learned, such as more in person recruitment and methods for more time efficient methods of processing narrative data, which will help to accommodate larger sample sizes for future work. The size of the small group discussions was smaller than anticipated due to scheduling complications and participants opting to not participate after the timing of the groups had been confirmed. Future research should attempt to engage a larger sample and accommodate more discourse and insights. Future studies should also seek to recruit and engage with participants within the community to increase the amount and diversity of people eligible to participate.

There was an under sampling of Hispanic/Latino participants that should be addressed in future studies. All of study engagements were conducted remotely, limiting participants to people with access to a smart phone or computer, an internet connection, and a general fluency of technology. Flow of engagement, particularly within the small group discussions, may have been stifled by the remote interface.

One objective of this study was to explore the factors influencing the propensity to use pooled TNCs; however, at the time of this study, UberX Share and Lyft Line, the two most popular shared TNC services, were just beginning to become available again in the Bay Area. Accordingly, many participants either specifically reported they were or were assumed to be describing their pre-pandemic experiences using these services. This limits our understanding of how COVID has impacted the use of shared rides. Now that shared services are much more widely available, future studies should address this by more clearly differentiating between participant's current experiences and past experiences with shared rides.

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Literature Review

The social equity implications of TNCs are a growing research topic among many academics. This literature review covers equity focused studies on ride-hailing, followed by an overview of narrative methods.

TNCs/Ride-hailing

Traditional taxis predominantly operate in high-demand areas to maximize profit. As a result, lower demand areas, which often already have fewer transportation choices, do not have sufficient taxi service (Pan, 2019). One study attempted to quantify the spatial equity of taxi services and found that traditional taxis in New York City were more inequitable than TNCs. However, it also found that following the advent of TNCs, spatial equity of taxis improved (Pan, 2019).

Numerous studies have characterized overall TNC usage trends across demographic groups. For example, one study found generally that TNC users tend to be younger, earn higher incomes, have higher levels of education, and are more likely to reside in urban areas in contrast to the general U.S. population (Grahn, 2020). The studies have had similar findings, describing TNCs as a “wealthy, younger generation phenomenon'' (Young, 2019). However, a recent study of TNC users in four California cities (Los Angeles, Sacramento, San Diego, and the San Francisco Bay Area) using a stated preference methodology found that heavy TNC use varies notably across race and ethnicity, reflecting differences in socio-economic disparities in each region studied (Shaheen et al., 2021). Caucasians/Non-Hispanics were found to be significantly less likely to be heavy TNC users than all other racial/ethnic groups in both the San Diego and Sacramento regions, while Asians were the least likely to be heavy TNC users in the Los Angeles region. In the San Francisco Bay Area, African Americans were significantly more likely to be heavy TNC users compared to Asians and Caucasians/Non-Hispanics. This is probably due to a particularly high rate of heavy TNC use (44%) among African Americans earning less than $35,000 a year in the San Francisco Bay Area (Shaheen et al., 2021).Lazarus et al., building off of Shaheen et al., 2021, found that TNC users using TNCs once per week or more are more likely to use pooled rides in addition to using a wider variety of transportation modes than less frequent TNC users (Lazarus et al., 2021).

Studies also have found that some demographic groups do not receive the same service as others. African American travelers in Seattle experienced statistically significant longer delays waiting for a trip request to be accepted through Lyft and Uber. The study also found in Boston that travelers with African American sounding names were more than twice as likely to have their rides canceled compared to people with Caucasian sounding names. The study concluded that African American male travelers were more than four times as likely to have their rides canceled by drivers than White male travelers (Ge et al., 2016). An analysis of data from Washington D.C. similarly revealed differing service qualities between Black/African American and White people. Specifically, the study found that census tracts with higher percentages of people of color wait significantly longer for a ride (Stark et al., 2016). While no cause can be easily attributed, these studies theorize that the difference may be attributable to some drivers discriminating on the basis of the perceived traveler race. A more recent study (Brown et al., 2018) found that ride-hailing essentially eliminated these differences of ride-hailing service between Black and White riders, yet Black riders were still more likely than White riders to have a taxi trip cancelled and were more likely to wait longer.

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Racial bias within TNCs extends well beyond wait times and cancellations into service pricing. A study by George Washington University found that fares tended to be higher for drop-offs in Chicago neighborhoods with higher percentages of non-White populations. (Pandey et al., 2021). These studies suggest that the driver/supply-side of TNCs has the potential to perpetuate and create new biases and inequities in how services are delivered.

Methodology

In our year one NICR study, *Understanding Curb Management and Targeted Incentive Policies to Increase Transportation Network Company Pooling and Public Transit Linkages*, we employed a novel methodology: photovoice. Typically, photovoice studies allow participants to document the strengths and needs of their community through photography and video and then discuss what they have captured in a group setting. From these discussions researchers can identify and codify themes about community needs. The images, videos, and research findings can then be shared with community leaders, inspiring policy change and a stronger connection between leaders and residents (Wang et al., 1997). The use of this methodology for year one of this study led to the development of several strategies for improving curb management and creating targeted incentive policies to increase pooling (Shaheen et al., 2021).

Qualitative research has been commonplace in social science research for decades, and it encompasses numerous techniques. One such technique is narrative or discourse research, which allows researchers to probe in-depth responses that are not possible through traditional survey techniques. This study focuses on applying this method. This method helps collect in-depth data on an individual's views, values, and perspectives, as well as their priorities for change around a topic area. Narrative research explores and develops knowledge about human experiences that often fall outside what is conventionally possible to validate (Polkinghorne, 2007). Accordingly, the use of narrative research and other innovative context sensitive research methods is gaining popularity to better understand the transportation needs of underserved populations. These methods can reveal and give meaning to perspectives and experiences traditional methodologies are not designed to capture.

A narrative is a story or a first-person telling or retelling of events (Ollerenshaw et al., 2002). Narrative research involves the collecting and analyzing of these stories, which in our study was accomplished through interviews and small group discussions. Narrative inquiry was first developed as a method to describe the personal stories of teachers (Connelly et al., 1990). Throughout the narrative research process, it is critical that there exists continuous collaboration between researcher and participant. This collaboration ensures congruence between the narrative told and the narrative reported (Ollerenshaw et al., 2002).

After collecting and transcribing the narratives, researchers can begin to process them. Guided by research questions and the engagements themselves, researchers can iteratively and systematically analyze this unstructured data to find patterns and develop key findings. This can be done deductively, a top-down approach where researchers begin with a set of codes and find excerpts to fit those codes, or inductively, a bottom-up approach where researchers develop codes as they process the dataset (Delve). Our study used a combination of inductive and deductive coding, beginning with a list of codes to identify excerpts related to our research questions and adding to or editing this list as we process the data and identify additional themes that do not match the preconceived list of codes. After processing and coding each transcript one time, researchers

revisited the list of codes assigned to excerpts, which in our case were our initial set of codes as well as the ones we added along the way. Researchers can examine these codes, merge codes as necessary to eliminate redundancies, edit them, and group them into categories. This process creates a new, refined list of codes that can then be used to code the transcripts during a second reading. This process can be repeated multiple times to allow researchers to systematically identify key themes, ideas, and patterns throughout the dataset (Delve). ATLAS.ti facilitates this process by managing the documents, the codes, and the excerpts and all their interconnections. The development of software, such as ATLAS.ti, has enabled the expansion of narrative methodologies into other fields. ATLAS.ti is a set of powerful tools to analyze qualitative data, such as text and audio (ATLAS.ti). In one study on the role of narratives in socially sustainable development, the authors note the importance of capturing lived experiences in community engagement in urban planning, especially the experiences of a place. Citing Kallus, 2001, they write that "community narratives shift the interests of design and planning processes toward pluralistic and subjective perceptions of space and its use, emphasizing the fundamental relationships between space and socio-cultural processes." This paper provides a compelling argument for transportation researchers to more fully embrace the theories of the humanities and arts, namely narrative theory (Foth et al., 2008).

A 2006 study investigating the relationship between neighborhood design and active aging included interviews with small group discussion participants about their experiences with and hopes for aging in their neighborhood. These interviews were transcribed, and ATLAS.ti was used to organize the data, facilitate the coding, and to identify themes, as was implemented in our study. The results suggested that neighborhood design promoted activity among older adults, not unlike the results of quantitative studies (Michael et al., 2006). While this study and its results may not be generalizable, it demonstrates how qualitative methods can be used to study transportation and supplement quantitative studies. A critical component of these methods is the ability of participants to review and respond to the research summary, allowing them to verify the accuracy of the comments that had been recorded. A key limitation of this methodology is the distrust among potential participants in the lowest socio-economic neighborhood.

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Results

Semi-Structured Interviews and Small Group Discussion Findings

We conducted semi-structured interviews and small group discussions to better understand the role of TNCs in meeting the transportation needs of lower-income people of color who use TNCs at least once per week. Participants were asked a series of questions related to their general transportation needs, their experiences using TNCs privately, and their experiences or attitudes toward TNC pooling. While each interview and the small group discussion were conducted employing the same protocol, researchers had flexibility to explore certain topics and unique ideas brought into the interview by each participant. Small group discussions had the added element of participants engaging in discourse with each other while researchers facilitated. Semi-structured interviews and small group discussions followed similar protocols and yielded similar findings; thus, these findings are reported together. Key findings derived specifically from one engagement activity are noted.

Demographics

Respondents to the screener survey were selected to be eligible to participate if they met the following criteria:

- Were age 18 years or older
- Lived in the San Francisco Bay Area
- Used TNCs one or more times per week
- Were non-White
- An annual household income of less than $70,000
- Had access to the internet, a web camera, and able to use the Zoom teleconferencing application

Lower income and non-White TNC users were specifically chosen to explore their specific experiences and fill gaps in the literature, which has largely focused on higher income, White TNC users. In addition, it was our intention to include participants that rely on TNCs three or more times per week, which was the definition of "heavy TNC users" from Lazarus et al. 2021. This criterion was relaxed to once or more per week to increase the amount of eligible participants. While our participants do not represent the heaviest, most frequent TNC users, they still represent a sample who relied on TNCs more regularly than the majority of interested participants. Participants provided their demographic and travel behavior information in the screener survey, the demographic and travel behavior survey, and in their interview. For some participants, there were some discrepancies between the information reported on each of these data collection tools. Discrepancies in travel behavior are likely due to difficulty in estimating transportation used as it often changes day to day. Discrepancies in racial data are likely due to data entry errors. As a result, some participants appear to fall outside of the desired demographic, but overall these conditions were met in the study. Data reported in this section is what was reported in the demographic and travel behavior survey found in Appendix C.

Participant Demographics

We collected participant demographic information including gender, age, race/ethnicity, educational attainment, and household income prior to interviews and small group discussions. The survey is provided in Appendix C. The demographic information was then compared to the 2019 American Community Survey (ACS) for the study region, the San Francisco Bay Area (United States Census Bureau, 2019). Key participant demographic findings include:

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- Age: Participants ages ranged from 22 years to 65 years old with the majority of participants between 20 to 45 years old. These demographics reflect an over representation of young adults as compared to the San Francisco Bay Area region as a whole.
- Race/Ethnicity: The participant's race and ethnicity statistics reflect the goal to oversample non-White participants. Black/African American participants were oversampled, and Hispanic/Latino participants were underrepresented. Our sample had approximately the same proportion of Asian/Pacific Islander participants as the region.
- Educational attainment: Interview participants had slightly higher levels of educational attainment than the San Francisco Bay Area demographics. Approximately 86% of participants had some college education or more as compared to 74% of San Francisco Bay Area residents.
- Income: Research participants were specifically sampled to reflect a lower household income than average Bay Area residents, with the majority of participants with incomes between $50,000 to $75,000.

The data from the participant survey and ACS are located in **Table 1**. Note that percentages may not add up to 100% as some participants elected to not report all demographic information.

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Table 1: Participant Demographics

	Characteristic	Interview Participants (n = 19)	Small group discussion Participants (n = 8)	Total Participants (n = 27)	San Francisco Bay Area (n = 4.73 million)
Gender	Male	47%	50%	48%	49%
	Female	47%	38%	44%	51%
	Other	5%	0%	4%	N/A
Age	Under age 20 years	0%	0%	0%	22%
	Age 20 to 24 years	32%	0%	22%	6%
	Age 25 to 34 years	21%	75%	37%	16%
	Age 35 to 44 years	21%	0%	15%	15%
	Age 45 to 54 years	16%	0%	11%	13%
	Age 55 to 59 years	0%	0%	0%	7%
	Age 60 to 64 years	5%	0%	4%	6%
	Age 65 years and over	0%	13%	4%	16%
Race/Ethnicity	Asian/Pacific Islander	26%	25%	26%	27%
	Black/African American	47%	50%	48%	7%
	Caucasian	5%	0%	4%	39%
	Hispanic/Latino	11%	13%	11%	22%
	Two or more races	0%	0%	0%	4%
	Other	5%	13%	7%	1%
Educational Attainment	Less than high school	5%	0%	4%	6%
	Some high school	0%	0%	0%	5%
	Graduated high school or equivalent (GED)	5%	0%	4%	16%
	Some college, no degree	26%	0%	19%	16%
	Associate's degree	5%	0%	4%	7%
	Bachelor's Degree	47%	75%	56%	30%
	Graduate or professional degree	5%	13%	7%	21%
Household Income	Less than $10,000	11%	0%	7%	4%
	$10,000 to $14,999	5%	0%	4%	3%
	$15,000 to $24,999	11%	0%	7%	5%
	$25,000 to $34,999	5%	0%	4%	5%
	$35,000 to $49,999	16%	13%	15%	7%
	$50,000 to $74,999	37%	75%	48%	11%
	$75,000 to $99,999	5%	13%	7%	10%
	$100,000 to $149,999	0%	0%	0%	18%
	$150,000 to $199,999	0%	0%	0%	12%
	$200,000 or more	0%	0%	0%	26%

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Household Vehicle Ownership

We also asked participants about the number of vehicles per household. The majority of participants had at least one car. Very few reported having no car, and even fewer reported owning or leasing three automobiles. It is important to note that while the majority of participants reported having autos, some noted throughout the interview that they themselves did not use the car very frequently or even at all. **Table 2** summarizes household vehicle ownership rates.

Table 2: Vehicles per Household

Number of Vehicles per Household	Interview Participants (n = 19)	Small Group Discussion Participants (n = 8)	Total Participants (n = 27)
Zero	11%	25%	15%
One	63%	63%	63%
Two	21%	0%	15%
Three	5%	13%	7%
Average	1.21	1.00	1.15

TNC Use Frequency

TNC use ranged across participants with all reporting using TNCs at least once per month. This reported frequency from the travel behavior survey, displayed in **Table 3**, differed from the reported frequency in the eligibility survey, where every participant reported using ride-hailing at least once per week. Participants explained these discrepancies by noting how month to month their TNC use can vary making it difficult to consistently and accurately report their usage frequency. Nevertheless, most participants reported using TNCs at least one to three days per week, matching the frequency of use that was desired for study participation. Table 3 presents the frequency of private TNC use, of the interview and small group discussion participants.

Table 3: TNC Use Frequency

Frequency of TNC Use (Private)	Interview Participants (n = 19)	Small Group Discussion Participants (n = 8)	Total Participants (n = 27)
Never in the last year	5%	0%	4%
Once a year	0%	0%	0%
Once every 6 months	0%	0%	0%
Once every 3 months	0%	0%	0%
Once a month	21%	0%	15%
Every other week	11%	13%	11%
1 to 3 days per week	47%	50%	48%
4 to 6 days per week	11%	0%	7%
Once a day	0%	0%	0%
2 to 4 times a day	0%	38%	11%
More than 4 times a day	5%	0%	4%

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TNC Pooling Use Frequency

The research team is particularly interested in the frequency that participants used the pooling option of TNCs given the potential implications pooling has for congestion management. Most noted during the interviews that COVID has altered their use of pooled services due to these rides not being offered and/or concerns about their health and safety. As a result, some participants reported on and discussed their use of pooled TNCs from prior to the pandemic. The frequency of use of pooled TNCs varied much more than the use of private TNCs, with over one third of participants reporting never having used pooling in the past year. Overall, participants reported using pooled rides less frequently than private rides. **Table 4** shows these results in more detail.

Table 4: Pooled Ride Frequency

Frequency of TNC Use (Pooled)	Interview Participants (n = 19)	Small Group Discussion Participants (n = 8)	Total Participants (n = 27)
Never in the last year	37%	25%	33%
Once a year	0%	0%	0%
Once every 6 months	5%	0%	4%
Once every 3 months	5%	13%	7%
Once a month	16%	13%	15%
Every other week	11%	0%	7%
1 to 3 days per week	21%	25%	22%
4 to 6 days per week	5%	13%	7%
Once a day	0%	0%	0%
2 to 4 times a day	0%	0%	0%
More than 4 times a day	0%	0%	0%

Demographics: Key Findings

Overall, the 27 participants were evenly distributed by gender yet represented an oversampling of, Black/African American people an under sampling of Hispanic/Latino participants, and an oversampling of people 34 years old or younger. Participants had slightly higher educational attainment yet represented a lower-income cohort than the San Francisco Bay Area as a whole, with about half of participants reporting earning between $50,000 and $74,999. The majority of participants had at least one car in their household. Most used TNCs one to three times per week, with some reporting different frequencies of use across each data collection tool. Finally, most participants employed the pooled option for TNCs less frequently than the private option, which is in part due to COVID-19 impacts. Thus, future research is needed to revisit pooling potential and impacts following additional COVID recovery.

Interview and Small Group Discussion Results

The interviews and small group discussions provided the research team with a deeper understanding of the role TNCs play in meeting the transportation needs of these Bay Area residents. These interviews and small group discussions further revealed the specific considerations that go into transportation decision-making. Cost and time were the most prevalent considerations among participants, with each participant mentioning these factors at least once throughout researcher engagement. Safety concerns were another pronounced consideration among participants, particularly among women; the lesbian, gay, bisexual, transgender, queer plus (LGBTQ+) community; Black/African American people, and Asian/Pacific Islander participants

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Key insights from the interviews and small group discussions are summarized in the following areas: 1) TNCs and use of other modes, 2) private and pooled TNC trips, and 3) unique considerations for demographic and travel behavior groups.

TNCs and the Use of Other Modes

Almost all participants (n = 25 of 27) reported using other transportation modes in addition to TNCs. The modes most frequently reported as being used by participants in addition to TNCs include:

1. Driving a personal vehicle (n = 18 of 27)
2. Bus such AC Transit (n = 16 of 27)
3. Rapid transit such as BART (n = 16 of 27)
4. Bicycle (n = 8 of 27)
5. Taxis (n = 5 of 27).

All participants (n = 27 of 27) reported predominantly choosing which modes they will use based upon at least one of the following factors or combination of them: cost (n = 25 of 27), time efficiency (n = 24 of 27), and safety (n = 20 of 27). The time efficiency consideration includes elements such as: anticipated travel time, estimated waiting time, the ability to use the travel time effectively (e.g., work, exercise), and the relative reliability. Safety encompasses concerns related to personal safety from harassment or crime, as well concerns related to possible bodily harm from the vehicle or mode itself (e.g., traffic collisions). **Table 5** provides some quotes from participants highlighting the benefits and drawbacks of each mode with regards to time efficiency, cost, and safety.

Interview participant on factors influencing mode choice:
"[Ride-hailing] is quite expensive but depending on the purpose of the trip sometimes you find it…helps. You are sometimes more than just worrying about the pricing…. Timing is more important because let's say you are running late, and you have [an important event]. And then you maybe consider a bus [or Uber]…. You don't have to worry about the pricing because there is a greater price in front of you. Just ignore the pricing and take that Uber or Lyft trip so that you can go and win that contract…. You find out that it's not expensive. It was worth it."

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Table 5: Participant Insights into Benefits and Drawbacks of Each Mode

		Time Efficiency	Cost	Safety
TNCs (n = 27 of 27)	+	"Most of the time I get to where I'm going on time…for me, [I like]… the speed." **Small group discussion participant**	"I find that [the price] is very acceptable. I mean, it's not expensive at all." **Interview participant**	"I would say it's been maybe twice, I felt unsafe…. For the most part, absolutely, yes [I usually feel safe]…." **Interview participant**
	-	"[Sometimes] it takes a while…if there aren't a lot of drivers available, you have to wait…" **Interview participant**	"It's obviously a luxury….but it's just expensive." **Small group discussion participant**	"When taking [TNCs], be careful because you never know…whose car you're going into." **Interview participant**
Personal Vehicle (n = 18 of 27)	+	"…to get places, you kind of have to use [a car]. I like the ease and convenience of a car…" **Interview participant**		
	-		"You have to pay insurance… expensive parking…gas…the technician if there is some fault in that car… that's so expensive." **Interview participant**	"I'm so stressed out that I'm going to get into an accident because I'm not used to driving in the Bay Area." **Interview participant**
Public Transit (n = 20 of 27)	+	"I take AC transit across the bridge [to work]. If I miss the bus, then I end up taking [a TNC]…. But there's that traffic that I hit on the bridge." **Interview participant**	"I still have to take the bus occasionally...because it costs less; [otherwise]…I would not want to be on the bus." **Small group discussion participant**	
	-	"[There was a joke,] if you don't want to get where you're going, take the bus. You'll grow old." **Small group discussion participant**	"I don't think people who live farther from the heart of the city should have to pay more…." **Small group discussion participant**	"[The BART station is underground]. It feels isolated...if something happened out there. I can't escape." **Interview participant**
Bicycle (n = 8 of 27)	+	"I really like doing it, and I get really good exercise." **Interview participant**	"I wish I could take [my bicycle, which is] very inexpensive." **Interview participant**	"I pretty much always feel safe on my bike….I'm in control of it." **Interview participant**
	-	"[Biking] obviously takes…longer." **Interview participant**		"It is too car focused….It's just not safe for people on bikes." **Interview participant**
Taxi (n = 5 of 27)	+			
	-	"Taxis were very difficult because it took so long for them to pick you up." **Interview participant**	"I realized this guy has a meter in his car, so I overpaid. We're haggling over price, and all the cars have meters on them." **Small group discussion participant**	

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Small group discussion participant on factors influencing mode choice:
"Am I taking my kids out? How far am I going? At the beginning of the month, then I still have some cash.... The weather conditions.... I have this like whole thing going on in my head to make this decision about what transport system to use.... I feel it comes with the circumstances around you at the moment."

Interview participant on circumstance
"I don't use Lyft every day, just when either I missed the bus or the bus doesn't show up or the bus is late. That's the only time I would use Lyft and Uber, so I won't do it every day."

The majority of participants (n = 21 of 27) also pointed out that unique day-to-day circumstances often change how they value each of these factors and how they select which mode to use. The most commonly cited circumstance under which TNCs are chosen was when they are running late or the other mode they were planning on using is late or not accessible temporarily (n = 16). Other day-to day circumstances include the weather, changes in their personal schedule, trip purpose, who they're traveling with, where they are going, or how far they are going.

Every participant (n = 27 of 27) related the benefits and drawbacks of other modes – autos, public transit, bicycles, and taxis – to those of TNCs and how that influences when they choose to use TNCs. The next subsections focus on the core benefits and drawbacks identified by participants for 1) TNCs, 2) driving a personal vehicle, 3) public transit, 4) bicycles, and 5) taxis. Discussions of the alternative modes to TNCs used will specifically highlight how those modes compare to TNCs as reported by participants. Note that bus and rapid transit are reported together as "public transit" because the majority of participants discussed these modes generally as "public transportation."

TNCs

In general, convenience was the number one benefit that participants identified with TNCs (n = 24 of 27). Some of the elements of the service that participants noted contributed to the superior convenience of TNCs included the on demand nature, the ability to be picked up and dropped off exactly where you want, the ease of ordering a ride, and the ease of paying for a ride.

Interview participant on TNC convenience
"I just like the ability to be in your location, and you can just call someone to come pick you up after a certain time period…the convenience and the ability to drop you off at where you want to be.... It really minimizes the hassle for me. It's easy.... You don't have to think as much."

Concerns about cost were the primary drawback participants identified with using TNCs regularly 20 participants, across all income groups, discussed that TNCs are expensive. But, that was not always as important as other factors, predominantly being on time, the efficiency, or the convenience. These 20 participants conceded that paying that price was at times worth it, contributing to their frequent use of TNCs despite this concern of cost.

Small group discussion group participant on weighing TNC cost and efficiency
"Sometimes… I don't want to deal with the hassle, I just want to get there now.... I'll just pay [for a TNC]."

Interview participant on TNC efficiency
"…The rideshare is costing me, but it's efficient."

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Of particular concern among six participants is surge pricing, particularly during the morning or evening commute hours or when there were special events in San Francisco. One participant, with flexibility on when and where they work, reported changing or cancelling plans if costs were too high as compared to the usual cost of a ride. Three participants highlighted that while TNCs are expensive, they do not necessarily want them to be less expensive because they value the drivers and want to make sure they are also being taken care of for the services they are providing.

Interview participant on the cost of TNCs
"I'm getting to the point that I understand [the cost], because that's how they make a living and we're in a pandemic right now, so times are a little tougher than before. With the gas prices I'm a little more receptive of [the cost] now than maybe about two months ago."

The majority of participants (n = 24 of 27) reported some level of concern for their safety, whether from dangerous drivers (n = 20 of 27), interpersonal conflict (n = 19 of 27), or COVID-19 transmission (n = 8 of 27) both while in a TNC and while waiting for a TNC. Dangerous driving was most frequently cited and specific concerns included speeding, driving too slowly, looking at their phone, or making last minute adjustments to correctly follow the directions. While these instances were scary, all of these participants (n = 20 of 27) stated they were rare and did not necessarily change their travel behavior. The magnitude of fear of interpersonal conflict was noticeably higher among women (n = 12 of 27) and LGBTQ+ (n = 2 of 27) participants and fears skewed heavily toward interpersonal violence or harassment. Unsafe instances happened to the majority of participants (n = 24 of 27) but were still perceived to be relatively rare and not a deterrent to using TNCs.

Interview participants on TNC driver safety
"It was raining and… she was just driving like a bat out of hell. She had a stick shift and… was speeding and slamming on the brakes. At the end of the hill I thought we were going to for sure die. I thought she had a death wish and she was going to take me down with her."

"I get in the car… I felt like it was a dangerous situation. You could get this sixth sense… You see energy drinks… you're hearing that he works another job and he's a full time student… It's maybe 2 o'clock in the morning and the car is speeding or the car is a little wavy."

Small group discussion participant on personal safety in TNCs
"I saw the driver's details and the car plate number… I got to the car and the plate number was right, the car was spot on, but then the driver was a different person… I saw him and I'm like, 'no, no, this is not the same person…' and I didn't go on board."

All participants were asked about the characteristics of places they like waiting for a ride. One third (n = 9 of 27) provided specific qualities they look for. All nine participants stated the importance of good visibility, open space, and sidewalks to pull over to make it easier for the driver to see them and pick them up. Additional qualities mentioned include good lighting, residential, or mixed land use, and the presence of other people at all times of day. This preference for having people around was also identified in Year 1 of this study, particularly for women.

Interview participant on meeting the driver
"I choose a place where it's very easy for you to come to the right spot."

Eighteen participants considered broader factors in reflecting on their experiences with and perceptions around TNCs such as their impact on their community, the environment, and the ethics of the ride-hailing company. This included expressing concern about the accessibility of these services for low-income people, the impact of transportation on climate change, unfamiliarity with data

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privacy practices, and treatment of drivers, as shown in **Table 6**. These 18 participants concluded that, at least for now, TNCs were nevertheless a "necessary evil." Specifically, they noted that TNCs meet a previously unmet need with their ease of use, on-demand service and operate better and more reliably than public transportation. They hope that improvements to other modes, such as public transit and enhanced bicycle infrastructure, will reduce their, and others, need to use TNCs, which will be better for their community. Until then, they will continue to use TNCs because there are no other modes that can provide this type and quality of service.

Table 6: Broader Factors Shaping Participant Perceptions of TNCs

Context	Quote
Small group discussion participant on the accessibility of TNCs for low-income people	"I've seen that most of the people there cannot afford to use a rideshare. So it's been a problem for the people in the community [because it is] something they cannot afford."
Small group discussion participant on the environment	"It's not really great for the environment. But I mean obviously, if I use it discerningly it's a treat."
Interview participant on their unfamiliarity with TNC data privacy practices	"With Uber or Lyft one of my biggest concerns would be the third-party information. Who are you guys? I think it says they don't share or maybe they share third-party information…. I just want to make sure my information is not getting into the wrong hands…. Where I'm going, when… Is it being tracked? … Privacy is key. I'm tired of a lot of these companies sharing information; you don't know who the heck these people are and what information they're sharing, you know?"
Small group discussion participant on the treatment of TNC drivers	"From what I last recall, they don't really treat their employees well when it comes to benefits and recognizing them…. [With] the whole gig economy, when I'm using a service it feels political…. I try to use them as little as possible…. [I think they could] certainly treat their employees better."

Every participant (n = 27 of 27) related these characteristics of TNCs to the characteristics at least one other mode including autos, public transit, bicycles and other micromobility, and taxis. Across the board, participants reported that TNCs uniquely allow passengers a safe, direct, door-to-door ride that is usually reasonably priced and reliably on time.

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Driving a Personal Vehicle

A common theme throughout the interviews and small group discussions was the notion of having the convenience of a car without the need to drive, maintain and pay for their own vehicle, nor fill up their gas tank. Participants, regardless of access to a personal vehicle, reported this convenience as their motivation for using TNCs as opposed to driving. In total, 17 participants reported that TNCs were better than driving their own car, 14 specifically citing avoiding the task of driving as a key benefit. When asked if TNCs were less expensive than driving their own car, 13 of 27 participants mentioned they believed it was, and therefore opted to avoid driving their car as much as possible. One participant shared that they were considering selling their car entirely. At the time these interviews and small group discussions were conducted (March 2022 through June 2022) gas prices were notably higher than typical, with one participant reporting seeing prices above seven dollars per gallon. Another consideration that discouraged five participants from driving was the challenge, expense, and at times, risk of parking their car. Specifically, these participants thought that parking, particularly in San Francisco or Oakland was difficult, it wasted time, was costly, and came with the risk of having their car broken into. In sum, participants, whether they have a car or not, tended to prefer TNCs to driving a personal vehicle on the basis of lower cost and exceptional convenience.

Interview participants on avoiding the driving task

"I am in the in the process of trying to decide whether to sell my car…just being where I am, it doesn't make much sense to keep a car around because I do use Uber and Lyft a lot."

"I don't want to put the responsibility of driving on myself and having to deal with traffic and all the craziness on the road."

"I like having the convenience of driving without actually driving."

"I just don't want to have my own [car]…. I'd rather just have someone else's."

Interview participant on not using their car to drive to work

"Right now the gas is super expensive. And in San Francisco the parking is a really huge hassle, and I don't want to have the risk of someone breaking into my car…the cons outweigh the pros."

Public Transit

Almost all participants (n = 26 of 27) stated public transit was undesirable on the basis of at least one factor. The reported shortcomings of transit were contrasted with how TNCs mitigate these concerns. 12 participants specifically stated that TNCs were better than taking public transit. Specific reasons given for why participants are less favorable toward public transit, in order of frequency stated, include: feeling like personal safety is at risk (n = 16 of 27); origins and destinations are inaccessible to transit stops or stations (n = 10 of 27); finding that public transit stops too much and takes too much time (n = 10 of 27); unable to trust the reliability of transit (n = 9 of 27); needing to transfer vehicles too much (n = 9 of 27); feeling as though transit is overly crowded (n = 8 of 27); finding public transit vehicles, stations, and stops are too noisy or dirty (n = 5 of 27). All these factors contribute to the perception among participants that transit is inconvenient and undesirable. **Table 7** highlights some participants' perspectives on these issues with public transit.

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Table 7: Public Transit Drawbacks

Concern	Participant quote
Feeling like personal safety is at risk (n = 16 of 27)	"In Toronto…they have they have a subway, but it's not as extensive as BART, but there was one big difference I did notice is that…it's not as dangerous to ride public transit there as it here. You did see transients and people with issues, but there it wasn't like this. It was just much safer." – Interview participant
Origins and destinations are inaccessible to public transit stops or stations (n = 10 of 27)	"Right now, I have to walk a mile to a bus stop and I'm not doing it." – Interview participant
Finding that public transit stops too much and takes too much time (n = 10 of 27)	"I get to the gym faster [with TNCs] than if I take the bus." – Interview participant
Unable to trust the reliability of public transit (n = 9 of 27)	"[I prefer Lyft over AC Transit] because Lyft is always on time or ahead of time, and they're never late." – Interview participant
Needing to transfer vehicles too much (n = 9 of 27);	"I'm all for public transit, if it just makes sense. But if you're going a really long distance and need to do multiple transfers or get off different transit systems like Muni, BART, to AC transit and [take] a 45-minute walk, as I have to do sometimes, [it is challenging]. Some of those days, I just don't have the energy and I will look up Lyft rides." – Small group discussion participant
Feeling as though public transit is overly crowded (n = 8 of 27)	"When I first got this job back in January, I was enjoying [taking the bus] so much because it felt like I had the bus all to myself almost. But then I guess people are going back to work on site, so it's getting packed, so it's not as enjoyable for me as it used to be." – Interview participant
Finding public transit vehicles, stations, and stops are too noisy or dirty (n = 5 of 27).	There has been a whole bunch of safety issues with BART. The cleanliness of BART, sometimes the unruly passengers. Yeah, I, absolutely just like to avoid that." – Interview participant

Safety was the biggest concerns for transit users and non-users. One of the most common instances where participants differentiated between the bus and the Bay Area Rapid Transit (BART) or subways, as in New York City, was in reference to personal safety, where of the 15 participants who had concerns about the safety of

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public transit, nine participants specifically noted their concerns with BART or subways. The majority stated safety concerns related to interpersonal violence, yet two people referenced recent terror attacks on transit, specifically the shooting in the New York City subway. Underground rail, as opposed to buses, were uniquely scary from this perspective, as participants stated fear of being stuck and not in control. Three participants reported that their safety concerns were particularly high late at night and preferred to use TNCs in these circumstances. COVID transmission on buses was a concern among five participants. These participants all reported reducing or completely stopping their use of public transit during the first two years of the pandemic. However, the nature of all these participants public health concerns at the time of the interviews had changed. All five were back to using public transit with added precautions of double masking, using hand sanitizer, and social distancing.

Half of participants (n = 14 of 27) reported a willingness to use public transit more, especially with remedies to their concerns. The desire for additional routes and more robust schedule was the most frequently desired improvement (n = 7 of 27). Two participants reported that they could not be convinced to use public transit more or even at all. Three people reported not using transit frequently or at all because they were unfamiliar with transit, unsure of how to use it, or found the payment confusing. Nevertheless, 11 participants stated that despite these drawbacks, public transit was a more affordable option than TNCs. Nine participants reported that using TNCs and public transit together was a happy medium between the convenience of TNCs and the cost effectiveness of transit.

Interview participants on choosing to use public transportation

"It's cheaper. Oh my goodness… it's time consuming and I'm on a time crunch because BART ends at a certain time, but it's cheaper. It's so much cheaper."

"What I usually try to do, which is cost effective, is I usually just catch an Uber to BART. Say I need to pick up my rental car in Berkeley or San Francisco, I would BART to that location, either catch transit or if I could walk [from BART to the car rental pick-up location], or if it's in an obscure location, I'll catch transit or at a certain point I'll Uber.

Bicycles

Bicycling was discussed by eight participants but only regularly used for trip making by five participants. While one person reported feeling safe and in control on their bicycle, three reported feeling in danger of collisions with vehicles and noted a lack of quality, safe bicycling infrastructure (such as bicycle lanes) in their neighborhood. These participants expressed a willingness and desire to use their bicycle more if there were more bicycle lanes in their neighborhood. One participant stated switching to relying on TNCs more regularly after being struck and injured by a vehicle while riding their bicycle. Two bicyclists reported electing to use TNCs instead of bicycles to avoid weather conditions such as cold weather, rain, and wind. Despite these deterrents, five bicyclists spoke favorably of bicycling with two participants noting key benefits of bicycling including helping the environment, saving money, and getting exercise.

Taxis

Five participants reported using TNCs as a better replacement for taxis. Specific attributes of TNCs that stood out to those who reported using taxis in the past were their cleanliness, higher quality and newer vehicles, ease of booking a ride, ease of paying for the ride, and nicer drivers. One participant discussed her

Interview participant on preferring TNCs to taxis

"The cabbies were dirty… everything was just dirty, and the price was sky high…. [With TNCs] the driver is always be nice, the cars always be nice, and the prices is reasonable."

experience with discrimination and taxis, telling a story of taxi drivers who would assume her destination based on her race, tell her they would not drive that far, and picked up other people just down the street. She was not even trying to go to that neighborhood and was not given an opportunity to even say where she was going.

Choosing Between Private and Pooled TNC Trips

Each interview and small group discussion session also included questions about participant experiences using private and pooled TNC trips including the perceived benefits and drawbacks of each option. The key reported benefits and drawbacks were generally focused on convenience, cost, and safety (summarized in **Table 8).**

Table 8: Key Benefits and Drawbacks of Private and Pooled TNC Trips

	Private TNC Trips	**Pooled TNC Trips**
Convenience	+ Less time traveling between origin and destination + Direct, door-to-door ride	- Picking up and dropping off additional passengers adds travel time - Possibility for additional walking
Cost	- Generally more expensive	+ Generally less expensive
Safety	- Being alone with driver in their vehicle presents opportunity for inappropriate interactions with no escape + No other passengers in the back seat to interact with	+ Additional passengers provide perception of added accountability and deterrent to drivers to harass passengers - Additional passengers means more people to harass each other

Saving money was the primary benefit identified for pooled rides. Of the 21 participants who discussed the cost of pooled rides, 15 agreed that the cost savings were the primary reason to employ them. For 19 participants there was particular concern about the reliability and speed of pooled rides. This included concerns about the accuracy of the predicted arrival times, longer waiting times, and longer travel times of pooled rides. Getting to places on time was as relevant a concern as travel time. Eighteen participants, whether they use pooled TNCs or not, noted that cost savings would always need to be weighed against the extra time if they were going to choose a pooled ride over a private ride. Five participants believed that pooled rides were not significantly more affordable than private rides and were generally not worth losing out on the convenience, reliability, privacy, and speed of private rides. The strongest deterrent to using pooled rides after concerns about travel times was the lack of privacy or just simply a desire to be alone (n = 4 of 28).

Interview participant on weighing the cost and time of pooled rides
"I've taken pooled trips when it's significantly cheaper, and it's not going to change the time much."

Small group discussion group participant on cost and time tradeoffs of pooled rides
"I don't feel it's worth it to save the $4, if it's like an extra 15 or 20 minutes."

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Interview participants on the reliability of shared rides
"If I have to be there at a certain time, I don't really want to chance it with a shared ride. But if it's somewhere I don't have a set time or an appointment that I have to be at, then I can share."

"[I was in the car longer than I expected]…good thing I did not have an appointment at that time or else that was a bad idea."

Another benefit of pooled rides, as discussed by participants ((n = 4 of 27), three of whom are women) is the enhanced feelings of personal safety due to riding in the car with more people. This was similarly identified in the earlier study as a benefit of pooling important to women primarily. This benefit was contrasted, however, by ongoing public health concerns about COVID transmission and concerns around interpersonal conflict.

Among the five participants with public health concerns, four expressed that health considerations were typically not enough to prevent them from using pooled rides at all, but they emphasized the importance of other passengers wearing masks in allowing them to feel comfortable getting into a pooled ride.

Interview participant on pooled ride safety
"That's why I started to do Uber Pool. Because as long as there's someone else there then [the driver] can talk or they can look back in the rearview and give whatever looks they want to, but they're looking at two people…. I would be like 'Dude, why are you saying weird stuff to her' or vice versa. Most of the time when it's pooled, I notice that the drivers don't really talk, rather they do that when it's just one on one."

Fear of interpersonal conflict in pooled TNCs (n = 11 of 27) was cited nearly twice as much as for in private rides (n = 6 of 27). Three participants talked about their personal experiences with negative pooled ride experiences, describing racial discrimination and intimidation by other passengers as well as riding with overly intoxicated people. The remaining concerns for conflict in pooled rides were more general including fears about who they would be riding with, would they be safe, and would they be kind. Participants, noted that conflict with drivers was relatively rare.

Unique Considerations for Demographic and Travel Behavior Groups

Some subpopulations had unique travel behavior that is described in the following sections. Characteristics such as the frequency of TNC use, disability status, gender identity, sexuality, and racial identity impacted travel behavior and perceptions to some degree for participants.

Most Frequent TNC Users

Those who used TNCs at least four days per week (n = 8 of 27) exhibited some unique travel behavior from those using TNCs less frequently. For example, these more frequent users (n = 8 of 27) reported using TNCs for the widest variety of trip purposes. One of the most frequent users reported using TNCs for 15 different trip purposes. In contrast, in the less frequent TNC users group (n = 19 of 27), the highest reported number of trip purposes to use TNCs for was seven.

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The most frequent TNC users represented the least and most multimodal. Two of the most frequent TNC users, using TNCs between two and four times per day and who used TNCs for the greatest variety of purposes, reported solely relying on TNC and using no other modes other than TNCs. Excluding these cases, more frequent TNC users were more multimodal than less frequent ride-hailing users, consistent with the findings of Lazarus et al. 2021. Among participants who reported using TNCs at least four times per week (n = 8 of 27), three users reported using three to four different modes for one trip, for example, taking a TNC to a BART station, taking BART to San Francisco, getting a bus from the BART station, then exiting the bus and walking the remainder of the way to work.

Interview participant on using multiple modes
"I was taking BART and AC Transit…. [Since moving], I take the Caltrain sometimes too because my job has a shuttle to Caltrain…. It's a 10-minute ride [on the shuttle], then I hop on the Caltrain and then [I have] a two minute walk…. Sometimes I will Uber to work, and then when I get off I will get picked up sometimes by my boyfriend."

Small group discussion participant on using TNCs to connect to public transit
"I will take a [TNC] to the train station…and then go to downtown Mountain View…. And then the office is three blocks away…. Sometimes I do [take the bus to the train station]."

People with Disabilities

Two participants (n = 2 of 27) discussed their experience with chronic physical disabilities and another two participants (n = 2 of 27) discussed their experience with temporary disabilities resulting from injury. All of these participants (n = 4 of 27) reported that their disability impacts their travel behavior and accessibility. For one participant with a disability, being immunocompromised discouraged them from using any form of shared transportation, including ride-hailing or public transit, altogether during the first year of the pandemic. This participant has since returned to using TNCs, predominantly for medical appointments, noting they feel "spoiled" and "enjoy the peacefulness" of using TNCs before lengthy appointments.

Interview participant on challenges using TNCs with a disability
"I hurt my hip…, and the doctor said you're not allowed to walk. [The drivers] were forcing me to walk to the point where I said look, you're taking me to my doctor or you're taking me home from the doctor, I have a hip problem. Please come to my exact location…but they refused."

Interview participant on their disability's impact on their transportation options
"If [I lose consciousness] behind the wheel, I could crash or hit somebody else…if I'm in public, like on the bus, I could hit my head…. If I'm on a bike, [I could fall into] traffic. That's not going to end up too good for me."

One participant was temporarily unable to walk far distances due to an injury. She had a particularly difficult time walking and was frustrated that drivers didn't always go to the exact pick-up or drop-off location she requested. Overall, these participants agreed that disabilities can have profound impacts on a person's transportation and additional accommodations are needed.

Another participant with a disability reported that their disability dramatically influenced their travel decisions. She stated that her medical condition makes driving or biking particularly dangerous. This participant believed TNCs provide a safe option for travel to a variety of destinations, yet there is significant concern about a scenario where they

have a medical emergency while a passenger. They noted that while TNCs often have specific accommodations for disabilities that require the use of a wheelchair, there are a variety of disabilities (e.g., neurological conditions, cardiovascular conditions), including their own, that need different accommodations. This participant noted the lack of safe, reliable transportation for people with disabilities, particularly for disabilities that preclude people from driving.

Gender Identity and Sexuality

All but three women or LGBTQ+ participants interviewed (n = 10 of 13) reported being a victim of sexual harassment, knowing someone who endured sexual harassment, or actively worrying about sexual harassment while a passenger in a TNC. Women and LGBTQ+ participants discussed experiences ranging from being asked out on dates and being asked about sexual history to being locked in a vehicle against their wishes. Most women and LGBTQ+ participants (n = 9 of 13) were acutely aware of the dangers of not only being in a TNC, but also on public transit, whether from their own experience, the experience of someone they know, or media stories. While these concerns do not stop these women from using TNCs, they heavily influence how they use them and their experience using them.

Interview participants on personal safety in TNCs

”I’m a lesbian and obviously I'm not into dudes…. I've had drivers hit on me and try to get my number or things like that, and I'm… not interested. I don't even want to talk to you in the first place. It just really makes me want to step out of the car right there. I find it to be sexual harassment. I'm stuck in a car with you. It's disgusting you’re stuck in their vehicle, and you don't have any way out.”

“I hopped out the window… And then when I was running home some guy was telling me: ‘Are you in danger? The guy that you got out of the car from at the light made a U turn, and he's waiting for you on the other side….” – Interview participant

A variety of methods of protection were shared by participants including: 1) waiting for the ride inside, 2) asking a male friend escort them to their vehicle, 3) avoiding certain neighborhoods, 4) using pooled TNCs or riding with friends, 5) employing their mobile phone to share their location with a trusted person, 6) carrying self-defense equipment such as pepper spray, 7) riding with the windows open, 8) avoiding using TNCs after dark, and 9) being hypervigilant These strategies employed by these participants are displayed with relevant quotes from participants in **Table 9**.

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Table 9: Safety Strategies Employed by Women and LGBTQ+ Participants

Method of Protection	Interview Participant Quotes
Waiting for the ride inside	"If I'm at work, I'll wait inside my workplace until the Lyft or Uber gets there."
Asking a male friend escort them to their vehicle	"My friend's boyfriend walked [with me] to the car and… pretended he was my man."
Using pooled TNCs or riding with friends	"Sometimes I would actually feel safer if there was a passenger other than me."
Employing their mobile phone to share their location with a trusted person	"I can actually share my location in the rideshare app that I'm using and a friend can see, and they'll be able to follow along."
Carrying self-defense equipment	"I keep Mace in my purse regularly, but then [I also keep] one on my person."
Always riding with the windows open	"I would say the only thing that I do get scared of is the driver putting the child locks on and keeping me in. That's never happened to me, but it has happened to many of my friends before and more people than I'm comfortable acknowledging. That's one thing that I am fearful of. That's kind of why I always try to keep the window open. Because then in case of an emergency I can at least try to reach outside the door or try to bust out the window."
Avoiding using TNCs after dark	"I'm also a lot more hesitant to take Uber at night. When it's really late and then maybe if you're in kind of a seedy area, or a kind of desolate area, that makes you feel not safe."
Being hypervigilant	"It's always on my mind, but there's also an extent to which, if I worry as much as the actual threat of lack of safety there is, then I'll be paranoid all the time, and so there comes a time when I just have to kind of cut my losses. I can either be paranoid all the time and be hyper aware and nervous and send myself and my nerves into a state of despair or I just have to accept that this is what it is for what I'm trying to do, and I'm doing the best I can to keep myself safe."

Note: participants were not asked about their sexuality or religious beliefs, but some participants chose to disclose these identities during their interview.

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Most women and LGBTQ+ participants (n = 10 of 13) acknowledged, appreciate, and actively use the existing safety features in the Uber and Lyft apps such as pin verifications, option to share location with trusted contacts, and check ins when the ride is off course. Many also had additional ideas and concerns about what could be done to increase their safety such as: asking riders and requiring drivers to confirm they have been dropped-off safely and notifying trusted contacts without confirmation. TNCs users have the concern unique to this mode of often being alone with a stranger, ability to be locked into the vehicle and driven away, and drivers having access to address information. Nevertheless, safety concerns extended to public space and public transit as well, specifically BART. Three women discussed how they avoid public transit, particularly in the evening, and generally find TNCs to be a safer option.

Small group discussion participant on personal safety in TNCs
"When I talk to other, women, they feel more vulnerable at night, taking BART pretty late. So that's something I've considered too, just in dicey areas."

Religious minorities, LGBTQ+, Asian/Pacific Islander, and Black/African American people reported how having multiple oppressed identities compounded in the harassment or violence they experienced.

Interview participant on personality identity and safety when using transportation
"It's one of those things where what is the risk you take by using a TNC or even BART? I've known people who have been assaulted on public transit. But there's really no other way unless you decide to walk all the time, which people sometimes don't have the time to do. Some of my friends are trans and are affected by trans misogyny, and they're Black too. So sometimes TNCs are the safest thing for them just because they risk so much more just being out in public, and [TNCs] offer them that level of like security and safety and privacy. But then again it's not like you're evading that threat of harm because now you're just one on one with this person in a car. They have much more control over you. But the alternative to that is, you're out there, and there could be more people that you could come in into extreme conflict with."

Racial Identity

Less than half of participants (n = 11 of 27) discussed how their race or ethnicity impacted their experience with transportation, specifically TNCs. About half of Black/African American participants (n = 7 of 13) noted how their racial identity negatively affects their experience with TNCs. The majority of these participants (n = 11 of smaller group of 13) did not necessarily believe that TNCs were uniquely more dangerous or prone to discrimination than other modes such as driving, public transit, and walking nor more prone to racism than the world in general. One Black/African American participant expressed concern about how safety issues could be better managed due to fears it might result in increased surveillance and police intervention.

Small group discussion participant on racism in TNCs
"I'm a Black American and there was this time I was supposed to share a ride with someone. I was the second person to be picked up, and [the other passenger] was already right in the car. When she saw me, she said she's going to cancel. I was kind of confused at first, but with the look she gave me, I understood that it was my skin color that she wasn't comfortable with…. She happens to be pregnant and for the sake of. that child and [it being] around 7:00 PM, I told her she could use the ride. I had to cancel my ride, but that was a very painful experience for me. I felt really devastated."

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Three participants commented on how most of the drivers they have had are not White. But two of these participants, who both identified as Asian/Pacific Islander, had different perceptions on how this impacted them. For one participant, drivers who match their racial identity eliminate perceptions of possible mistreatment. However, for one Asian/Pacific Islander woman, who also identified as Muslim, drivers of the same race and religion opened the door to being targeted for harassment. In particular, this participant discussed how the older male drivers made assumptions about her and the "type of woman" she was based on her appearance and their cultural expectations of how young Muslim women should behave. Another Asian woman discussed how TNCs seemed to eliminate the discrimination she faced when trying to get a taxi as an Asian woman in New York City.

Interview participant on their religious identity
"I think I was targeted as a Muslim woman because that's one of the questions that I was asked… I probably didn't look like it because I was dressed to go out… and they were like, 'you're a Muslim, if you're dressed like this, you must be this type of woman.'"

Two participants, one Asian woman and one Hispanic/Latino woman, discussed while conflict due to race or ethnicity is a possibility and a reality for some, for them their self-described "racial ambiguity" or "White-passing" features seemingly protected them from these conflicts. One Hispanic/Latino participant, while not being victim to racism personally in TNCs, expressed concern for Asian/Pacific Islander friends and hoped that transportation professionals would develop a better understanding of how to address the TNC experiences for people of different races.

Interview participant on race and transportation
"[I wish people understood better the] experiences that people of different races have had with public transportation. When…Asian hate crimes were going on, Uber was offering [rides] for people that were Asian so that they didn't have to take public transit. But ,I wonder what their experiences with those kind of apps are in general, and how safe like they feel… but I feel like a lot of my Asian friends pretty much don't really like to use Uber and Lyft at all, really. They also feel kind of uncomfortable with transit in general, which kind of makes sense."

While the sample of Hispanic/Latino and Asian participants was relatively small, a few expressed concerns about experiences with TNCs due to their race. Both demographic groups are often victims of various types of discrimination and bias. Thus, future studies should seek a deeper understanding of the impacts of racism and discrimination on non-White travelers' behavior.

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Key Takeaways and Policy Options

The literature review, expert interviews, semi-structured interviews with TNC users, and small group discussions resulted in a variety of key findings, which we used to develop some suggested policy options. The key findings are summarized in the following subsections: 1) Pooling interest, 2) consideration of other modes, 3) TNCs for people with disabilities, and 4) safety concerns.

Key Takeaways

Pooling Interest

Approximately two-thirds of research participants (n = 18 of 27) reported using pooled TNC services within the last year, while the majority of participants noted pooling at least once in their life. The cost savings were the primary motivation for using pooled services yet were not compelling enough to use pooled rides. Nearly every participant expressed concerns about pooled rides. The primary concerns about pooled rides include: the added time and loss of reliability that comes from using the pooled option, the loss of privacy, and public health risks that come with having additional passengers in the car. Most participants (n = 18 of 27), regardless of income, reported needing to weigh the cost savings against the added time when choosing pooled rides. Participants frequently suggested that often saving money was not the most important aspect of making their decision.

Consideration of Other Modes

Almost all participants (n = 25 of 27) reported using multiple transportation modes in addition to TNCs. All participants balance cost, time efficiency, and safety factors when choosing or not choosing to use a particular mode. Nearly two thirds (n = 17 of 27) participants preferred TNCs to driving for reasons such as: avoiding the task of driving and saving money by avoiding fueling their car. These participants nearly universally preferred the experience of TNCs as opposed to driving. Nearly all participants (n = 26 of 27) shared fervent concerns about public transit use, even if changes were made. Half of participants (n = 14 of 27) noted significant challenges in using public transit despite it being identified as an affordable mode. Participants expressed a desire to use public transit more often if remedies are made, especially the addition of more routes and more frequent service. Five participants (n = 5 of 27) reported using their bicycles for trip-making, and all expressed a desire to use them more for their transportation needs in the future with the addition of bicycle infrastructure upgrades. These participants were primarily concerned about safety while using their bicycle in mixed traffic. Participants agreed that TNCs uniquely allow passengers a safe, direct, door-to-door ride that is usually reasonably priced and reliably on time as compared to other modes. Other modes need to compete with these attributes to be competitive.

TNCs for People with Disabilities

The transportation needs and challenges of travelers with disabilities remains a vastly understudied topic as noted in the study's expert interviews. While only a small sample of participants with disabilities (n = 4 of 28) were included in this study, key insights include the need to think about the wide variety of disabilities that people have (e.g., cognitive impairments, cardiovascular conditions) and the associated accommodations needed (e.g., sensory-friendly environments, protocols for managing passenger medical episodes such as fainting).

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Safety Concerns

Safety concerns were commented on by participants (n = 27 of 27) across all transportation modes. Overall, the concerns focused on the transmission of COVID-19, dangerous driving by TNC drivers, and harassment or violence from TNC drivers and/or other passengers. Personal safety concerns were primarily directed at the in-vehicle portion of the TNC or public transit experience. They were most pronounced among women (n = 12 of 27) and LGBTQ+ (n = 2 of 27) participants. Many women and LGBTQ+ participant (n = 10 of 13) reported specific measures they take to increase their safety, such as asking male friends to wait with them, sharing their location with trusted contacts, or leaving the windows rolled down. Most participants reported feeling unsafe due to driving behavior. Safety concerns were not necessarily a deterrent against using TNCs, yet heavily influenced how participants used TNCs.

Policy Options

The research team developed policy options based on the findings from the literature review, expert interviews, semi-structured interviews, and small group discussions. Many of the policy options overlap with those identified in year 1 of the study. These options include:

1. **Data Sharing:** Sharing of data between key private and public stakeholders could allow for a more effective and efficient transportation system.
2. **Operational Improvements:** Improvements that could enhance the reliability, availability, and safety of public transit service, pooling, and micromobility are a significant opportunity for changing travel behavior overall to be more multi-modal.
3. **Personal Safety Strategies:** Expanding on and educating about existing technological and built environment-based safety features, as well as introducing new ones, could help alleviate some barriers to use of TNCs
4. **Addressing the Needs of People with Disabilities:** Making transportation more accessible and accommodating to people with a variety of disabilities could increase the mobility and access to opportunities among this population.

These strategies could be employed by a variety of stakeholders, as shown in **Table 10**.

Table 10: Policy Options by Relevant Actors

	Public Transit	Government	TNC Operators	Individual
Data Sharing	**X**		**X**	
Operational Improvements	**X**	**X**	**X**	
Personal safety strategies			**X**	**X**
Addressing the needs of people with disabilities	**X**	**X**	**X**	

Data Sharing

Similar to the earlier study, we identified increased data sharing between public and private stakeholders as an opportunity for improved congestion management strategies. While not specifically addressed among participants, data sharing remains an important consideration. Participants expressed a strong desire for

operational enhancements such as more reliable arrival times for both public transit and TNCs. Data sharing could allow for better coordination among public and private stakeholders working on projects impacting operations. This data-driven coordination could lead to better operational outcomes for a variety of congestion management initiatives. This would encompass agreements that provide public agencies access to more information on TNC use in their communities to improve curb and road management while also maintaining the data privacy needs of TNCs to protect personally identifiable information and proprietary data for their business. Tackling issues, including congestion, requires access to sufficient data on how and where TNCs are being used. Data sharing could be limited to only some key data points such as popular pick-up and drop off locations.

Operational Improvements

All participants reported using a variety of transportation modes. Improvements in public transit service (e.g., more frequent service, dedicated infrastructure for pooling) could have a notable impact on people's propensity to switch from private TNC rides to higher-occupancy rides or public transit. Specifically, most users were more concerned about reliability and travel time than cost. While experts note the importance of financial incentives for encouraging mode shifts, the addition of more public transit routes and more frequent transit service could encourage more public transit use and first- and last-mile linkages to public transit. Infrastructure improvements, such as dedicated lanes for public transit and pooled TNC rides, could further increase the attractiveness of higher-occupancy transportation modes. Many participants were concerned about the reliability and travel time of pooled TNCs. TNC operators could consider how to more efficiently pool passengers and how to convey more accurate and reliable travel time data. It was also observed that more frequent users (e.g., more than four days per week) report using TNCs for the greatest variety of trip purpose, trip length, and are more multi-modal, consistent with the findings of Lazarus et al. 2021. These users present the greatest opportunity for shifts to higher-occupancy modes. The above improvements, as well as increasing access to shared micromobility modes (e.g., bikesharing and scooter sharing) and the addition of separated infrastructure for travel on these modes could help reduce the use of private TNCs for short trips. Each of these options could aid in congestion relief efforts.

Personal Safety Strategies

As noted earlier, safety was an important consideration among all participants across all transportation modes (not just TNCs). While participants reported using these modes despite their concerns, continuing to improve safety features can increase confidence and feelings of safety while traveling and perhaps also encouraging more people to consider higher-occupancy modes such as pooled TNCs and public transit.

Participants reported concerns for their safety while walking and on public transit. Efforts to improve safety in public space should be carefully considered to avoid an increase in surveillance and police-citizen interactions as some Black/African American participants noted interventions that lead to increased surveillance (e.g., police patrols, security cameras) could further reduce their feelings of being safe in public environments. Community-led safety programs and long-term investments in mixed-use, high-density development are two options to consider for increasing feelings of safety while walking or waiting for a vehicle or transit vehicle in a public space.

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Many women and LGBTQ+ noted the added feelings of safety from pooled rides. Efforts to further incentivize pooled rides through cost savings, more reliable travel time estimations, and reduced travel times where possible could allow users to feel more able to choose that option to ease their concerns about personal safety. Additional in-app safety features were desired by participants. Features that allow trusted contacts to check in with the status of a passenger's ride and be notified of confirmation of drop off could increase feelings of safety among TNC customers. Additional in-app features described included being able to choose who is driving or sharing the ride with the passenger. Since gender appeared to have a notable influence on safety perceptions in both our studies, the option to select the gender of the driver or other passengers also could increase feelings of safety among women and LGBTQ+ passengers and should be explored further. Black/African American participants also noted racism they endure while traveling on a variety of modes. With regards to TNCs, education on and expansion of existing antiracism resources, such as Uber's "Zero Tolerance for Racism" webpage is one option for beginning to address this issue. These strategies could improve feelings of safety among existing passengers as well as increase the willingness of non-users to consider using these services. However, these problems faced by people of color, women, and LGBTQ+ people are larger, systemic issues. Public and private sectors actors should lead, cooperate with, and commit to efforts addressing gendered violence, homophobia, transphobia, racism, and discrimination in all forms. This is essential for making transportation safer and more accessible to all.

Addressing the Needs of People with Disabilities

People with disabilities noted some of the unique challenges they face with transportation in this study. Experts noted the importance of improving the availability and reliability of existing TNC services designed for people using wheelchairs. In addition, greater attention should be given to other types of disabilities, such as autism spectrum disorders or medical conditions that prevent people from driving. Engagement with these communities is critical to ensuring appropriate accommodations are provided. Possible ideas shared by a participant with a disability included reduced costs for persons with disabilities, optional driver training that prepares drivers for transporting with various conditions, and identification of drivers as someone willing and able to help with certain needs of people with disabilities. This is an important area for future research.

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Conclusion

This research sought to better understand the factors impacting the willingness and propensity to use pooled TNCs among low-income people and people of color and to identify strategies/policies that could be employed to reduce congestion from TNC users. Researchers used a mixed-methods approach to answer these questions. The methods used included a literature review of TNCs, pooling, transportation equity, and qualitative methods; interviews with experts on TNCs and social equity; semi-structured interviews with 19 lower-income and non-White TNC users; and two small group discussions with eight total lower-income and non-White TNC users. The findings of the literature review and expert interviews helped our team develop the research protocols. Specifically, these findings encouraged the research team to explore the impact personal identities such as gender and race have on transportation decision-making. The semi-structured interviews and small group discussions yielded key findings on particular strategies that could incentivize increased pooling and the use of other modes such as public transit and micromobility. These findings suggest that the reliability and convenience of private TNCs are particularly motivating when making decisions about transportation.

Working to add these elements to other transportation modes could help encourage a modal shift. Some strategies that should be considered are: 1) improved data sharing among public and private stakeholders, 2) operational improvements to public transit and pooled TNCs, 3) additional in-app safety features such as increased information sharing with trusted contacts, and 4) new programs and policies that address the diverse needs of people with disabilities. TNCs present both an opportunity to contribute to and mitigate traffic congestion. Encouraging pooled ride-hailing usage among all demographics is one of the tools that can be used to alleviate traffic congestion. Future work to better understand the needs of low-income, people of color, people of disabilities, LGBTQ+, and women identified TNC users, who are or can be frequent yet understudied users, is a particularly important tool toward advancing equity and congestion management. This study provided deeper insight on an understudied demographic of TNC users and some strategies that could be employed to improve TNC services.

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Appendix A – Expert Interview Guide

Introduction of Researchers

My name is Kate Gosselin. I am a graduate student at the University of California, Berkeley working with my faculty advisor, Professor Susan Shaheen, in the Department of Civil and Environmental Engineering.

Explanation of Guidelines and Consent

We will be recording our conversation. None of your personal information will be used in any reporting, publications, or presentations. Your participation in this research is completely voluntarily and you will not be compensated for your time. If that is okay with you, we can start with introductions and then I have some questions I was hoping we could discuss.

Introduction of the Interviewee

Could you tell me your name, the organization you work with and what work you do there?

Introduction of Research and Purpose of Study

The purpose of the study is to understand the factors impacting the willingness to use pooled TNCs among people of color while assessing innovative and context sensitive research methods. We are grateful to have this opportunity to interview you given your expertise in the adoption of new technologies. With that said, I can start with my questions.

Questions

TNCs

- Describe your professional experience with TNCs.
- How common do you think pooling was (before the pandemic, and is today)?
- Why might people choose to pool?
- Are there any characteristics that define a heavy TNC user versus an infrequent user?

Equity

- How would you define equity?
- Under that definition, are TNCs equitable?
- How could they be more equitable?
- Do you think TNCs are an effective strategy for increasing equity in transportation?
- What are the biggest gaps in the TNC and equity literature?
- In your work, have you found that there are barriers that specifically impact racial minorities? What about people with disabilities? What role does gender play?
    - What are those barriers?
    - How could they be overcome?
    - What research is needed in this area?
- In your work, have you found that there are differences in the travel behavior of these different groups?
    - Is there any indication for why that may be?

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- Is pooling more popular with certain groups?
    - Is there any indication for why that may be?
- What are the biggest challenges faced by racial minorities using TNCs? What are the biggest challenges faced by persons with disabilities using TNCs?
- What are the biggest challenges faced by women using TNCs?
- How does equity factor into decision-making currently?

Methods

- What methods have you had the most success with when studying TNCs?
- What is your experience with qualitative methods such as interviews or small group discussions?
- What are the most important elements of successfully conducting interviews and small group discussions?
- Have you used narrative research or grounded theory?
    - In what context did you use these methods?
    - Where has it worked and where hasn't it worked?
    - In your own words, what is narrative research/grounded theory/discourse analysis?
    - Describe your experience with using this method.
    - What types of questions have you answered through this method?
    - What are its crucial elements?
    - How could this methodology be better applied to the study of TNCs and equity?
    - How has this method been applied to the study of transportation in the past?
    - Briefly describe to me a general process for this methodology.
    - What are best practices in terms of standardizing this process?
    - How have you analyzed the narrative or qualitative data in the past?
    - What are the strengths of this method?
    - What are the weaknesses of this method?
    - What is your advice to ensure these methods are reproducible?
    - In your experience, has using these methods provided new insights that data or surveys would have missed?
    - What is your biggest lesson learned from using these methods?
- How do I ensure equitable recruitment?

Final Thoughts

- Any final thoughts you would like to share?

Reminders

I expect this to be our only interview; however, follow-ups may be needed for added clarification. If so, may I contact you to request this? These follow-ups will be brief and would happen within one year of our initial conversation. The questions asked would be to expand on the topics we discussed today.

Thank You

Thank you for your time and openness in responding to my questions. If you have any questions or concerns, do not hesitate to reach out to me. Thank you again.

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Appendix B – Semi-Structured Interview and Small Group Discussion Screening Survey

Consent and Introduction

Thank you for expressing your interest in this research study. Should you be selected to take part in the study, we will email you with further instruction. We appreciate your time and effort in taking this survey.
This survey will take approximately 5 minutes. From the consent form, you do not have to answer all questions, you may skip any questions you do not wish to answer, and you may terminate participation at any time. Per UC Berkeley requirements, you must be 18 years of age or older to take this survey. By clicking [I agree to take this survey] you confirm that you are 18 years of age or older and consent to participate in this research. If you have questions about the survey or procedures, you may email Katherine_gosselin@berkeley.edu.

1. I am 18 years or older, and I agree to take this survey.

TNC Usage

1. Have you ever used the ridesourcing/TNC services Uber or Lyft?
    a. I have never heard of Uber/Lyft
    b. I have heard of Uber/Lyft, but I do not know how to use these services
    c. I have heard of Uber/Lyft, and I know how to use these services, but I have never used them
    d. Yes, I have used Uber/Lyft

2. How often do you use the ridesourcing/TNC services Uber or Lyft?
    a. Never in the last year
    b. Once a year
    c. Once every 6 months
    d. Once every 3 months
    e. Once a month
    f. Every other week
    g. 1 to 3 days per week
    h. 4 to 6 days per week
    i. Once per day
    j. 2 to 4 times per day
    k. More than 4 times per day

3. When using Uber/Lyft, I use the shared ride option…
    a. I didn't know there was a shared ride option
    b. Almost always
    c. Most of the time (more than 50%)
    d. Half of the time (50%)
    e. Some of the time (less than 50%)
    f. Never

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Demographic Information

1. What ethnicity do you identify with (check all that apply)?
    a. American Indian or Alaska Native
    b. Asian
    c. Black or African American
    d. Hispanic or Latino
    e. Middle Eastern
    f. Native Hawaiian or other Pacific Islander
    g. White
    h. Mixed
    i. Other, please specify: _____
    j. Prefer not to answer

2. Do you have a disability?
    a. Yes
    b. No
    c. Prefer not to answer

3. Do you live in the San Francisco Bay Area?
    a. Yes
    b. No

Screening Information

1. Are you willing to commit up to 90 minutes of your time to take part in this study?
    a. Yes
    b. No

Contact Information

Please provide your first name, your phone number, and the days/hours of your availability for a 10-minute informational phone call:

First Name:_____
Phone number:_____
Dates/times available for call:_____

In order to participate in this study, we will need a reliable email address, which will be our primary mode of contact with you.

Email address:_____

Thank you

Thank you for your participation in this survey. Should you meet the criteria for participation in this study, a member of our research staff will call you at the phone number during the time availability provided to discuss next steps. If you are not selected for this study, your responses to this survey will be destroyed and will not be used for any further research. After submitting your responses, you can protect your privacy by clearing your browser's history, cache, cookies, and other browsing data (Warning: This will log you out of online services).

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Appendix C – Semi-Structured Interview and Small Group Discussion Demographic Survey

Consent and Introduction

Thank you for agreeing to be a part of this research. This survey will take approximately 15 minutes. You do not have to answer all questions, you may skip any questions you do not wish toanswer, and you may terminate participation at any time. By clicking [I agree to take this survey] you confirm that you are 18 years of age or older and consent to participate in this research. Thank you!

1. I am 18 years or older, and I agree to take this survey.

Demographic Information

1) What is your age, in years?
   a) Open Response
   b) Prefer not to answer

2) What gender do you identify with?
   a) Male
   b) Female
   c) Other, please specify:_____
   d) Prefer not to answer

3) What is your race or ethnicity? (Please select all that apply.)
   a) American Indian or Alaskan Native
   b) Asian
   c) Black or African American
   d) Caucasian/White
   e) Hispanic or Latino
   f) Middle Eastern
   g) Native Hawaiian or other Pacific Islander
   h) South Asian (e.g., Indian, Pakistani, etc.)
   i) Southeast Asian (Thai, Filipino, Malaysian, etc.)
   j) Other, please specify:_____
   k) Prefer not to answer

4) What is the highest level of education you have completed?
   a) Less than high school
   b) Currently in high school
   c) High school graduate/GED
   d) Currently in 2-year college
   e) 2-year college degree
   f) Some college (currently not in college)
   g) Currently in 4-year college
   h) 4-year college degree
   i) Currently in post-graduate program
   j) Post-graduate degree (MA, MS, PhD, MD, JD, etc.)

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k) Prefer not to answer

5) What was your employment status? (Please select all that apply.)
   a) Employed full-time (total 35 or more hours per week)
   b) Employed part-time (total less than 35 hours per week)
   c) Self-employed full-time
   d) Self-employed part-time
   e) Student
   f) Stay-at-home parent
   g) Homemaker
   h) Unemployed, active job seeker
   i) Unemployed, not currently seeking a job
   j) Retired

6) What was your total annual household income in 2021?
   a) Less than $10,000
   b) $10,000 to $14,999
   c) $15,000 to $24,999
   d) $25,000 to $34,999
   e) $35,000 to $49,999
   f) $50,000 to $74,999
   g) $75,000 to $99,999
   h) $100,000 to $149,999
   i) $150,000 to $199,999
   j) $200,000 or more
   k) Prefer not to answer

7) How many automobiles (car, SUV, pickup, or van) does your household own or lease?
   a) 0
   b) 1
   c) 2
   d) 3
   e) 4
   f) 5 or more
   g) Prefer not to answer

8) How many motorized bikes (motorcycle, scooter) does your household own or lease?
   a) 0
   b) 1
   c) 2
   d) 3
   e) 4
   f) 5 or more
   g) Prefer not to answer

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Transportation Profile

1) Which of the following transportation modes did you use in the past year? (Please select all that apply.)
   a) Drive alone (in a personal vehicle)
   b) Drive/Ride with others (non-commute; in a personal vehicle)
   c) Carpool (for commuting, not Uber/Lyft)
   d) Vanpool (for commuting)
   e) Employer Shuttle (for commuting)
   f) Public Bus (e.g., AC Transit)
   g) Rapid Transit (e.g., BART)
   h) Light Rail (e.g., Muni)
   i) Commuter Rail (e.g., Caltrain)
   j) Uber/Lyft Ride Alone (e.g., UberX, Lyft)
   k) Uber/Lyft Shared Ride (e.g., Uber Pool, Lyft Shared rides, Uber Express Pool, LyftShared Saver)
   l) Taxi (not Uber or Lyft)
   m) Personal Bicycle
   n) Docked Bikeshare (e.g., Bay Wheels)
   o) Electric Dockless Bikeshare (e.g., JUMP Bikes)
   p) Non-electric Dockless Bikeshare (e.g., Lime, Spin)
   q) Round trip carsharing (e.g., Zipcar, Getaround, Turo)
   r) One-way carsharing (e.g., GIG Car Share)
   s) Hourly rental cars
   t) Motorcycle or Scooter
   u) Moped Sharing (e.g., Revel)
   v) Scooter Sharing (e.g., Bird, Lime, Spin, etc.)
   w) Microtransit (e.g., Via, AC Transit FLEX, Tri Delta Transit Tri MyRide)
   x) Ferry (for commuting)
   y) Other, please specify._____

2) Please indicate how frequently you used the following transportation modes.

[*All modes selected will be displayed in a table format, with the following options as columns for each]*

More than 4 times per day
2 to 4 times per day
Once per day
4 to 6 times per week
1 to 3days per week
Every other week
Once per month
Once per every 3 months
Once per every 6 months
Once per year
Never

3) How many days per week do you typically work and/or go to school?
   a) I did not work/ I did not go to school

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b) 1
c) 2
d) 3
e) 4
f) 5
g) 6
h) 7

Private Transportation Network Company (e.g., Uber or Lyft) and Usage

1. In what year did you use either Uber or Lyft **for the first time**? Please consider bothprivate rides and shared (or pooled) rides with strangers.
    a. 2021
    b. 2020
    c. 2019
    d. 2018
    e. 2017
    f. 2016
    g. 2015
    h. 2014
    i. 2013
    j. 2012 or earlier
    k. I do not know/ I do not remember

The following questions are related to your use of ***private*** Uber/Lyft trips. These are Uber/Lyfttrips where you do not ride with strangers (other than the driver) and there are no additional passenger pick-ups/drop-offs (e.g., UberX, UberXL, Lyft, Lyft XL).

2. How often do you use the ***private*** option of Uber/Lyft?
    a. Never in the last year
    b. Once per year
    c. Once every 6 months
    d. Once every 3 months
    e. Once per month
    f. Every other week
    g. 1 to 3 days per week
    h. 4 to 6 days per week
    i. Once per day
    j. 2 to 4 times per day
    k. More than 4 times per day

3. For what trip purposes do you use a ***private*** Uber/Lyft? (Please select all that apply.)
    a. Go to or from a restaurant/bar
    b. Go to or from major social/recreational events (e.g., sports events, concerts)
    c. Go to or from other social/recreational activities (not a restaurant or bar or major event)
    d. Commute to or from work

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e. Commute to or from school
f. Go to or from public transit
g. Go to or from work-related meetings during the day
h. Go to or from grocery shopping
i. Go to or from other shopping (non-groceries)
j. Run non-shopping errands
k. To visit friends or relatives
l. To pick-up or drop off children
m. Go to or from healthcare services
n. Go to or from the airport
o. Go to or from the gym
p. Other, please specify:
q. I did not take private Uber/Lyft trips

Pooled TNC Trip Information

The following questions are related to your use of ***shared*** (or pooled) Uber/Lyft trips. These are Uber/Lyft trips that pair you with strangers traveling in a similar direction (e.g., Uber Pool, UberExpress Pool, or Lyft Shared rides (formerly Lyft Line)).

1. How often do you use ***shared*** (or pooled) ride options?
    a. Never in the last year
    b. Once per year
    c. Once every 6 months
    d. Once every 3 months
    e. Once per month
    f. Every other week
    g. 1 to 3 days per week
    h. 4 to 6 days per week
    i. Once per day
    j. 2 to 4 times per day
    k. More than 4 times per day

2. For what trip purposes do you use ***shared*** (or pooled) Uber/Lyft? (Please select all that apply.)
    a. Go to or from a restaurant/bar
    b. Go to or from major social/recreational events (e.g., sports events, concerts)
    c. Go to or from other social/recreational activities (not a restaurant or bar or major event)
    d. Commute to or from work
    e. Commute to or from school
    f. Go to or from public transit
    g. Go to or from work-related meetings during the day
    h. Go to or from grocery shopping
    i. Go to or from other shopping (non-groceries)
    j. Run non-shopping errands
    k. To visit friends or relatives
    l. To pick up or drop off children
    m. Go to or from healthcare services

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n. Go to or from the airport
o. Go to or from the gym
p. Other, please specify:
q. I did not take pooled Uber/Lyft trips

3. When using a shared (or pooled) Uber/Lyft, I used the "walk to pick-up location"option…
   a. Almost always
   b. Most of the time (more than 50%)
   c. Half of the time (50%) Some of the time (less than 50%)
   d. Never
   e. This option was not available in my region
   f. I didn't know there was a "walk to pick-up location" option

Pooled/Private TNC Trip Preferences

Please indicate how often the following statements applied to you.

	Almost Always	**Most of the time**	**Sometimes**	**Rarely**	**Never**	**I Don't Know**
I was uncomfortable being driven by a stranger.						
I enjoyed chatting with my driver.						
I was uncomfortable sharing my rides with strangers.						
I enjoyed chatting with other passengers.						
When I was in a rush, I preferred to ride alone.						
I think that shared ride options are optimally routed (they travel the fastest route possible, including pickups and drop offs for additional passengers).						
Shared ride options took longer to match me to adriver than the ride alone option.						
I think that TNC services like Uber/Lyft have a positive overall impact on the environment.						
I think that using a shared ride option is better for the environment than choosing to ride alone.						

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Thank You

Thank you for completing this survey. After submitting your responses, you can protect your privacy by clearing your browser's history, cache, cookies, and other browsing data. (Warning:This will log you out of online services).

Additional Comments

Please include any additional comments or questions in the text box below.

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Appendix D – Semi-Structured Interview and Small Group Discussion Guide

Introduction of Researchers

Thank you for taking the time to join us to talk about your experiences with TNCs and pooling. My name is Kate Gosselin. I am a graduate student at the University of California, Berkeley working with my faculty advisor, Professor Susan Shaheen, in the Department of Civil and Environmental Engineering.

Introduction of Research and Purpose of Study

Transportation network companies, abbreviated as TNCs, are businesses that use an online app to connect passengers with drivers or car owners, such as Uber and Lyft. The purpose of the study is to better understand the role of TNCs in meeting your transportation needs.

Explanation of Guidelines and Consent

We will be recording this discussion to make sure that we do not miss any of your comments. None of your personal information will be used in any reporting, publications, or presentations. Your participation in this research is completely voluntarily and you will be compensated for your time. We can start with introductions and then I have some questions I was hoping we could discuss. If you do not understand any of my questions or need me to repeat them, please let me know. I am expecting this interview to last between 40 and 60 minutes.

Introduction of the Interviewee

Could you tell me your name and what you do for work?

Questions

Overview

- What do you do in a typical day? Where do you need to go?
- What is your primary mode of transportation to these activities?
- Do you find transportation to be a challenge in your day-to-day life?

TNC Usage

- How often do you use TNCs such as Uber or Lyft?
    - Which platform do you prefer and why?
- Why do you use TNCs?
    - Is it the convenience? Availability? Only option? Etc.
- What is the biggest challenge you face using TNCs?
- Describe to me a typical TNC trip you would take.
    - At what time of day do you typically take TNC trips?
    - Where do you typically travel to and from when you are taking TNCs?
    - For what purpose do you typically use TNCs?
    - Do you use TNCs to connect with transit? Why or why not?
    - How many people are typically going with you?
- What factors affect your decision to use TNCs?

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    - What about the price?
    - How does your identity impact your decision to use TNCs?
- Do you feel safe using TNCs?
    - Why or why not?
    - If you are comfortable, describe to me a time you did feel unsafe.
- What, in your mind, would make using TNCs better for you?

TNC Pooling

- How frequently do you take pooled trips?
- What factors affect your decision to use pooled TNCs?
    - In what way does the built environment affect your choice?
    - What about the price?
    - Do you think your racial identity/gender identity/ disability status is a factor in your choice?
- Do you enjoy taking private or pooled rides more? Why or why not?
- How do you decide whether to take a pooled or private trip?
- What, in your mind, would make you select the pooled option more?

Final Thoughts

- What do you wish researchers, such as me, would ask you?
- What do you want my main takeaway from this conversation to be?
- Any final thoughts you would like to share?

Reminders

This will be our only conversation; however, follow-ups may be needed for added clarification and to ensure the accuracy in my understanding of your experiences. May I contact you in the future to request this? These follow-ups will be brief and would happen within one year of our initial conversation. The questions asked would be to expand on the topics we discussed today.

Thank You

Thank you for your time and openness in responding to my questions. We will send you a Visa gift card to the email you provided to us. If you have any questions or concerns, do not hesitate to reach out to me. Thank you again.

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