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Going My Way? Understanding Curb Management and Incentive Policies to Increase Pooling Service Use and Public Transit Linkages in the San Francisco Bay Area

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Abstract: Despite lower user costs, only 20% to 40% of transportation network company (TNC) users select a pooled, or shared, ride option. Why are existing TNC users not selecting the pooled option or using TNCs to connect to public transit, and what role do built environment features and incentives play in their decision? This study explores the factors that influence TNC user decisions through a multi-method approach comprising photovoice small group discussions and a workshop. Between March 2021 and May 2021, 15 San Francisco Bay Area TNC users shared photographs they took of TNC pick-up locations through two-to-three-person guided small group discussions. The photos revealed that users prefer waiting in retail or in well-lit, good-visibility locations. Participants' primary concern was personal safety, particularly female users who may take additional precautions when walking to pick-up locations and waiting for and taking rides. In July 2021, 12 photovoice participants and 5 stakeholders provided feedback on key findings from the photography discussions. The pooling improvement strategies identified include the following: designated TNC stops with lighting and marked pick-up areas; enhanced in-app safety features; TNC partnerships with employers and retailers to incentivize riders; and mode transfer discounts for connecting TNCs to public transit. The findings suggest that safety related to the built environment plays an outsized role in a TNC user's decision to pool or connect to public transit, and the out-of-vehicle portion of the TNC trip should be equally considered when developing policies to increase pooling.

Keywords: transportation network company; pooling; photovoice; public transit connection; safety

1. Introduction

Prior to the COVID-19 pandemic, cities all over the globe experienced year-after-year increases in traffic congestion [1]. Some researchers determined that transportation network company (TNC) services may have contributed to traffic congestion in specific cities [2–4]. Increasing TNC vehicle occupancy is one strategy with which to potentially reduce traffic congestion and other negative impacts of the transportation sector (e.g., greenhouse gas emissions) [5,6].

TNCs (e.g., Uber, Lyft) allow travelers to order and pay for rides on-demand using online-enabled applications that connect them with drivers using their personal vehicles. The "pooled" version of these services (e.g., Uber Pool, Lyft Shared) allows the same vehicle to pick-up and drop-off users with different origins and destinations by matching users that share a common route. Pooled TNC trips can result in lower emissions than private TNC or personal vehicle trips because pooled riders are grouped for portions of their trips [6,7]. TNC users often receive a discount for choosing the pooled trip option. Users of pooled TNC trips can also potentially save travel time and vehicular emissions if

they opt to walk a short distance from their origin and destination to pick-up and drop-off points that employ optimal straight-line routing (e.g., Uber Express Pool, Lyft Shared Saver) [6]. TNCs tend to give users a steeper discount to select this "indirect" (i.e., corner-to-corner) pooled option than they do for the "direct" (i.e., door-to-door) one [8].

Despite the potential benefits of sharing rides, TNC users typically do not select either the direct or indirect pooled option. Depending on the location, pooled services comprise only 20% to 40% of TNC trips, and only an estimated 49% to 72% of pooled rides are matched with other riders [4,8–10]. This raises a key question: why are existing TNC users not selecting the pooled option or using TNCs to connect to public transit, and what role do built environment features and incentives play in their decision? Prior research has investigated this question; however, past studies relied on survey methods or aggregated data, which have a limited ability to incorporate feedback from TNC users to help shape the analysis. Additionally, there has been limited research into the perception of safety while walking to or waiting at a TNC pick-up location.

The goal of this paper is to address these gaps in the literature and explore what factors play into a TNC user's decision to pool and use a TNC to connect to public transit. Users of pooled TNCs took part in the data collection and analysis process of the study as part of the highly participatory photovoice methodology. From March 2021 through May 2021, 15 TNC users from the San Francisco Bay Area documented the built environment at TNC pick-up locations with smartphone photography. In guided small group discussions, the TNC participants shared their photographs, past pooling experiences, and perspectives on built environment improvements and policies to incentivize pooling and connecting to public transit. The TNC user discussion revealed that pricing incentives to pool or connect TNCs to public transit are effective in garnering interest, but safety concerns are the most important factor in their decision to pool and where they choose to walk and wait. The TNC users liked having benches, wide sidewalks, and signage and markers at pick-up locations, but above all, they preferred well-lit areas with good visibility of surroundings. Many opt to wait inside retail or other establishments as an alternative to waiting on the street.

In July 2021, a workshop brought together 12 photovoice participants and 5 stakeholders from public, private, and non-profit transportation organizations. Attendees were presented photographs and findings from the small group discussions and gave feedback and shared their individual perspectives about pooling. The workshop concluded with the group collaborating to ideate actionable strategies for improving pooling, including the following: designated TNC stops; in-app safety feature enhancements; incentive programs that focus on pooling groups of users that make regular trips in the same direction; and mode transfer discounts to encourage TNC connections to public transit.

This article is organized into five sections. First, the literature review provides background on the relevant literature related to TNC pooling, the perception of safety in public spaces, and the photovoice methodology. Next, the methodological approach provides a review of the research tools the researchers used. Following this, the results of the photovoice small group discussions and workshop are presented. The article concludes with a discussion of key research takeaways, policy recommendations, and areas for future research stemming from this work.

2. Literature Review

This section briefly reviews the body of relevant literature and is divided into four subsections. The first summarizes prior research on the users of pooled mobility services; the second subsection reviews prior research regarding the perception of safety in public spaces; the third describes strategies previously suggested in the literature to increase the use of TNC pooling; and the final presents the photovoice methodology and previous photovoice studies focused on transportation and the built environment.

2.1. Who Is (or Isn't) Pooling?

Research exploring TNC users identified that typical private TNC users are young, well-educated, and middle-income [11–14]. Other studies found that typical users of pooled TNCs are young, lower-income, minority males [15,16]. Most individuals take TNCs as an alternative to driving their own cars [17]. The impact of TNCs on public transit is less clear, as a consensus has yet to be reached about whether TNCs are used as a replacement for public transit [3,4] or as a complementary means to access public transit [18]. Evidence does suggest that individuals in areas with poor transit service and/or with limited mobility take TNCs to increase their mobility [19,20].

Prior work has also identified several reasons for why certain users may not pool. First, certain demographics of TNC users (i.e., women, older adults, and non-Hispanic white users) are less likely to use pooling due to the extra time pooled trips can take [16]. Additionally, economically disadvantaged users and those with a physical or cognitive disability may face TNC accessibility challenges, such as the need to access a smartphone to use a TNC or to navigate directions to a pick-up location specified by the app [21,22]. The last reason some users choose not to pool, particularly for those who prefer private trips, is a negative perception of safety relating to the driver and the other passengers [11].

Past studies focused primarily on the in-vehicle part of the TNC trip, and there is limited research on the role that walking to or waiting at a TNC pick-up location plays in private or pooled trip selection. Many of the previous studies employed stated-preference surveys with TNC-related choice scenarios [11,12,15,16,19]. While valuable for quantifying the role of individual characteristics into choice models, stated-preference surveys have a limited ability to determine the context behind a participant's choice or explore more deeply into what lead to a participant's decision [23]. Participant feedback is also difficult to reintegrate back into survey instruments, limiting the participant's say in the direction of the analysis, which can be a vital tool in exploratory work. Several other past studies relied on aggregated census [13,14] and geographic [9,22] data for their analyses. Aggregated data are important for trend analysis and big-picture comparisons but are unable to lead to individual-level conclusions because they are aggregated at the population level [24].

To explore the factors that play into a TNC user's decision to pool or connect to public transit, using methods that allow for individual-level decisions to be investigated more deeply can result in new insights that build upon and reframe existing conclusions.

2.2. The Perception of Safety in Public Spaces

Safety is viewed as a key factor as to why certain TNC users choose not to pool. Studies have identified that traveler gender plays a large role in an individual's perception of safety in public. Women tend to be more conscientious of their potential vulnerability to major or nuisance crimes, particularly those who are older, lower-income, and non-white [25–28]. This directly impacts how and where women choose to travel. Many women prefer not to travel at night, only visit certain public spaces when accompanied by a friend or significant other, and drive or take a taxi rather than walk or take public transit [26,27,29–32]. Additionally, the increased presence of homelessness at transit stops and in transit facilities has been pointed to as potentially contributing to a declining perception of comfort and safety of public transit [33,34].

Relevant work has also explored the topic of safety at public transit facilities. One key finding from this work is the role that land use and natural surveillance (i.e., design features that maximize visibility of people and activities) play in the perception of safety and crime prevention. For example, public transit stops located near perceived negative land uses (e.g., liquor stores, bars/taverns, pawn shops, etc.) or in low-surveillance areas (e.g., near surface parking lots with poor sightlines and parking structures with alcoves) are viewed as less safe [35].

Though there is an abundance of research on the perception of safety in public and at public transit stops, little prior work has aimed to contextualize the previously outlined

findings through the lens of shared mobility, particularly as it relates to the experience of walking to or waiting at a TNC pick-up location, or while in the TNC vehicle.

2.3. Strategies to Shift TNC Users to Pooling

Previous studies identifying TNC users suggest several areas for improvement that could lead to an increase in pooled TNC trips. These strategies fall under two predominant categories: (1) curb management and built environment improvements; and (2) changes to pricing policies and incentives.

Curb management and built environment strategies focus on providing pick-up locations at which drivers are safe to park and riders are safe to wait [36]. Using geofencing technology and restricting curbside use to authorized vehicles can help ensure that TNC vehicles are consistently directed toward appropriate pick-up locations and have ample capacity without requiring TNC users to enter traffic during access or egress [37–39]. Built environment features such as lighting, signage, and waiting shelters can provide safety and signal high-quality service, while also reducing confusion for both riders and drivers [40–42]. Designating curbspace and building loading zones for TNC vehicles can help make private and pooled TNCs more accessible for users new to the service or with mobility challenges [39,43].

Additionally, changing TNC pricing policies can help incentivize users to shift from private to pooled trips. Pricing pooled rides lower than private options, particularly for commuting trips, trips starting or ending near employment centers, and for users with limited access to cars, could lead to an increase in pooling for non-recreational TNC trips [16,19]. Other strategies with which to incentivize users to pool include placing a premium on private TNC trips and providing a free pooled TNC trip for first-time users. Research suggests that those who have pooled before are more likely to do so again [19,44].

The curb management and built environment strategies were identified through expert interviews [38,43] or are strategies designed for a different context, such as for taxi services at airports [37,41], public transit stops, and mobility hubs [39,40,42]. To the authors' best knowledge, no prior work has explored the role that the built environment plays in the pooled TNC experience. The incentive strategies were determined using survey methods to quantify the trade-offs users make when selecting TNC options [16,19,44]. However, the previous studies had limited direct input from the passengers of these services and lack the context for why certain trade-offs are made, which could inform more effective policymaking.

2.4. Background on the Photovoice Method

The authors selected the photovoice methodology to learn how TNC users view the pooled trip experience. Initially developed for the field of public health, photovoice allows participants to reflect on their personal experiences and community while permitting outsiders to view life through their eyes via photography [45,46]. Photovoice studies typically recruit through existing organizations and provide cameras to participants to lower barriers to participation [45]. The ideal number of photovoice participants per study is between seven and ten [47–49]. Photovoice participants document the strengths and needs of their community with cameras then share the photos and stories behind the images in focus group discussions [45]. From the focus group discussions, themes about community needs can be codified. Individual interviews have also been used to communicate with participants who are unable to meet communally [50,51]. The culmination of most photovoice studies is a presentation or public display, often with community leaders and decision-makers present to learn more about their constituents' perspectives [45].

In recent years, the growing use of different technologies and smartphones has allowed the photovoice methodology to expand. Increasing smartphone and internet accessibility has led to the integration of these technologies into the photovoice method. Studies have engaged with participants over social media, allowing participants to take their photographs with their own smartphones and share the photographs with researchers via

hashtag, and to post a final collage of participant images to social media to allow for increased community exposure [52,53]. The Qualtrics survey software tool has been used to increase flexibility and allow photovoice participants to submit photographs and captions at their convenience [54]. Other photovoice study facilitators have used the Zoom teleconferencing software to hold interviews when participants were unable to meet in person [55].

To the authors' best knowledge, there has been no prior application of the photovoice method to exploring TNC user preferences, and few applications of photovoice to transportation research in general. One relevant study used photovoice to consider the everyday interactions of 22 women of color with public transit. However, due to challenges with participant responses to photo prompts, the study shifted towards an interview-based method [55]. Another recent study employed the photovoice method to explore the perceptions of 15 participants who cycled as transport and found that they primarily did so for time- and cost-saving-related reasons, though inclement weather, a lack of road safety, and fears of bicycle theft or biking at night detracted from their likelihood to cycle [56]. A final relevant study employed photovoice to view travel from the perspective of five different paratransit users. The participant photos identified long wait times, difficulties navigating pick-up/drop-off areas, and the steep price of subsidized accessible cabs as factors leading to users actively choosing not to travel [52]. These recent examples demonstrate the potential of using photovoice with TNC users to help identify what factors of pooled TNC experiences (including built environment features) affect their decision to pool.

3. Methodological Approach

This study used the photovoice methodology to (1) explore how TNC users factor infrastructure and incentives into their decision to pool and connect TNCs to public transit; and (2) engage TNC users and community stakeholders in a dialogue on strategies to improve pooling. The authors modified the typical photovoice recruitment and collaboration procedures to allow it to be conducted remotely due to restrictions (e.g., social distancing measures) from the COVID-19 pandemic. For this study, the authors required participants to have access to a smartphone for photography and the Zoom teleconferencing tool for the group discussions. Additionally, although photovoice studies traditionally recruit through a community organization, because no formal TNC passenger organization exists, the authors recruited study participants using Craigslist. This is a common approach for photovoice study administrators not working directly through a community organization [57,58]. Using Craigslist also allowed the authors to recruit a varied representation of San Francisco Bay Area TNC users. The Craigslist advertisement is available for download in the Supplementary Materials. Figure 1 describes the modified photovoice methodology used.

From March 2021 through May 2021, the authors recruited TNC users to participate in the study based on their location in the San Francisco Bay Area and prior experience using private and pooled TNCs. Fifteen TNC users were recruited for this study with a near-even distribution of "frequent" and "periodic" and male and female TNC users. Lazarus et al. [15] defines "frequent" TNC users as those who use private or pooled TNCs more than three days per week, and "periodic" TNC users as those who use private or pooled TNCs three or fewer days per week. Because the San Francisco Bay Area was an area of focus in the Lazarus et al. paper, the same definitions of "frequent" and "periodic" TNC users are used in this paper for consistency. Seven frequent (four male, three female) and eight periodic (four male, four female) TNC users were recruited for this study. The study participant demographic information is available for download in the Supplemental Materials.
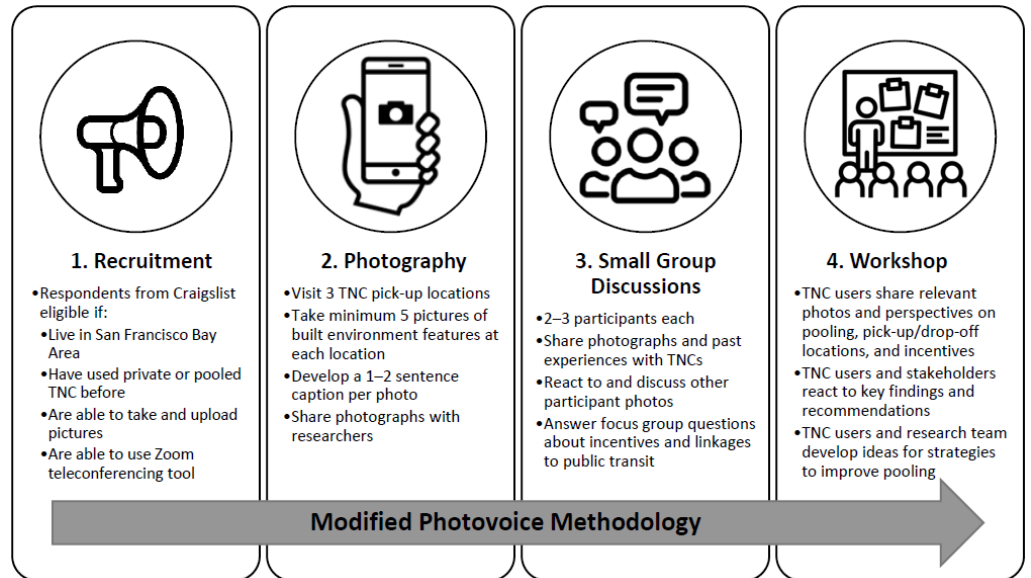
Figure 1. The modified photovoice methodology used to explore preferences of transportation network company (TNC) users (Source: Authors, 2021).

Upon confirming their participation in the study, the 15 TNC users visited three different TNC pick-up locations of their choosing. Using smartphone cameras, participants took a minimum of five photographs of built environment/infrastructure features at or near each location. The photography locations for the photovoice participants are presented in Figure 2. Following the photography, participants shared their photographs with the authors with a one-to-two sentence caption describing the image and any associated comments via a secure Qualtrics survey form (March 2021 version). Any photographs with identifiable information were removed from the study to maintain participant confidentiality.
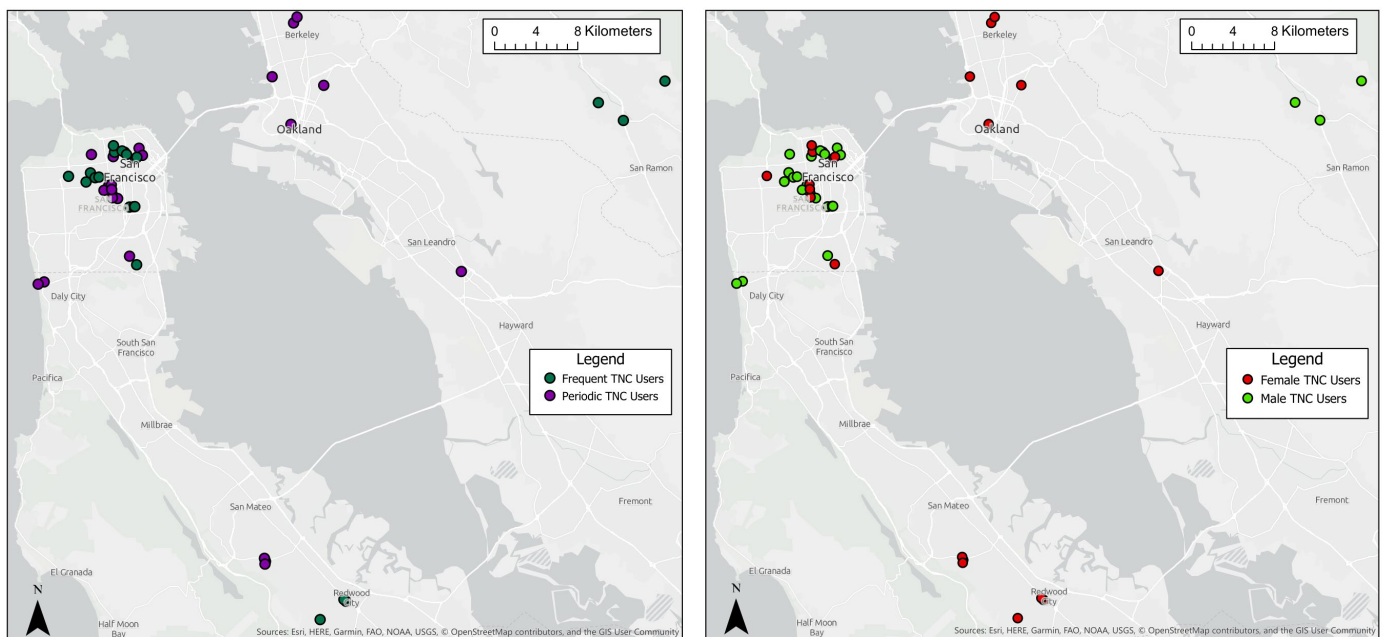

(**a**)   (**b**)

Figure 2. Photovoice participant photography locations: (**a**) frequent and periodic TNC users; (**b**) male and female TNC users. (Source: Authors, 2022).

After the photographs were taken and submitted, the authors held five small group discussions (with two-to-three participants each) and one individual interview using Zoom version 5.6.0. In each 1.5-h discussion, participants shared their photographs and reflected on the built environment features pictured. Participants also answered questions related to their TNC use, discussed preferences for incentives to pool and walk to pick-up locations, and shared thoughts on using TNCs to connect to public transit. Participants were asked to only use their first names in the Zoom meeting to maintain their confidentiality. Participants received a USD 75 Amazon gift card as compensation for attending the small group discussion. The protocol for the photovoice small group discussions is provided for download in the Supplemental Materials.

The authors qualitatively coded transcripts from each discussion. A modified version of Saldaña's "generic" coding process was used to develop key findings and recommendations [59]. First, the authors coded high-level attributes about the participants in each discussion group, including travel characteristics and the types of locations photographed. Pictures taken by participants were tagged by subject matter and then linked to transcript sections where they were discussed. Then, the authors performed multiple passes reviewing the collection of transcripts at different levels of granularity (e.g., line-by-line, statement-by-statement, topic-by-topic). On each subsequent pass, data were tagged based on shared themes, points of disagreement, patterns that developed in and between the conversations, and evaluations and judgements of policy and program suggestions. The authors used the ATLAS.ti qualitative data analysis tool version 9.0.24 to collate and analyze the tags to determine key thematic takeaways and perceptions shared by participants [60].

In July 2021, a Zoom workshop with 12 of the photovoice participants and five pooling stakeholders concluded the photovoice study. The stakeholders included department directors, program managers, and section supervisors from a public transit agency, regulatory agency, city department of transportation, transportation advocacy non-profit, and private mobility provider. During the two-hour workshop, the photovoice participants shared their photographs and pooling perceptions. The authors presented key findings and recommendations from the qualitative coding process and encouraged photovoice participants and stakeholder experts to react and provide feedback. To maintain their confidentiality in the workshop, photovoice participants were asked to only use their first names and were given the option to keep their cameras off. Photovoice participants who attended the workshop were compensated with an additional USD 50 Amazon gift card for their participation. The protocol for the workshop is provided for download in the Supplemental Materials.

4. Results

This section presents the results from the photovoice method. The results from the discussion groups are presented first, followed by the results from the workshop held with TNC users and key pooling stakeholders.

4.1. Photovoice Small Group Discussions

The following subsections discuss key findings from the small group discussions held with the photovoice participants. The first subsection presents the factors that participants identified as influencing their decision to take private TNC, pooled TNC, and public transit. The second subsection outlines the safety concerns that participants described having when walking to or waiting at TNC pick-up locations, as well as when riding in the TNC vehicle itself. The third subsection describes the differences identified between the safety perceptions of male and female TNC users, and the fourth subsection discusses the differences identified between the preferences of frequent and periodic TNC users.

4.1.1. Factors Influencing When to Take Private TNC, Pooled TNC, or Public Transit

The photovoice sessions began with a discussion of participants' experiences taking private and pooled TNC trips. Ten of the fifteen participants selected private over pooled TNC rides because of the added time from picking up and dropping off additional passengers on pooled trips. Participants also used private TNCs when they preferred privacy (e.g., on a date, to a doctor's appointment). Thirteen of the fifteen participants had taken pooled TNC trips before. Several participants mentioned surge pricing as a factor to choose more affordable pooled trips. Participants also selected pooled trips based on feelings of safety (e.g., sharing a ride with other passengers rather than just the driver). When compared to public transit, participants viewed pooling as more attractive due to shorter trip times and fewer transfers. Additionally, participants selected pooled rides when traveling outside of public transit operating hours or in locations with limited public transit access.

Participants expressed a high willingness to take indirect pooled trips within short walking distances (i.e., five to seven minutes) and for discounted trip costs. However, six of the fifteen participants expressed concern about taking indirect pooled trips if they had to walk in an unsafe area, for a long distance (i.e., more than 10 min), or in hilly areas. Others had reservations about walking at night: *"If I need to go like four blocks at 2 a.m., then that's not worth it…walking is quite dependent on the time frame"*. Two participants said that they would take indirect pooled trips when alone but had concerns about pooling when traveling with companions. As one of them explained: *"I rarely subject my friends to pooling"*. Multiple participants also expressed dissatisfaction with past indirect pooled trip experiences due to difficulty locating the TNC.

Nine of the fifteen participants used TNCs to connect to and from public transit. Participants made these connections when they could not otherwise access public transit, carried luggage or other items, lacked last-mile public transit service to the destination, or traveled outside of public transit operating hours (e.g., if feeder bus routes ended service earlier than trunk line routes). Participants who did not use TNCs to connect to public transit primarily did so out of a preference to use a single mode (i.e., public transit) for the entire trip duration. As one TNC user who frequently took transit put it, *"It's like, if I'm gonna do Muni, I'm doing Muni"*.

4.1.2. Safety Concerns with Walking to and Waiting at Pick-Up Locations, and Inside the TNC Vehicle

When discussing the photographs and pick-up/drop-off locations, virtually all participants mentioned safety as an issue or consideration when deciding where to take TNC trips from and whether to walk to the pick-up location (including to a public transit connection). Participants expressed safety concerns when walking to or waiting at pick-up locations, particularly at night: *"At that hour [11 p.m.] downtown on Market Street, you won't see as much… regular people walking around, it's probably more like homeless people just hanging out and about… If I'm by myself, I just feel like it's my safety at risk"*. Several participants mentioned not wanting to walk through or wait in neighborhoods in San Francisco that are perceived as being high in crime (e.g., Tenderloin, Hunter's Point). More than half of the participants mentioned the presence of unhoused people loitering at potential waiting areas as a source of discomfort. Participants shared fears of being approached on the street, robbed, or encountering someone facing mental health challenges with violent outcomes. As one TNC user explained, as to why she does not wait on the bench outside her apartment complex: *"They've gotten robbed in front of this bench by just, you know, people, and are harassed by the homeless people in the park across the street. And then there's also like homeless encampments just everywhere. It's not safe at all"*. Participants also described avoiding crowded areas because of possible phone snatchings and certain streets because alleyways could provide hiding places.

TNC users also factored safety into their decision of where to meet TNC drivers and make public transit connections. Participants preferred well-lit and maintained areas with clear sightlines to help them monitor their surroundings. They preferred pick-up spots

located near retail locations equipped with shelters and benches or seating and in safe neighborhoods. Figures 3–5 present collages of photovoice participant photos demonstrating these considerations.

Figure 3. "*Looks like there's a nice, wide sidewalk where you can sort of get out of people's way. So yeah, looks like a good location*". TNC users preferred to wait in areas with wide sidewalks and open visibility of the road where it is easy to connect with drivers (source: photovoice participants, 2021).

Figure 4. "*There's usually some kind of store that I can…hop in and out of if I wanted to. Like at Trader Joe's for instance, once I'm finished grabbing something, sometimes I might just…hold back a little bit and wait down by the escalators…while I wait for my Uber*". TNC users preferred pick-up spots located near retail in safe neighborhoods that are away from homeless encampments (source: photovoice participants, 2021).
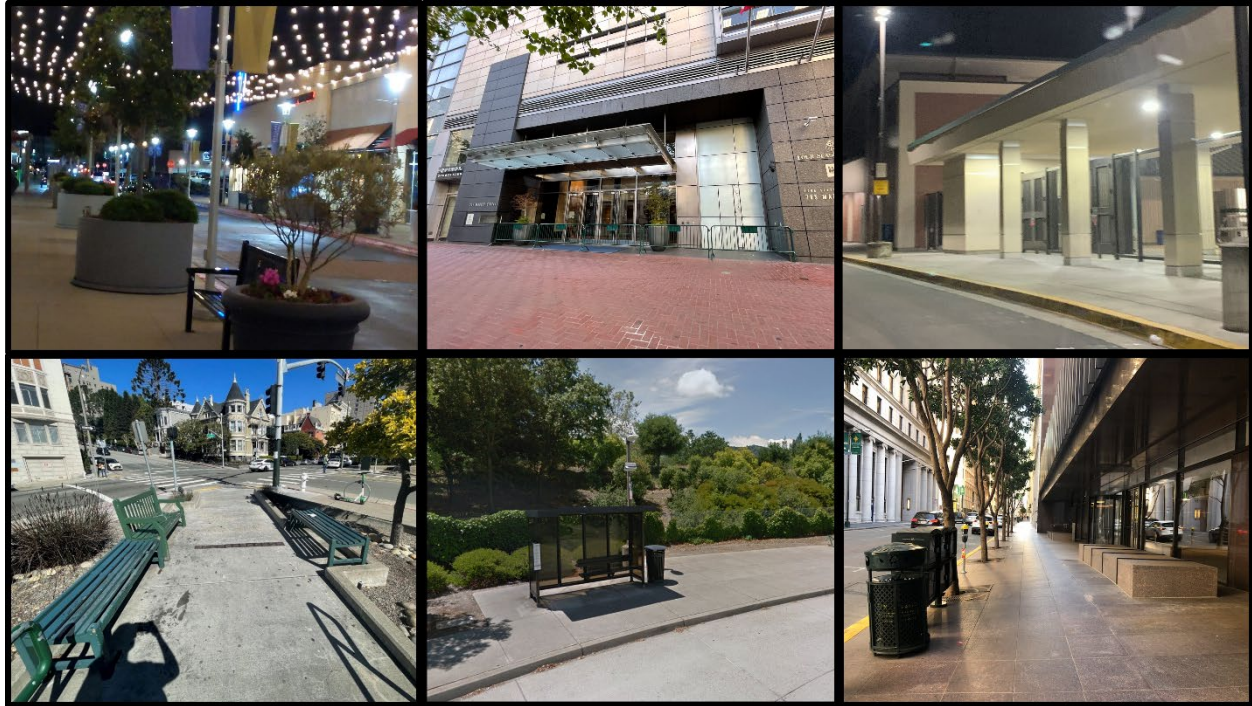
Figure 5. "*This says 'Pick me up and take me places,' it's no question*". TNC users liked waiting at pickup locations that were well-lit with shelter, covering, benches, or seating available (source: photovoice participants, 2021).

In addition to safety, participants also considered the ease of connecting with TNC drivers when deciding where to wait or connect a TNC trip to public transit. Participants preferred waiting at locations where drivers could easily pull over (e.g., white-painted curbs indicating passenger loading zones, areas with ample or unused street parking). Regarding one of his photos of a street with no safe space for pulling over, a participant pointed out: "*This is an example of nowhere to really pick up or drop off except in the crosswalk…this is sort of what I try to avoid, but I don't have any control. These are one-way streets, so if [the driver] miss[es] you…it's going to be five minutes until they can circle back and get you…this would be an example of a non-ideal location*". Participants liked locations with clear landmarks (e.g., large statues, recognizable storefronts) that aided in directing the driver to their location. Participants identified that crowded spaces were also difficult for drivers because they made locating the correct passenger a time-consuming challenge.

For the in-vehicle aspect of TNC trips, participants had mixed responses. Several felt the phone applications' current safety features do not need improvement. Others recommended changes to improve in-vehicle safety, including rating other passengers in pooled trips, automatically sending trip information (e.g., the route, passenger and driver information, estimated arrival time) to an emergency contact, and setting gender preferences for the TNC driver and other passengers. Some participants raised concerns about the lack of background checks for new TNC drivers and media stories regarding TNC drivers preying on passengers: "*We've all heard stories and stuff on the news…Especially when you have like, a mixture of late at night, and potentially drinking, and a stranger picking you up in their car…There's always the opportunity for something bad to really go wrong*".

4.1.3. Gender Differences

The discussion of safety preferences revealed key differences between male and female TNC users, which are presented in Table 1 below.

Table 1. Key differences in safety perception between male and female TNC users.

Difference	Female TNC Users	Male TNC Users
Information Disclosure	• Concerned about the TNC drivers having their home address; • Willing to be picked up or dropped off down the block from their residence to protect privacy.	• No major concerns about information disclosure.
Private versus Pooled Rides	• Those who preferred private rides did so because it offered them more control over their environment; • Those who preferred pooled rides liked having passengers other than the driver.	• Price-/time-dependent preference for private versus pooled rides.
Pick-up Locations	• Preferred waiting for TNCs near retail opportunities.	• Preferred waiting in areas where they can use phone.
Waiting Activities	• Preferred activities that did not involve having their phone out (e.g., shopping).	• Preferred using their phone while waiting (e.g., to check emails, monitor the estimated arrival time).
Surrounding Crowds	• Preferred well-traveled, not isolated locations with open and/or transparent shelters.	• Preferred waiting in areas with low foot traffic and fewer crowds.
Additional Safety Precautions	• Have a male order the ride; • Ask a male to walk them out to the vehicle; • Have a male wait outside for the ride; • Wait near a security guard or police officer; • Change the drop off location if they feel unsafe; • Share location information with a friend; • Send ride information (e.g., origin and destination, license plate number) to a third party.	• No additional safety precautions.

The male and female TNC users clearly perceived the safety of TNC experiences differently. Male TNC users made their decisions based on price and time and preferred to wait in locations where they could be on their phone without it being stolen. For female TNC users, safety directly factored into virtually every aspect of their decision making. One female TNC user described being on guard everywhere she goes: "*I try to be very careful as a woman to not be in most vulnerable positions*". Additionally, female users frequently took extra precautions (many asking a male for assistance) to feel comfortable taking a TNC trip. When another female TNC user was asked why she only takes the more expensive private TNC trips, she explained: "*Cost doesn't matter—it's about me being comfortable as a black woman and as a woman*".

4.1.4. Incentives to Pool, Walk to Pick-Up Locations, and Connect TNCs to Public Transit

Following the photography discussion, participants evaluated discounts and promotions to incentivize them to change services. The participants considered discounts as a dollar or percentage amount off the base cost and promotions as bundled services (e.g., Mobility as a Service) and "frequent rider" reward programs (i.e., participants would receive redeemable points or credits after taking X number of TNC trips).

Fourteen of the fifteen participants expressed interest in incentives to shift from private to pooled TNC trips, preferring discounts on individual trips over promotions. Participants would be incentivized to shift to pooling with discounts of about 20% to 50% off the base ride cost. As one frequent TNC user described, "*I love a good deal. When pooled rates were an option, I would ride as much as I could…as much as possible*". Additionally, eight of the fifteen participants showed interest in receiving a discount for walking to pick-up locations (i.e., taking indirect trips). Participants preferred incentives ranging from a few

dollars off the base pooled cost to an additional 20% to 50% discount. Participants with no prior experience using the indirect trip feature showed interest in trying the service for a discount, though their interest depended on the time of day and neighborhood.

Participants showed mixed interest in incentive programs to connect TNCs to public transit. Participants generally had one of three perspectives on discounts to connect TNCs to public transit: (1) a discount would not impact their behavior (e.g., they do not connect TNC trips to public transit or do so infrequently); (2) they would accept the discount but would connect TNCs to public transit regardless of if the discount existed (e.g., they are required to connect TNC trips to public transit due to transportation network gaps); or (3) they would be more likely to connect to public transit because of the incentive. The cost of the TNC connection and the convenience of the mode currently used to connect to public transit (e.g., walking, driving a personal vehicle) contributed to these perspectives.

4.1.5. Differences between Frequent and Periodic TNC Users

From the small group discussions, frequent and periodic TNC users had several differences related to their preferences on multimodal trips, incentives, and waiting locations. These differences are described in Table 2.

Table 2. Frequent and periodic TNC user differences.

Difference	Description	Frequent TNC Users	Periodic TNC Users
Multimodal Trips	Frequency in which TNC users take TNCs to connect to other modes (e.g., public transit, walking)	• Six of the seven frequent users had connected to public transit; • Six of the seven had taken indirect trips; • Five of the seven used indirect trips for at least half of their TNC trips.	• Only two of the eight periodic users had connected to public transit; • Five of the 8 had taken indirect trips; • Only three of the eight used indirect trips for at least half of their TNC trips; • Three of the eight did not know indirect trip options existed.
Incentives	Preferences for different incentive types	• Preferred "frequent ride promotion" but as a passive feature to run in the background (e.g., such as credit card rewards); • Preferred discounts for indirect trips.	• Preferred individual trip discounts; • Preferred discounts for indirect trips.
Waiting Locations	Ideal characteristics of waiting locations	• Less concerned with physical space and amenities; • More concerned with space for drivers to pull into; • Desired large, highly visible signage.	• Strong desire for select built environment features (e.g., wide sidewalks, lighting); • More selective with location (e.g., uncrowded locations, not on one-way streets). • Desired more subtle, discreet signage.

There are a few potential reasons for the differences between frequent and periodic TNC users. Frequent TNC users take TNCs for different trip types (e.g., commuting, errands, recreation) and with greater frequency. These riders likely aim to minimize their per-trip cost by taking more multimodal trips (including walking to pick-up locations) and prefer incentives catered toward frequent trips. However, periodic TNC users tend to take TNCs for "choice" trips and have other preferred options (e.g., public transit, personal car) available. They likely try to minimize the overall number of TNC trips they take, preferring incentives that reduce the cost of these "one-off" trips. Additionally, frequent TNC users exhibited fewer preferences for built environment features, likely be-

cause they are more accustomed to waiting for TNCs at ad hoc pick-up locations and concerned about easy access to the driver. Periodic TNC users, likely because they are less comfortable with accessing TNCs, showed stronger preferences for built environment features that may make the pick-up area less ambiguous.

4.2. Photovoice Workshop with TNC Users and Key Pooling Stakeholders

The workshop with TNC users and key pooling stakeholders gave participants from the photovoice activity the opportunity to share relevant photographs and discuss their perspectives on pooling, pick-up and drop-off locations, and incentives. The workshop participants identified strategies to improve TNC trips, namely, the use of designated TNC stops and enhanced in-app safety features. The participants also discussed a variety of programs to incentivize pooling and connecting TNC to public transit.

4.2.1. Designated TNC Stops

Many TNC users suggested designated TNC stops to address driver connection, trip time, and safety challenges. Designated TNC stops could provide drivers with a clearly defined space to pull over, even on busy one-way roads. Stops could also provide passengers with known waiting locations, which can improve driver and TNC user coordination and simplify time-sensitive transfers between TNCs and public transit. Additionally, designated stops could help protect safety-conscious users' privacy by offering drop-off locations other than their home address. Using designated TNC stops to provide safer, easier access to pooling could also address concerns for people who may be hesitant to try pooling.

Despite these opportunities, TNC users and stakeholders expressed concerns pertaining to designated TNC stops. As one photovoice participant put it, "*I like that idea but…I'm like afraid if there is like more shelter or seating that'll just become taken over by the homeless, and [become] dirty like the bus stops are*". Many users agreed that unhoused individuals may loiter at stops if shelters or seating were available, and they wondered how cleanliness would be maintained. One city department of transportation representative raised the point of the difficulty of paying for the upfront and maintenance costs of sheltered stops. The stakeholder shared that such concerns are part of a larger discussion on how to make people feel safe in public spaces. They recommended a better investment of resources might be to provide strong lighting at waiting locations and ensure that designated curbspace that is clearly marked in-app is available for TNC vehicles.

4.2.2. Increased In-App Safety Features

Workshop participants also pointed to enhanced in-app safety features as another way to improve TNC rides. Users and stakeholders supported adding information-related features, including providing riders with upfront information about their pooled route and fellow passengers, increasing trip preferences (e.g., driver gender selection), and adding the option to share trip information with emergency contacts. The female TNC users felt these features would help them feel safer at night or in private TNC trips, with one saying: "*I like the idea for a pooled or non-pooled trip to be able to select a female driver. For me personally, I would feel more comfortable, especially at nighttime…That would definitely make me take it more*". The private mobility provider was receptive and suggested that implementing safety information features seemed feasible.

Users and stakeholders opposed using location-based safety features (e.g., user-selected waiting preferences for geofencing pick-up areas). Users noted that geofencing might affect travel time and adding restrictions might require drivers to travel further off the optimal path to reach a new passenger's preferred pick-up zone. The private mobility provider added that restricting the number of pick-up locations could greatly increase the ride matching time. Another expert noted that location filtering presents an equity challenge—users geofencing areas they perceive as unsafe could lead to issues providing those areas with equal service.

4.2.3. Pooling Incentive Programs

Workshop participants shared ideas for pooling incentive programs beyond typical discounts and promotions. One strategy involved TNCs partnering with retailers to offer incentives to pool (e.g., discounts on products at the retailer). Participants also suggested TNCs work with high-demand venues (i.e., where parking may be limited and pooling may be more appealing, such as stadiums) to provide food or drink vouchers to pooling users. Some users showed interest in receiving discounts to purchase multiple, regular pooled trips ahead of time (e.g., to commute to school or work), with one regular TNC user saying: "*I like the bundle trip discount [idea]…when school was open, I knew the days and the times that I would need a ride and I could plan that…I don't mind paying in advance for a discount*". Workshop participants suggested that employers and schools incentivize employees and students to pool trips in the same direction by subsidizing bundled trip purchases. Finally, because the TNC users preferred waiting in or near retail spaces, the department of transportation representative suggested TNCs develop partnerships with retailers to allow TNC users to wait in their space for their ride. Retail partnerships with TNCs could provide users with safe and preferred locations to wait in, drivers with clear and recognizable landmarks, and retailers with potential customers.

4.2.4. Incentives to Connect TNCs to Public Transit

Workshop participants also shared strategies with which to incentivize connecting TNC to public transit. TNC users showed interest in public transit connections if timed transfers existed between the two modes. This could address concerns about missing a public transit transfer due to a late TNC connection. Users also liked the idea of transferring between TNC and public transit using an integrated fare payment system that provided mode transfer discounts, with one public transit riding TNC user saying: "*Setting the discount for transfers is interesting. I think a lot of bus passes have a discount if you transfer within a certain time, so I think that would be good [for TNC] as well*".

The stakeholders had positive feedback about incentivizing TNC connections to public transit. However, the logistics of mode transfer discounts raised concerns. The private mobility provider shared that connecting users to public transit is a key aspect of their existing service model. The largest challenge they face with facilitating transfers is integrating fare payment because people often use fare cards or other forms of payment that may be incompatible with their service's payment system. Additionally, while supportive, the public transit stakeholder expressed concern about the discount multimodal trips would receive. The stakeholder stressed that incentives should be tied to mode efficiency or sustainability and shared that they think pooled TNC trips connecting to public transit should be incentivized the most, followed by indirect pooled trips, and then direct pooled trips.

5. Discussion and Conclusions

The results of this study highlight the similarities between TNCs and typical public transit modes. TNCs and public transit are often treated as having different (sometimes interacting) sets of challenges. The photovoice methodology revealed that the preferences and concerns shared by the TNC user participants are nearly identical to those expressed by public transit users found in the literature.

The TNC users identified benches, lighting, shelter, wide sidewalks, and ample signage as the primary built environment features they preferred at pick-up locations. These features are directly in line with those preferred by public transit users and suggested in transit stop design guides [61,62]. Some of the TNC users stated they do not use TNCs to connect to public transit out of a preference for not changing modes, and others valued trip planning features and timed transfers. This sentiment is consistent with bus and rail transit riders who prefer to minimize transfers in their own travel, as well as the significant increases to public transit ridership resulting from transit smartphone applications and timed transfers [63,64]. The pricing incentives the TNC users preferred are also similar to

incentives that have proven successful with increasing public transit ridership, namely, discounts on bundled rides and mode transfers [65].

In addition, the TNC user perceptions of safety were also largely consistent with those found in the public transit literature. Study participants preferred waiting in locations near retail and in areas with clear visibility of surroundings. This mirrors previous findings that describe public transit riders choosing to wait at certain stops based on their perceptions of negative land use or avoiding areas with poor natural surveillance [35]. The differences in the male and female TNC user perceptions of safety are also identical to those found in the literature, including the fact that female users of both modes take additional precautions to feel safer, such as having a significant other wait with them at the stop [29].

One difference in safety perceptions between TNC users and the literature on public transit riders is the perception of the driver and fellow passengers. TNC users in the photovoice discussions expressed safety concerns regarding TNC drivers due to their lack of background checks, and in some cases, they felt safer taking a pooled ride with others because it meant they were not in the vehicle alone. This is in stark contrast to public transit user perceptions, where the driver is typically viewed as a figure of authority and security whose presence improves in-vehicle safety, while fellow transit passengers are viewed as a possible safety concern [66–68].

Despite the advanced technology of TNCs and the ability for their users to order rides from virtually anywhere, many of the participants in this study approached using TNCs in a manner similar to how they approach waiting for and riding public transit. Although prior research on TNCs tends to focus on the in-vehicle part of the trip, the results from this study suggest that future TNC studies should mirror the public transit literature and factor in the built environment and out-of-vehicle trip aspects when considering the TNC user experience.

In addition to revealing similarities between TNCs and public transit, the photovoice discussions confirm and expand upon conclusions regarding the different preferences of frequent and periodic TNC users. Lazarus et al. identified that users who take TNCs with a similar frequency (i.e., frequent versus periodic use) often exhibit similar travel behavior patterns and preferences [15]. The photovoice discussions suggest that the differences in these user groups extend to how the users perceive incentives and the built environment. The frequent TNC users prioritized ease of locating the driver and bundled incentives, while periodic TNC users prioritized comfort at waiting locations and single-trip discounts. While further research is needed to quantify the magnitude of these differences, the results of this study suggest that future policies designed to increase pooling should consider taking different approaches based on the type of TNC user to whom the policies are catered.

5.1. Policy Recommendations

Decision-makers can use these findings to develop policies that support pooling. City governments and departments of transportation can use curb markings, signage, and strong lighting to create designated areas for pooled pick-up/drop-off on busy streets and near popular destinations. TNCs can also work with local retailers to make their stores "safe waiting locations" that support the pooling system through existing infrastructure. Stakeholders could work with TNCs to ensure they present designated pick-up areas and safe waiting locations in their applications and that indirect pooled trips prioritize routing to these locations. Forming data-sharing agreements between public agencies and TNCs can help reduce some of the existing friction with implementing these changes, while improving curbspace use and transportation safety and efficiency. TNCs can also work to improve the user experience by incorporating safety features in-app that provide riders with more upfront trip information, the option to share trip information with emergency contacts, and the location of nearby security personnel.

This study also suggests that more users could be incentivized to pool and use TNCs to connect with public transit. Trips that people make regularly (e.g., to employers or schools), without urgency (e.g., to retailers), or to/from popular destinations (e.g., to venues, from airport departures) are low-hanging fruit for pooling. Representatives from these destinations can form mutually beneficial partnerships with TNCs to develop incentive packages to encourage people traveling to or from these locations to pool their rides. Public transit agencies can encourage the use of TNCs to connect to public transit by working with TNCs to integrate fare payment systems and provide discounts for mode transfers. As over 80% of cities in the United States have plans to deploy near-field-communications mobile ticketing systems within the next decade, TNCs can leverage this technology in smartphones to allow users to make one payment for their whole trip [69]. TNCs can also facilitate public transit connections by incorporating public transit trip planning in their applications and providing in-app walking directions between pick-up/drop-off points and public transit stations to minimize transfer time.

5.2. Study Limitations

The photovoice methodology has several limitations. Photovoice studies generally have small sample sizes due to the time commitment required of participants. This can lead to results that may not be representative of the larger population [70]. In this study, 15 TNC users from the San Francisco Bay Area participated. While shared themes were found across the different photovoice discussion groups, suggesting that data saturation was sufficiently reached, given the geographic restriction on participation, the results may not be representative of all TNC users [71]. A future study using the same methods with a larger sample size and geographic area could likely gain further insights on the topic.

Additionally, the quality of photos in a photovoice study can be inconsistent due to differences in participants' photography skills [72]. To mitigate inconsistency issues, the authors encouraged participants to respond to others' photos in addition to their own during the small group discussions.

Finally, due to ethical concerns and possible consent issues, photovoice participants were not allowed to take photographs of other people [73]. This can bias responses, particularly in situations when others affect a participant's experience. For this study, the authors asked participants to not take photos of others and instead describe how a person may have affected their experience in a caption. The authors also used probing questions to identify how interactions with others affected the TNC experience.

Another limitation of group discussions in qualitative research is that an "extrovert" or "group leader" effect can occur, which could affect group dynamics or potentially skew opinions [74]. The authors tried to reduce the potential for this effect by having photovoice participants capture their original thoughts about pick-up locations via their photograph captions, which were submitted prior to the group discussions. Additionally, the moderator for the photovoice discussions and workshop made a concerted effort to use probing questions to explore inconsistencies and ensured that all participants were able to speak an equal amount. Future work on this topic could extend these measures by holding one-on-one interviews with all participants prior to the group discussions.

The modifications made to the photovoice methodology created several additional limitations. Because the authors screened participants for their ability to take and upload photographs and use Zoom, populations with limited internet or cell phone access may have been excluded. The authors also asked participants who self-identified as being vulnerable to COVID-19 to abstain from participating since the study involved participants taking photographs outside. This may have excluded groups vulnerable to COVID-19 (e.g., older adults, people with pre-existing medical conditions) [75]. Future photovoice implementations not conducted during a global pandemic can address these limitations by making participation accessible to potentially marginalized communities and communities with limited access to technology.

A final limitation was that TNCs stopped offering the pooled option (direct or indirect) in March 2020 due to COVID-19, and only resumed them in mid-2022 [76–78]. The photovoice participants were asked to discuss their most recent pooled TNC trips; however, due to the pandemic, they would not have been able to take a pooled TNC trip in over a year by the time of the photovoice discussions (May 2021). Participants had to rely on their recollection of pooled trips, which could have led to responses being altered due to recall bias [79,80]. The authors tried to mitigate this possibility by asking probing follow-up questions to ensure details were not omitted or misremembered.

5.3. Future Research

This study identified many areas for future research on pooling. One area of interest identified by stakeholders is to work to re-align the goals of TNC drivers and users. One stakeholder noticed that many of the issues users cited stemmed from driver-based factors (e.g., drivers rushing passengers during pick-up, drivers not picking up at the location shown in-app). This is largely because drivers try to meet certain goals, some of which may be promoted by the TNC provider through the app (e.g., completing trips in a time limit, expedient pick-ups/drop-offs). However, driver goals are often in opposition to the users' goals (e.g., safe and comfortable rides). Further research exploring system adjustments and driver-focused incentive strategies could lead to greater parity from both perspectives.

Another area for future research stems from the gender differences in how TNC users perceive the safety of pooled trips. While in-app safety features are helpful, they do not address the root problem, i.e., that the perception of safety while waiting in public is inequitable between males and females. Research exploring how incentives and environmental factors impact the decision to pool specifically as it relates to user gender could illuminate why certain users feel uncomfortable. Strategies developed to address these issues can lead to making pooling equitable for all users.

This study also invites further inquiry into quantifying the effect of safety features and built environment improvements on pooling and public transit connections. The photovoice discussions highlight an interest in these features among existing users, but they do not quantify their possible impact. A future study with a larger sample of existing and new TNC users could implement several built environment improvements or incentive policies and compare the impact on pooling and public transit connections to a control group without improvements to measure if a significant travel change results. Another area for inquiry is to quantify the trade-off that TNC users make between the distance to walk to a pick-up location and the quality of the walking experience.

References

1. TomTom Traffic Index. *TomTom Traffic Index: Global Traffic Congestion Up as Bengaluru Takes Crown of 'World's Most Traffic Congested City'*; TomTom Traffic Index: London, UK, 2020.
2. Schaller, B. *Unsustainable? The Growth of App-Based Ride Services and Traffic, Travel and the Future of New York City*; Schaller Consulting: New York, NY, USA, 2017.
3. Henao, A.; Marshall, W.E.; Janson, B.N. *Impacts of Ridesourcing on VMT, Parking Demand, Transportation Equity, and Travel Behavior*; University of Colorado: Denver, CO, USA, 2019.
4. Gehrke, S. *A Survey of Ride-Hailing Passengers*; PSU Transportation Seminars: State College, PA, USA, 2018; p. 152.
5. International Transport Forum. *Shared Mobility Simulations for Helsinki*; International Transport Forum: Leipzig, Germany, 2017.
6. Anair, D.; Martin, J.; Moura, P.d.; Cecilia, M.; Goldman, J. *Ride-Hailing Climate Risks*; Union of Concerned Scientists: Cambridge, MA, USA, 2020.
7. California Air Resource Board. *About*; California Air Resource Board: Sacramento, CA, USA, 2023.
8. Shaheen, S.; Cohen, A. Shared Ride Services in North America: Definitions, Impacts, and the Future of Pooling. *Transp. Rev.* **2018**, *39*, 427–442.
9. Young, M.; Farber, S.; Palm, M. The True Cost of Sharing: A Detour Penalty Analysis between UberPool and UberX Trips in Toronto. *Transp. Res. Part D Transp. Environ.* **2020**, *87*, 102540.
10. Martin, E.; Shaheen, S.; Stocker, A. *Impacts of Transportation Network Companies on Vehicle Miles Traveled, Greenhouse Gas Emissions, and Travel Behavior Analysis from the Washington D.C., Los Angeles, and San Francisco Markets*; Transportation Sustainability Research Center: Richmond, CA, USA, 2021.
11. Sarriera, J.M.; Álvarez, G.E.; Blynn, K.; Alesbury, A.; Scully, T.; Zhao, J. To Share Or Not to Share: Investigating the Social Aspects of Dynamic Ridesharing. *Transp. Res. Rec.* **2017**, *2605*, 109–117.
12. Moody, J.; Zhao, J. Adoption of Exclusive and Pooled TNC Services in Singapore and the US. *J. Transp. Eng. Part A* **2020**, *146*, 4020102.
13. Schaller, B. *The New Automobility: Lyft, Uber, and the Future of American Cities*; Schaller Consulting: New York, NY, USA, 2018.
14. Young, M.; Farber, S. The Who, Why, and when of Uber and Other Ride-Hailing Trips: An Examination of a Large Sample Household Travel Survey. *Transp. Res. Part A Policy Pract.* **2019**, *119*, 383–392.
15. Lazarus, J.R.; Caicedo, J.D.; Bayen, A.M.; Shaheen, S.A. To Pool Or Not to Pool? Understanding Opportunities, Challenges, and Equity Considerations to Expanding the Market for Pooling. *Transp. Res. Part A Policy Pract.* **2021**, *148*, 199–222.
16. Kang, S.; Mondal, A.; Bhat, A.C.; Bhat, C.R. Pooled Versus Private Ride-Hailing: A Joint Revealed and Stated Preference Analysis Recognizing Psycho-Social Factors. *Transp. Res. Part C Emerg. Technol.* **2021**, *124*, 102906.
17. Clewlow, R.R.; Mishra, G.S. *Disruptive Transportation: The Adoption, Utilization, and Impacts of Ride-Hailing in the United States*; University of California: Davis, CA, USA, 2017.
18. Grahn, R.; Harper, C.D.; Hendrickson, C.; Qian, Z.; Matthews, H.S. Socioeconomic and Usage Characteristics of Transportation Network Company (TNC) Riders. *Transportation* **2019**, *47*, 3047–3067.
19. Lavieri, P.S.; Bhat, C.R. Investigating Objective and Subjective Factors Influencing the Adoption, Frequency, and Characteristics of Ride-Hailing Trips. *Transp. Res. Part C Emerg. Technol.* **2019**, *105*, 100–125.
20. Shaheen, S. *Shared Mobility: The Potential of Ride Hailing and Pooling*; Springer: Berlin/Heidelberg, Germany, 2018.
21. Shaheen, S.; Bell, C.; Cohen, A.; Yelchuru, B.; Booz Allen Hamilton, I. *Travel Behavior: Shared Mobility and Transportation Equity*; Bureau of Transportation Statistics: Washington, DC, USA, 2017.
22. Jiao, J.; Wang, F. Shared Mobility and Transit-Dependent Population: A New Equity Opportunity Or Issue? *Int. J. Sustain. Transp.* **2021**, *15*, 294–305.
23. Gill, P.; Stewart, K.; Treasure, E.; Chadwick, B. Methods of Data Collection in Qualitative Research: Interviews and Focus Groups. *Br. Dent. J.* **2008**, *204*, 291–295.
24. Davis, G.A. Possible Aggregation Biases in Road Safety Research and a Mechanism Approach to Accident Modeling. *Accid. Anal. Prev.* **2004**, *36*, 1119–1127.
25. Gordon, M.T.; Riger, S. *The Female Fear*; Free Press: New York, NY, USA, 1989; pp. xvi, 230.
26. Stanko, E.A. *Everyday Violence: How Women and Men Experience Sexual and Physical Danger*; Pandora; Unwin Hyman: London, UK; Winchester, UK, 1990; p. 167.
27. Ross, C.E. Walking, Exercising, and Smoking: Does Neighborhood Matter? *Soc. Sci. Med.* **2000**, *51*, 265–274.
28. Brownson, R.C.; Baker, E.A.; Housemann, R.A.; Brennan, L.K.; Bacak, S.J. Environmental and Policy Determinants of Physical Activity in the United States. *Am. J. Public Health* **2001**, *91*, 1995–2003.
29. Lynch, G.; Atkins, S. The Influence of Personal Security Fears on Women's Travel Patterns. *Transportation* **1988**, *15*, 257–277.
30. Wekerle, G.R.; Whitzman, C. *Safe Cities: Guidelines for Planning, Design, and Management*; Van Nostrand Reinhold: Washington, DC, USA, 1995; p. 232.
31. Loukaitou-Sideris, A. *Is It Safe to Walk Here? Design and Policy Responses to Women's Fear of Victimization in Public Places*; National Academies Press: Washington, DC, USA, 2023

32. Meredith-Karam, P.; Kong, H.; Wang, S.; Zhao, J. The Relationship between Ridehailing and Public Transit in Chicago: A Comparison before and After COVID-19. *J. Transp. Geogr.* **2021**, *97*, 103219.

33. Manville, M.; Taylor, B.D.; Blumenberg, E. *Falling Transit Ridership: California and Southern California*; Southern California Association of Governments: Los Angeles, CA, USA, 2018.

34. Bell, L.; Beltran, G.; Berry, E.; Calhoun, D.; Hankins, T.; Hester, L. Public Transit and Social Responsibility: Homelessness. 2018.

35. Loukaitou-sideris, A. Hot Spots of Bus Stop Crime. *J. Am. Plan. Assoc.* **1999**, *65*, 395–411.

36. Bhuiyan, J. *Uber's New 'Express Pool' Is All about Getting More Riders to Share Rides*; Vox: Washington, DC, USA, 2018.

37. Leighfisher; Dowling Associates; JD Franz Research, Inc.; WILTEC. *Airport Curbside and Terminal Area Roadway Operations*; Transport Research Board: Washington, DC, USA, 2010.

38. Shaheen, S.; Cohen, A.; Randolph, M.; Farrar, E.; Davis, R.; Nichols, A. *Shared Mobility Policy Playbook*; Transportation Sustainability Research Center: Richmond, CA, USA, 2019.

39. San Francisco Municipal, Transportation Agency. *Curb Management Strategy*; San Francisco Municipal, Transportation Agency: San Francisco, CA, USA, 2020.

40. American Public, T.A. *Design of On-Street Transit Stops and Access from Surrounding Areas*; American Public Transportation Association: Washington, DC, USA, 2012.

41. Mandle, P.; Box, S. *Transportation Network Companies: Challenges and Opportunities for Airport Operators*; Transportation Research Board: Washington, DC, USA, 2017.

42. Aono, S. *Identifying Best Practices for Mobility Hubs*; UBC Sustainability: Vancouver, BC, Canada, 2019.

43. Cohen, A.; Shaheen, S. *Planning for Shared Mobility*; American Planning Association: Chicago, IL, USA, 2018.

44. Alonso-González, M.J.; Cats, O.; van Oort, N.; Hoogendoorn-Lanser, S.; Hoogendoorn, S. What are the Determinants of the Willingness to Share Rides in Pooled on-Demand Services? *Transportation* **2021**, *48*, 1733–1765.

45. Wang, C.; Burris, M.A. Photovoice: Concept, Methodology, and use for Participatory Needs Assessment. *Health Educ. Behav.* **1997**, *24*, 369–387.

46. Hergenrather, K.C.; Rhodes, S.D.; Cowan, C.A.; Bardhoshi, G.; Pula, S. Photovoice as Community-Based Participatory Research: A Qualitative Review. *Am. J. Health Behav.* **2009**, *33*, 686–698.

47. Wang, C.C. Photovoice: A Participatory Action Research Strategy Applied to Women's Health. *J. Women Health* **1999**, *8*, 185–192.

48. Palibroda, B.; Krieg, B.; Murdock, L.; Havelock, J. *A Practical Guide to Photovoice: Sharing Pictures, Telling Stories and Changing Communities*; Prairie Women's Health Centre of Excellence: Winnipeg, MB, Canada, 2023.

49. Soma, T.; Li, B.; Shulman, T. A Citizen Science and Photovoice Approach to Food Asset Mapping and Food System Planning. *J. Plan. Educ. Res.* **2022**, *0*, doi:10.1177/0739456X221088985..

50. Castleden, H.; Garvin, T.; First Nation, H. Modifying Photovoice for Community-Based Participatory Indigenous Research. *Soc. Sci. Med.* **2008**, *66*, 1393–1405.

51. True, G.; Rigg, K.K.; Butler, A. Understanding Barriers to Mental Health Care for Recent War Veterans through Photovoice. *Qual. Health Res.* **2015**, *25*, 1443–1455.

52. Sitter, K.C.; Mitchell, J. Perceptions of Paratransit Accessibility among Persons with Disabilities: An Adapted Photovoice Study. *Health Promot. Pract.* **2020**, *21*, 769–779.

53. Foster, K.A.; Davis, B.; Foell, A. Innovations to Photovoice: Using Smartphones & Social Media. *Urban Aff. Rev.* **2022**, *59*, 1728–1744.

54. Tanhan, A.; Strack, R.W. Online Photovoice to Explore and Advocate for Muslim Biopsychosocial Spiritual Wellbeing and Issues: Ecological Systems Theory and Ally Development. *Curr. Psychol.* **2020**, *39*, 2010–2025.

55. Garcia, I.; Alberson, M.; Puczkowskyj, N.; Maheruma, S.; Fagundo Ojeda, K. *Public Transit and Gender-Based Harassment: A Photovoice Project*; Elsevier: Amsterdam, The Netherlands, 2022.

56. Bhandal, J.; Noonan, R.J. Motivations, Perceptions and Experiences of Cycling for Transport: A Photovoice Study. *J. Transp. Health* **2022**, *25*, 101341.

57. Oliffe, J.L.; Creighton, G.; Robertson, S.; Broom, A.; Jenkins, E.K.; Ogrodniczuk, J.S.; Ferlatte, O. Injury, Interiority, and Isolation in Men's Suicidality. *Am. J. Mens. Health* **2017**, *11*, 888–899.

58. Hanby, E.; Gazarian, P.K.; Potter, J.; Jones, R.; Elhassan, N.; Tan, A.S.L. "I Liked just that it was a Communal Thing": Feasibility and Acceptability of Engaging with Transgender and Gender-Diverse Persons in a Digital Photovoice Research Study on Commercial Cigarette Smoking Risk and Protective Factors. *Digit. Health* **2023**, *9*, 20552076231169819.

59. Saldana, J. The Coding Manual for Qualitative Researchers; SAGE: Newcastle upon Tyne, UK, 2012; p. 330.

60. ATLAS.ti. *Scientific Software Development GmbH*; ATLAS.ti Scientific Software Development GmbH: Berlin Germany, 2023.

61. Sun, S.; Fang, D.; Cao, J. Exploring the Asymmetric Influences of Stop Attributes on Rider Satisfaction with Bus Stops. *Travel Behav. Soc.* **2020**, *19*, 162–169.

62. Texas Transportation Institute; Texas A & M Research Foundation. *Guidelines for the Location and Design of Bus Stops*; National Academy Press: Washington, DC, USA, 1996.

63. Horowitz, A.J.; Zlosel, D.J. Transfer Penalties: Another Look at Transit Riders' Reluctance to Transfer. *Transportation* **1981**, *10*, 279–282.

64. Brakewood, C.; Macfarlane, G.S.; Watkins, K. The Impact of Real-Time Information on Bus Ridership in New York City. *Transp. Res. Part C Emerg. Technol.* **2015**, *53*, 59–75.

65. Hirsch, L.R.; David Jordan, J.; Hickey, R.L.; Cravo, V. Effects of Fare Incentives on New York City Transit Ridership. *Transp. Res. Rec.* **2000**, *1735*, 147–157.
66. Salonen, A.O. Passenger's Subjective Traffic Safety, in-Vehicle Security and Emergency Management in the Driverless Shuttle Bus in Finland. *Transp. Policy* **2018**, *61*, 106–110.
67. Park, K.; Farb, A.; Chen, S. First-/Last-Mile Experience Matters: The Influence of the Built Environment on Satisfaction and Loyalty among Public Transit Riders. *Transp. Policy* **2021**, *112*, 32–42.
68. Loukaitou-Sideris, A. Fear and Safety in Transit Environments from the Women's Perspective. *Secur. J.* **2014**, *27*, 242–256.
69. Global Mass Transit. *NFC Mobile Ticketing for Transit Report 2021–2030*; Global Mass Transit: Delhi, India, 2020.
70. Nykiforuk, C.I.J.; Vallianatos, H.; Nieuwendyk, L.M. Photovoice as a Method for Revealing Community Perceptions of the Built and Social Environment. *Int. J. Qual. Methods* **2011**, *10*, 103–124.
71. Hennink, M.; Kaiser, B.N. Sample Sizes for Saturation in Qualitative Research: A Systematic Review of Empirical Tests. *Soc. Sci. Med.* **2022**, *292*, 114523.
72. Turnbull, S. The Uses and Limits of Photovoice in Research on Life After Immigration Detention and Deportation. In *Methods of Criminology and Criminal Justice Research*; Deflem, M., Silva, D.M.D., Eds.; Emerald Publishing Limited: Bingley, UK, **2019**; Volume 24, pp. 151–164.
73. Woodgate, R.L.; Zurba, M.; Tennent, P. Worth a Thousand Words? Advantages, Challenges and Opportunities in Working with Photovoice as a Qualitative Research Method with Youth and their Families. In *Forum Qualitative Sozialforschung/Forum: Qualitative Social Research*; Institute for Qualitative Research and Center for Digital Systems: Berlin, Germany, **2017**; p. 18.
74. Stewart, D.W.; Shamdasani, P.N.; Rook, D.W. Group Dynamics and Focus Group Research; In *Focus Groups: Theory and Practice*; SAGE Publications, Inc.: Thousand Oaks, CA, USA, **2006**; Volume 20, p. 19.
75. Centers for Disease Control, and Prevention. *COVID-19 and Your Health*; Centers for Disease Control, and Prevention: Atlanta, GA, USA, 2020.
76. Hawkins, A.J. *Uber and Lyft Suspend Carpooling in Response to Coronavirus Pandemic*; Vox: Washington, DC, USA, 2020.
77. Desai, S. *Uber Pool Is a Zombie*; The Atlantic: Washington, DC, USA, 2022.
78. Holt, K. *Lyft Brings Shared Rides Back to More Cities, Including San Francisco*; Engadget: Sterling, AW, USA, 2022.
79. Ilagan, C.; Akbari, Z.; Sethi, B.; Williams, A. Use of Photovoice Methods in Research on Informal Caring: A Scoping Review of the Literature. *J. Hum. Health Res.* **2020**, *1*, 1–14.
80. Angelo, J.; Egan, R. Family Caregivers Voice their Needs: A Photovoice Study. *Palliat. Support Care* **2015**, *13*, 701–712.