To Share or Not to Share: Investigating the Social Aspects of Dynamic Ridesharing

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TO SHARE OR NOT TO SHARE: INVESTIGATING THE SOCIAL ASPECTS OF DYNAMIC RIDESHARING

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ABSTRACT

Transportation Network Companies (TNCs) have recently introduced shared ride versions of their ordinary services, such as UberPool or Lyft Line. The concept is simple: passengers pay less in fares for an incremental increase in time spent picking up and dropping off other riders. This paper focuses on the social and behavioral considerations of shared rides, which have not been explored as thoroughly as time and cost trade-offs in transportation. A survey of TNC users conducted through Mechanical Turk in June and July of 2016 with 997 respondents across the United States found that: (i) users of dynamic ridesharing services report that social interactions are relevant to mode choice, although not as much as traditional factors such as time and cost; (ii) overall, the possibility of having a negative social interaction is more of a deterrent than the potential of having a positive social interaction is an incentive to using dynamic ridesharing; (iii) there is evidence that a substantial number of riders harbor feelings of prejudice towards passengers of different social class and race, and these passengers are much more likely to prefer having more information about potential future passengers; (iv) that most dynamic ridesharing users are motivated to use it due to its ease and speed compared to walking and public transportation; and (v) that safety in dynamic ridesharing is an important issue, especially for women, many of whom report feeling unsafe and prefer to be matched with passengers of the same sex.

Keywords: Transportation Network Companies, Dynamic Ridesharing, Social, Prejudice, Carpooling.

INTRODUCTION

Uber and Lyft, two Transportation Network Companies (TNCs), have recently introduced carpool versions of their services in many cities throughout the world. The concept of this service is simple: passengers save money in exchange for the time lost while taking a longer route, as might be required to pick up or drop off other passengers. Therefore, if it is often assumed that the decision to use this service is based on this exchange of time for money, the only factors that would be relevant for understanding the behavior of potential users.

Another characteristic of these shared ride alternatives is that users accept to share the backseat of a car, a private and intimate space in private rides, with unknown fellow passengers. How users perceive the social dimensions of sharing time and space with strangers is still unclear. Some passengers may positively value the opportunity to interact with new people, while others may consider these interactions inconvenient, unsafe, or even as an experience during which they are subject to discrimination from fellow passengers.

Given the rapid spread of this service known as dynamic ridesharing, our research questions focused on investigating whether people perceive it as having positive or negative utility with respect to its social aspects, what influences those perceptions, and how they compare with traditional factors like time and cost. In order to better understand the social dimensions of dynamic ridesharing services, we designed a survey to explore how people of different ages, genders, sociodemographic backgrounds, travel behaviors, and personalities use and experience the social aspects of ridesharing, and what types of social interventions might make them more or less likely to use the service.

This research is potentially relevant from at least three perspectives. First, it could inform policy, communication tactics to riders, and capabilities to facilitate interaction between passengers. Second, the approaches proposed here could be considered when analyzing or modeling travel mode choices made by individuals. Finally, other modes could also benefit from the methodology developed, as they also have social dimensions that can affect decisions made by their users.

LITERATURE REVIEW

Socioeconomic factors

Previous carpooling literature has investigated socioeconomic factors, such as age, gender, income, in addition to distance, and travel time, that influence the propensity to share rides through traditional carpooling. Contrary to potential assumptions that women may be less likely to rideshare due to fears of strangers or physical harm, multiple studies have found that women are more likely to carpool than men. One survey of carpool participants in the Toronto area from 2009 (*1*) found women to be 1.3 times more likely to form a successful carpool than males, while another more recent study from 2012 (*2*) found gender (specifically being a woman) to be the most significant factor in determining the likelihood of respondents to carpool.

Age is another important factor: studies have found that carpooling tends to increase with age up to approximately 55 years, beyond which very few people carpool (*1*). Early literature also found that vehicle ownership is an important factor, with 30% of workers from households who have fewer vehicles than workers choosing to carpool, compared to just 16% when there is a vehicle available for every worker. Income and occupation have also been identified as important factors, with lower income and laborer occupations being more likely to carpool than

higher-income, professional occupations (*3*). Additionally, research by Kearney and De Young (*4*) has indicated that multimodalism matters: those who only drive are less likely to try ridesharing than those who are familiar with other modes.

More recent literature has begun to investigate the particular sociodemographic factors of users of TNCs such as Uber and Lyft. A 2014 survey in San Francisco (*5*) found users tend to be younger, own fewer vehicles, and travel more frequently with companions, and that passengers use ridesourcing, like taxis, as both a complement to and substitute for public transit.

Attitude, motivation, and other behavioral factors

In addition to socioeconomic factors, other literature has focused on people's personality types, attitudes, and motivations with respect to ridesharing, investigating extraversion, disposition towards diversity, convenience, reliability, comfort, safety, environmentalism, and constraints on autonomy as potential factors. Several researchers and practitioners have found evidence that people are resistant to the idea of sharing a ride with strangers, and that fostering trust among strangers is an important element to successfully encouraging ridesharing.

Some research has attempted to understand how different aspects of personality may influence people's attitudes towards sharing with strangers. A study by Deloach and Tiemann (*6*) found that those who spent more non-community time alone (used as a proxy for introverts) favored driving alone, while those who socialized more while eating and drinking (used as a proxy for extroverts) were more likely to use other alternatives. Being married also decreased the likelihood of carpooling.

In another study, Kauff et al. (*7*) investigated people's beliefs about the instrumentality of diversity, which is correlated with reduced prejudice and an increase in willingness to interact with others, and their likelihood of exhibiting bias against sharing rides with people with foreign-sounding names. In interviews for Li and Zhao's 2016 paper (*8*), over half of ethnically minority taxi drivers interviewed reported experiencing racist comments from passengers. As ride-matching services share more information about users and match people from different backgrounds, the potential for discrimination between passengers and drivers is likely to make this aspect even more relevant.

Some research has indicated that existing social ties, even if weak, may play a role in influencing travelers' attitudes towards ridesharing. A study in New Zealand in 2010 (*9*) found that 41% of commuter survey respondents thought it would be difficult to trust someone they did not know offering or requesting to share a ride. However, the same respondents were willing to share rides with friends of friends (69%) and with other members of their university community (50%), while just 7% were willing to share a ride with a complete stranger. An earlier study in 1997 (*10*) found similar results, stating that people preferred to form carpools with friends of the same sex and job level.

Potential for behavior change

While traditional ridesharing has maintained a relatively low mode share nationally, many believe that new technologies' potential to improve convenience poses a opportunity to increase ridesharing mode share. A 2004 thesis (*11*) from the Massachusetts Institute of Technology (MIT) modeled the role of technology, incentives, and personalized marketing on MIT single-occupant commuters, and estimated that 65% of consistent, single-occupant commuters could share rides, leading to a 19% institute-wide reduction in vehicle miles traveled.

Traditionally, successful policy interventions have included high-occupancy vehicle lanes, pricing parking, and employer commuter benefits, while marketing and information campaigns have had relatively little effect according to Hwang and Giuliano (*3*). Earlier research hypothesized that a lack of information about potential passengers was a major barrier to accepting ride sharing. A 1995 study (*4*) highlights that while technology makes the rapid sharing of personal information and matching possible, numerous questions arise about what type of information might be most effective in encouraging people to share a ride and what unintended consequences may arise.

In a recent review of the social aspects of transportation, Dugundji et al. (*12*) discovered a variety of studies with relevant findings. The authors found that the establishment of social norms within ridesharing and other travel modes is an important factor in individuals' decisions to use that mode. Similar to investigating the role of social capital and "weak ties," one study found that carpooling with "familiar strangers" – those we see on a regular basis in an urban setting but have never interacted with – provided people the positive benefits of a sense of security and ability to develop emerging rules on social aspects such as conversation and music choice without imposing a burden of commitments and obligation to future interaction. The familiar stranger concept could help inform dynamic ridesharing service design elements such as sharing information about passengers, rating systems, and prompting social norms (*13*).

Relatedly, Li and Zhao (*8*) identify that TNCs have leveraged technology to generate a perception of accountability, mediation, and human connection between drivers and passengers than traditional taxi relationships (Li & Zhao, 2016). They refer to this relationship as a "pseudo-relationship" in which customers do not share future likelihood of interacting with an individual driver but do share an expectation to continue interacting with the company. TNCs have so far experienced success by placing an emphasis on user experience, and particularly on driver-passenger interaction through sharing information and providing ratings.

For decades, researchers have investigated the demographic factors, attitudes, motivations, and potential interventions that make individuals more or less likely to share a ride in hopes of increasing carpooling mode share to reduce congestion and improve environmental outcomes. Today, the rise of technology-enabled, on-demand dynamic ridesharing through UberPool, Lyft Line, and others lowers many of the previous barriers such as easy matching, scheduling, and information, indicating an important need to re-investigate the driving factors of ridesharing behavior in this new environment and to identify interventions to improve the experience for riders.

METHODOLOGY

Our survey was conducted with individuals who identified as users of Uber or Lyft and who reside in those metropolitan areas in the United States in which UberPool or Lyft Line are available. As such, the sample included participants who have and who have not used dynamic ridesharing; however, all had had the option of requesting a shared ride at one point in time. Prior to creating the survey, we conducted personal open interviews with individuals who had used dynamic ridesharing to guide the survey questions, informing us of some of the important social and non-social characteristics and perceptions of dynamic ridesharing services amongst early adopters.

After completing the interviews, we designed the survey to assess the impact of social factors on the perception and use of dynamic ridesharing services. It was structured with groups of questions assessing: (i) sociodemographic characteristics, (ii) travel behavior, (iii) motivations and deterrents to using dynamic ridesharing (including social and non-social aspects), (iv) quality and frequency of past experiences using dynamic ridesharing (including social interactions), (v) social prejudice in ridesharing, (vi) respondent orientation on a social dominance scale (correlated with social prejudice), (vi) perception of women's safety, and (vii) personality traits of the respondents.

In most cases, the demographic and travel behavior questions were structured as multiple choice questions, while those focusing on dynamic ridesharing perceptions, social dominance orientation, and personality were structured as Likert Scale questions in which the respondent was asked to state his or her opinion (strongly disagree to strongly agree) about or assign a frequency to (never to every time) statements focusing on specific aspects of the hypothesis being tested.

In an effort to reach a broad sample, we utilized a survey built on Qualtrics (an online survey development service) and recruited participants through Mechanical Turk (a task distribution company which pays respondents a set amount to complete tasks, such as surveys). With Mechanical Turk, we attempted to reach as wide a variety of survey takers as possible; however, there were limitations to our being able to acquire a sufficiently representative sample of users of TNCs – an issue which is further discussed in the sociodemographic characteristics of survey takers. Additionally, because Mechanical Turk survey takers are paid by the number of tasks they complete, it may behoove survey takers to complete surveys with less attention to detail than is preferred. As such, we attempted to screen poor survey-taking behavior by (i) requesting that only experienced and well-reviewed users take the survey (users with at least 97% of their prior tasks approved and with a total of at least 500 tasks completed), (ii) adding attention checks during the survey which eliminated respondents that randomly answered questions, and (iii) creating a set of flags for completed surveys that identified suspicious patterns or inconsistencies in responses.

Conducted between June 26th and July 4th, 2016, the survey was completed by a total of 1,222 respondents who had used Uber or Lyft and who resided in metropolitan areas in which UberPool or Lyft Line were available. From the initial sample of respondents, we eliminated 225 who did not meet at least two of the nine criteria (flags) we used to gauge those respondents who did not complete the survey with their full attention. The final sample size of the analysis was 997 respondents, 752 of whom had previously used Lyft Line or UberPool and 245 that had not.

RESULTS

In discussing the results of the survey, we first begin by describing the makeup of those who participated in the survey before proceeding to an analysis of the results. We analyze the survey results by discussing the statistics of the several groups of questions and their correlations with sociodemographic characteristics and travel behavior attributes.

Survey respondent demographics

Survey respondents were predominantly young, male, white, educated, and lower- to medium-income, as shown in TABLE 1. Overall, a majority of survey respondents were under 35 years of age (78%), male (57%), and held a college or graduate degree (65%). Most respondents were

white (70%), while Asian, black, and Hispanic respondents made up 9%, 8% and 7% of the total sample, respectively, and household income was fairly evenly distributed. Among other surveyed characteristics, 40% reported being single, 29% reported being married or in domestic partnerships, and another 29% reported being in a relationship. Finally, 74% did not have children in their household.

Comparing with the population of TNC users and the populations of U.S. Mechanical Turk users, we inferred that our respondents are fairly representative of gender, age, education, and race, but were still skewed toward lower- to middle-income. The characterization of the population of TNC users and of Mechanical Turk users allowed us to make such inference. First, regarding the population of TNC users, Vugo Passenger Trip Data from 2015 (*14*) shows that it is predominantly young, has more males than females, and contains people from all income levels (although it is skewed towards higher income). Second, regarding the population of Mechanical Turk users, Ipeirotis (*13*) shows that most of the characteristics in our sample also coincide with those of Mechanical Turk users, with the exception of gender (Mechanical Turk has more female than male participants) and race (Mechanical Turk more closely represents the actual racial breakdown of the U.S. population).

With respect to the geographic distribution of the respondents, 26% resided in the Northeast, 24% in the West, 24% in the Southeast, 13% in the Great Lakes region, and 8% in the Southwest, according to the classification of the U.S. Bureau of Economic Analysis. Most respondents were in the metropolitan areas of Los Angeles, New York City, and Chicago, but many were also in metropolitan areas of San Francisco, Boston, Philadelphia, Washington, D.C., Atlanta, and Miami, which accurately represents the markets in which the dynamic ridesharing technology first arrived.

Travel Behavior

Among survey respondents, 75% indicated they have previously used dynamic ridesharing. TABLE 2 shows that there are statistically significant differences by group of respondents with respect to the share of those who have used dynamic ridesharing. First, we found that younger individuals (under 30 years old) tend to use dynamic ridesharing more than older individuals (80% to 69%, respectively). Second, car owners are less likely to be users of dynamic ridesharing. Third, we find a 10 percentage point difference in the proportion of users of dynamic ridesharing between married and unmarried, after selecting only individuals above 30 years old so as not to confound the result with an age effect (as younger people tend not to be married). Finally, we found no statistically significant difference in means for groups involving gender or income, suggesting that the service may cater equally to men and women, as well as to relatively poorer or wealthier individuals.

Most of the survey respondents had access to a car either because they owned one (68%) or because they had access to a family member's car or were members of a car-share service (11%). Statistically significant differences in car ownership rates are also observed between survey respondents with an annual household income below $50,000 (61%) and those with higher income levels (75%). Similarly, car ownership rates are significantly higher for people over 30 years old (76%) than among the youngest portion of the survey respondents (63%).

A majority of the respondents (94%) reported using at least two modes of transportation every month; in particular, TNCs (85%), walking (76%), driving (73%), and public

transportation (39%) are the most commonly used modes. Overall, driving is the mode that was most identified as the primary mode of transportation (53%), followed by public transportation (21%), walking (9%), and TNCs (9%). There is a statistically significant difference between respondents that have not used dynamic ridesharing services and those that have used them: although driving is the primary mode of transportation for each of these groups, the figure decreases from 62% in the former to 51% in the latter ($p=0.001$). Furthermore, while only 2% of the respondents who have never used dynamic ridesharing identify Uber or Lyft as their primary mode of transportation, this proportion increases to 11% among the group that have used UberPool or Lyft Line.

The survey also asked respondents who had used dynamic ridesharing before about the purpose of the trips for which they have used such services. As indicated by 65% of the people in this group, the most common trip purpose was for leisure (bar, restaurants, music venues, etc.), followed by trips to or from the airport (35%), and getting to or from work or school (28%). Despite the claims that TNCs work effectively as a complement to transit, the least number of respondents reported using dynamic ridesharing to get to or from public transportation nodes (12%).

On average, respondents that have used dynamic ridesharing services estimated that they use this option to make 33% of all TNC trips. Furthermore, roughly a quarter of the respondents in this group use dynamic ridesharing in more than half of their total TNC trips. Finally, only 3% of the people surveyed that have not used dynamic ridesharing services yet state that they would not consider using this option in the future, showing that there is potential for expansion of such services to a larger population.

Motivations and Deterrents

The survey explored social and non-social aspects that have motivated or deterred respondents from using dynamic ridesharing services. On the one hand, the questions related to non-social aspects that are frequently included in mode choice analysis, such as travel cost, travel time, and comfortability of the mode. On the other hand, aiming to identify social features, questions associated with dimensions that could influence the choices made by TNC users were also included in the survey. Such dimensions include the prospect of interacting with a fellow passenger, the possibility of reducing the environmental impact of transportation, and the interest in using innovative transportation services. TABLE 3 presents the distribution of responses on a Likert Scale for selected questions included in the survey.

As observed, a large proportion of respondents considered travel time, travel cost, and comfort to be motivations for using (or potentially using) dynamic ridesharing services. For example, 85% of dynamic ridesharing users agreed at some level that they have used these services because they are faster than taking transit or walking. Similarly, 83% of these same respondents confirmed that they have used dynamic ridesharing services because they are cheaper than the private ride option of TNCs. Likewise, 90% of the respondents who have never used the dynamic ridesharing option would consider using it because it is cheaper than the private ride options offered by TNCs.

Questions gauging the interest of having social interactions while sharing a ride revealed that most respondents disagree about considering such a possibility as motivation for using dynamic ridesharing services. For example, roughly half of the users disagreed at some level

with using dynamic ridesharing because of the potential of meeting people from different social circles, while another 30% agreed with the same statement. In the Southeast (including states such as Florida and Georgia) the share of users who agreed with this statement is larger, as well as with other statements about using dynamic ridesharing with social motivations. Nonetheless, the number of respondents that disagreed was still greater than those who agreed (TABLE 5). This shows that although social motivations seem to be of second order importance relative to the traditional ones in dynamic ridesharing, a third of survey respondents still generally agreed to using dynamic ridesharing for social social reasons.

With respect to the potential to meet dates or romantic interests in dynamic ridesharing, and as found in the interviews conducted prior to the survey, a large proportion of each group rejected suggestions that there was an interest for making new friends or meeting someone they found attractive. These questions presented important differences between genders, as 23% of the men who have used dynamic ridesharing services agreed with the statement related to meeting someone attractive, while only 12% of women said the same.

On a different note, respondents in general agreed with statements about the role of dynamic ridesharing in reducing the environmental impact and about using the service because of its perceived innovativeness. Finally, respondents that had never used dynamic ridesharing were divided about feeling safer someone else was in the car other than the driver, a sentiment which was often mentioned during the personal interviews as well.

In addition to the questions related to motivations, respondents were also surveyed on deterrents to using dynamic ridesharing services. While for individuals that indicated that they had previously used these services the questions were phrased to understand their reasons for not using UberPool or Lyft Line more often, respondents that had never used UberPool or Lyft Line were asked about their reasons for not to using them at all. As shown in TABLE 4, three major deterrents were found for both groups: (i) being paired with an unpleasant passenger, (ii) the uncertainty of the length of the trip, and (iii) the preference for privacy during the ride. It should be noted that the proportion of respondents that had *not* used dynamic ridesharing services that claimed that these situations deterred them from using those services was higher than the figure corresponding to the group of respondents who *had* used them. This suggests that either (i) previous experiences using these services could possibly reduce concerns associated with the expectation of uncomfortable situations or (ii) that individuals that use dynamic ridesharing are not as concerned with these factors as individuals that do not.

Perceptions of Positive and Negative Experiences

Questions aimed at assessing the frequency of past positive and negative social experiences while using dynamic ridesharing yielded few notable results across all respondents. Overall, respondents were as likely to have negative experiences as to have positive ones. Of the positive social experiences for which we tested, “Among the experiences when you were paired with other passengers… how often did you have a good conversation?” had the highest reported frequency, with 49% of all respondents claiming it happened about half of the time or more often. By comparison, 24% reported meeting passengers with whom they imagined they could be friends with the same frequency. Additionally, 48% and 30% of all respondents said that there were “awkward silences” in the car or that “the other passenger talked too much” at least half of the time they had been paired with another person, respectively.

Among non-social factors, 28% and 27% of all respondents said that it "took too long to pick up the other passenger" or the route taken to the destination was "too indirect" at least half of the time, respectively, suggesting that passengers more often experience unpleasant social interactions than dissatisfaction with more traditional aspects of transportation.

Separating respondents into their respective demographic categories brought about more pronounced differences in perceptions of social experiences with ridesharing. Although virtually no correlation was found between gender and perception of positive social experiences (with the exception of males being more than twice as likely as females to have met "someone you were attracted to"), female respondents were more likely on average to have had negative experiences. The most pronounced difference was for feeling intimidated by the other passenger, for which females were more likely than males to respond they felt that way (only 2% of men compared to 7% of women reported so – a difference that is significantly different than zero). Another statistically significant difference is that women tended to perceive the ride as having more awkward silences than men did.

Respondents' primary mode of transportation proved to have an effect on their perceptions of social experiences. Respondents whose primary mode of transportation was TNCs were more likely to have had positive social experiences and less likely to have had negative experiences than other groups. They were twice as likely to have felt that they met someone with whom they could be friends, to have had good conversations, to have met someone they were attracted to, or to have had a good networking opportunity. Despite the lower sample size of individuals that listed TNCs as a primary mode of transportation (n=72), all these differences in means are statistically significant from zero using a two-tailed t-test. Meanwhile, they were 37% less likely to have felt there was an awkward silence than individuals with other primary modes of transportation. This result may suggest that people who have more positive and fewer negative ridesharing experiences are more likely to use TNCs as a primary mode of transportation or that their using TNCs regularly provides them more opportunities to interact with other passengers, diluting perceptions of negative experiences. Alternatively, people who use TNCs as a primary mode of transportation may simply have fundamentally different characteristics and preferences.

Race and prejudice

Given historical and current evidence of discrimination against groups of minority racial, ethnic, sexual orientation, religious status, etc., a set of survey questions focused on understanding the attitudes of dynamic ridesharing users of different backgrounds with respect to being paired with people of different backgrounds to better gauge the current existence and potential for discrimination in ridesharing services. While measuring bias through stated preference surveys is known to underrepresent the prevalence of prejudiced attitudes, the results still show that discriminatory attitudes do exist within the current population of ridesharing users and that more research may be needed to further understand the prevalence and expression of those attitudes.

One set of survey questions sought to measure respondents' expression of prejudice towards being matched with other passengers in dynamic ridesharing, including "Sharing a ride with a person of a different ethnicity could make me uncomfortable", "Grouping passengers of different races in shared rides is a recipe for trouble", and "I would prefer to avoid being paired with a passenger of a lower social class in shared rides." More respondents who identified as white answered "somewhat agree" to "strongly agree" to one or more of those questions (18%) than

respondents who identified as non-white (11%), with a mean difference is statistically different from zero at a 99% confidence level. Overall, 16% of total respondents ("prejudiced respondents") expressed agreement with one or more statements of prejudice with respect to sharing rides using TNCs with people from different backgrounds, compared to "non-prejudiced respondents" who did not indicate any level of agreement with any of the statements of prejudice (a few selected results are shown in TABLE 5).

Survey respondents who expressed general attitudes of prejudice and bias were also more likely to express prejudice in dynamic ridesharing. Another set of questions, adapted from the Social Dominance Orientation scale, attempted to measure respondents' attitudes towards the relative status of different social groups. Of those who answered "somewhat agree" to "strongly agree" to one or more of the negative social values in the social dominance questions, 31% also expressed prejudice with respect to dynamic ridesharing, while just 11% of those who did not agree with any of the social dominance questions expressed any degree of prejudice in dynamic ridesharing (a difference in meuans that is significantly different from zero).

Prejudiced respondents were much more likely to indicate preference for more information about the fellow passenger when requesting a ride (TABLE 6). Prejudiced respondents reacted strongly to the potential to see the other passengers' photo, with 39% indicating a preference for seeing the other passengers' photo, while 24% of non-prejudiced respondents indicated a preference for the same. Along the same lines, prejudiced respondents also were much more likely to indicate a preference for seeing the name, gender, or age of the other passenger and to indicate a preference for rating and seeing the ratings of other passengers (with statistically significant differences between groups).

Prejudiced respondents were also much more likely to indicate that not having clear norms made them less likely to use dynamic ridesharing. Moreover, 45% of prejudiced respondents indicated a preference for being able to indicate if they would rather not interact with the other passenger, compared to just 29% of non-prejudiced respondents.

Gender and Safety

Female respondents were somewhat more likely to express feeling unsafe or intimidated while using dynamic ridesharing than male respondents. 19% of women who used UberPool or Lyft Line indicated they felt unsafe occasionally to always compared to 12% of men. Additionally, 22% of women reported they felt intimidated occasionally to always compared to 15% of men (both mean differences being statistically significant at a 95% level). Nevertheless, the survey did not reveal that shared rides using TNCs were perceived to be less safe than private rides using TNCs, since about half the women reported requesting or potentially requesting TNC shared rides because they felt safer with another person in the car other than the driver.

Female respondents were more likely to indicate a preference for more information about the other passenger than male respondents, although to a lesser degree as it pertained to seeing a profile photo. 36% of women indicated a preference for rating and seeing ratings of other passengers compared to 27% of men, 42% of women indicated a preference for seeing the name, age, and gender of the other passenger compared to 27% of men, and 30% of women indicated a preference for seeing a photo of the other passenger compared to 24% of men (the first two mean differences are statistically significant at the 99% level, while the latter only at the 95% level).

Men were much more likely to express indifference towards having the ability to state a preference for the gender of the other passenger, with 78% expressing indifference, while just 45% of women expressed indifference. At the same time, 16% of women said they would choose to only be paired with women if they could, compared to 0.2% of men who said they would choose to only be paired with men. Similarly, 37% of women said they would prefer to be paired with women but still accept men.

Potential for Discriminatory Attitudes

The survey results indicate that a substantial proportion of dynamic ridesharing users hold discriminatory attitudes towards sharing rides with people of different racial, class, and other sociodemographic backgrounds, and thus the potential for discrimination in these services does exist. While prejudiced respondents expressed stronger support for seeing more information about other passengers than non-prejudiced residents, women also expressed stronger support than men for having more information about other passengers. While women may express more support for having information about other passengers due to feeling less safe while using dynamic ridesharing than men, the potential to use additional information to discriminate – whether for safety or other reasons – still exists. The fact that prejudiced respondents expressed the strongest preference for seeing a photo of the other passenger, while women expressed the lowest preference for seeing a photo amongst the other interventions listed, indicates that enabling passengers to view a profile photo may introduce the greatest potential for discrimination in the system. Without careful design of interventions to improve the social aspects of dynamic ridesharing, these services have the potential to reinforce and even magnify latent prejudice and discrimination in society.

CONCLUSIONS

In an era when the use of ridesharing apps is becoming increasingly common and urban populations are growing rapidly, ridesharing poses a tremendous opportunity to move people from place to place in a more efficient, less congestion-inducing, less expensive, and more environmentally conscious manner.

Our study set out determine to what degree people perceive dynamic ridesharing as having positive or negative utility with respect to its social aspects, what influences those perceptions, and how they compare with traditional factors, such as time and cost. Our investigation revealed that a person's perception of the social aspects, both positive and negative, is a factor that can both motivate and deter the use of shared rides, while personality and demographic characteristics mattered less than previous literature had suggested in determining a person's willingness to rideshare.

Among some of its more significant findings, the survey revealed that: (i) users of dynamic ridesharing services report that social interactions, such as the possibility to have a networking opportunity or to have a good conversation with the fellow passenger, are relevant, but not as much as traditional factors such as time and cost; (ii) overall, the possibility of having a negative social interaction, such as being paired with an unpleasant passenger, appears to be more of a deterrent than the potential of having a positive social interaction is an incentive to using dynamic ridesharing; (iii) that there is evidence that a substantial number of riders harbor feelings of prejudice towards passengers of different social class and race, and these passengers are much more likely to prefer having more information about potential future passengers before

matching through the application; (iv) that most dynamic ridesharing users are motivated to use it by its ease, speed, and comfortability compared to walking and public transportation; and (v) that safety in shared rides is an important issue, especially for women, many of whom report feeling unsafe and prefer to be matched with passengers of the same gender.

This study shows that while social motivations for using dynamic ridesharing are relevant, they matter less than factors such as time and costs. However, the study does not quantitatively determine the magnitude of the effect of social aspects on mode choice. The survey was not designed to request respondents to compare trip alternatives (which would allow us to build a mode choice model), but to assess a wider range of aspects (social and non-social) of dynamic ridesharing which would not be measured in a traditional stated preference survey.

Future research seeking to expand upon this study would do well to further investigate some of its findings. An implicit bias test, for example, might reveal that even more passengers hold feelings of prejudice than were discovered in this anonymous survey. Deeper examination of what makes the potential for negative social interactions more influential to riders' perceptions of the service than positive ones would also be of value.

Dynamic ridesharing promises to be an increasingly prevalent mode of transportation in the future. Understanding the ways in which shared ride passengers interact with each other socially and how they perceive these social interactions will be valuable information for policymakers and TNC strategists alike. We hope that the results discussed here will serve as a starting point for future study and modification of ridesharing services.

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TABLE 1 Survey Socio-Demographics, by age group

		Age			
	Total	18-25	26-30	31-35	36 and over
Total (n=997)	100.0%	26.6%	30.8%	20.5%	22.2%
Gender					
Male	56.7%	15.1%	18.3%	11.8%	11.4%
Female	42.8%	11.0%	12.5%	8.5%	10.7%
Other	0.5%	0.4%	0.0%	0.1%	0.0%
Education					
High School or less	6.2%	1.9%	1.7%	1.0%	1.6%
Some College	27.9%	11.6%	6.4%	4.5%	5.3%
College Degree	49.4%	11.8%	16.9%	10.7%	10.0%
Graduate Degree	16.4%	1.2%	5.8%	4.2%	5.2%
Income					
less than $30,000	21.6%	9.2%	5.6%	3.3%	3.4%
$30,,000-50,000	24.3%	5.5%	8.3%	5.8%	4.6%
$50,000-$75,000	24.5%	4.9%	9.3%	4.9%	5.3%
$75,000 and above	29.7%	6.9%	7.5%	6.4%	8.8%
Occupation					
Employed	79.7%	14.5%	26.8%	18.9%	19.6%
Student only	13.5%	10.0%	2.3%	0.6%	0.6%
Not Employed	6.7%	2.0%	1.7%	1.0%	2.0%
Race/Ethnicity					
White	64.6%	16.5%	21.7%	14.8%	11.5%
Asian	10.0%	3.8%	2.4%	1.6%	2.2%
African-American	8.8%	2.0%	2.5%	2.7%	1.6%
Hispanic	7.2%	2.6%	3.0%	0.8%	0.8%

Source: Authors' survey.

TABLE 2 Proportion of Dynamic Ridesharing Users to TNC users, by groups

	Total	By Age			Car Owner			Household Income			Gender			Marital Status (31 and over[1])		
		<=30	>30	p-value diff.[2]	Yes	No	p-value diff.[2]	<$50k	>=$50k	p-value diff.[2]	Male	Female	p-value diff.[2]	Married	Not Married	p-value diff.[2]
% that used UberPool or Lyft Line	75.4%	80%	69%	0.0002**	73%	81%	0.03*	76%	75%	0.73	77%	73%	0.12	64%	74%	0.03*

1 Calculated for the sample of individuals 31 and over only, in order not to confound the results with an age effect.
2 p-value diff.: mean difference two-tailed t-test (Ho: No difference in means). ** Null hypothesis is rejected at 99%
4 confidence. * Null hypothesis is rejected at 95% confidence.
5 Source: Authors' survey.

1 **TABLE 3 Respondents motivations for using dynamic ridesharing (Users and Non-Users)**

	Average (1 to 7)	Agree (5,6,7)	Neutral (4)	Disagree (1,2,3)
Users (n=752): "When I chose to use UberPool or Lyft Line instead of other modes, it is because…"				
...because it is faster than taking transit or walking	5.7	85%	8%	7%
...because it is cheaper than the regular UberX or Lyft fare	5.6	83%	10%	7%
...because of the comfort of a car compared to transit, biking, or walking	5.4	78%	14%	8%
…because I know the exact price in advance	5.2	71%	18%	11%
...because sharing rides is better for the environment	4.7	60%	23%	18%
...because of surge pricing on UberX or Lyft when I request a ride	4.6	61%	16%	22%
...because there is a chance I do not get paired with another passenger	4.1	42%	28%	30%
…because I feel safer having another person in the car other than the driver	3.8	36%	21%	43%
…because I want to meet people heading to/coming from the same event as me	3.5	35%	17%	48%
…because I enjoy meeting people from different social circles	3.4	30%	18%	53%
…because I enjoy making small talk with new people	3.3	32%	15%	53%
…because of the potential to make new friends	3.2	30%	15%	55%
…because of the potential networking opportunities with another passenger	3.2	26%	16%	58%
…because of the potential to meet someone I am attracted to	2.7	18%	14%	68%
Non-Users (=245): "If I chose to use UberPool or Lyft Line instead of other modes it could be because…"				
...because it could be faster than taking transit or walking	5.8	89%	7%	5%
...because it is cheaper than the regular UberX or Lyft fare	5.8	90%	4%	6%
...because of the comfort of a car compared to transit, biking, or walking	5.4	80%	12%	8%
…because I would know the exact price in advance	5.4	81%	11%	8%
...because sharing rides is better for the environment	4.9	68%	19%	13%
...because of surge pricing on UberX or Lyft when I request a ride	5.1	79%	11%	10%
...because there is a chance I do not get paired with another passenger	4.0	33%	39%	27%
…because I would feel safer having another person in the car other than the driver	3.9	36%	27%	37%
…because I want to meet people heading to/coming from the same event as me	3.8	42%	18%	39%
…because I enjoy meeting people from different social circles	3.4	32%	16%	52%
…because I enjoy making small talk with new people	3.2	32%	11%	57%
…because of the potential to make new friends	3.5	33%	18%	49%
…because of the potential networking opportunities with another passenger	3.2	29%	16%	55%
…because of the potential to meet someone I am attracted to	2.6	16%	13%	71%

2 Source: Authors' Survey

1 **TABLE 4 Users deterrents to using dynamic ridesharing (Users and Non-Users)**

	Average (1 to 7)	Agree (5,6,7)	Neutral (4)	Disagree (1,2,3)
Users (n=752): "One of the reasons I DO NOT use UberPool or Lyft Line more often is that…"				
...I prefer privacy in the back seat of the car	4.4	54%	19%	28%
...it is uncertain how long the trip is going to take	4.3	51%	20%	29%
...I am afraid to be paired with an unpleasant passenger	4.2	53%	13%	33%
…there are no clear norms of interaction	3.6	33%	21%	46%
...I cannot indicate a preference not to interact with the other passenger	3.5	30%	24%	45%
...I cannot see the name, gender, and age of the other passenger	3.5	34%	16%	51%
...I cannot rate and see ratings of other passengers	3.5	30%	20%	50%
...I cannot see a picture of the other passenger	3.3	27%	18%	55%
Non-Users (n=245): "One of the reasons I DO NOT use UberPool or Lyft Line is that..."				
...I prefer privacy in the back seat of the car	4.7	61%	14%	25%
...it is uncertain how long the trip is going to take	4.7	61%	17%	22%
...I am afraid to be paired with an unpleasant passenger	4.5	62%	9%	30%
…there are no clear norms of interaction	3.6	32%	22%	45%
...I cannot indicate a preference not to interact with the other passenger	3.7	36%	19%	45%
...I cannot see the name, gender, and age of the other passenger	3.5	33%	16%	51%
...I cannot rate and see ratings of other passengers	3.6	33%	20%	47%
...I cannot see a picture of the other passenger	3.3	26%	17%	57%

2 Source: Authors' survey.

TABLE 5 Selected Survey Questions about the Level of Agreement with a Statement, by Selected Sociodemographic Characteristics (Users, Non-Users or All Respondents)

Users: When I choose to use UberPool or Lyft Line instead of other modes it is because it is cheaper than the regular UberX or Lyft fare

Income	*n*	*D*	*N*	*A*
<$50K	347	7%	11%	82%
$50K-$100K	278	6%	9%	85%
>$100K	127	6%	9%	85%

Users: When I choose to use UberPool or Lyft Line instead of other modes it is because I feel safer having another person in the car other than the driver

Gender	*N*	*D*	*N*	*A*
Male	436	51%	23%	26%
Female (**)	311	32%	18%	50%
Other	5	20%	60%	20%

Users: When I choose to use UberPool or Lyft Line instead of other modes it is because I enjoy meeting people from different social circles

Ethnicity	*n*	*D*	*N*	*A*
White	532	54%	17%	28%
Black (*)	63	48%	11%	41%
Hispanic	56	50%	30%	20%
Asian	67	49%	21%	30%
Other	34	47%	9%	44%
-	-	-	-	-

Users: One of the reasons I do not user UberPool or Lyft Line more often is that I am afraid to be paired with an unpleasant passenger

U.S. Region	*n*	*D*	*N*	*A*
Northeast	205	38%	9%	53%
Southeast	184	34%	13%	53%
Southwest	60	17%	13%	70%
Great Lakes	93	33%	14%	53%
Far West	179	33%	18%	49%
Other	31	39%	19%	42%

Users: One of the reasons I do not use UberPool or Lyft Line more often is that I am afraid to be paired with an unpleasant passenger

Gender	*n*	*D*	*N*	*A*
Male	436	38%	15%	47%
Female (**)	311	27%	12%	61%
Other	5	40%	0%	60%

Non-users: If I chose to use UberPool or Lyft Line instead of other modes it could be because I feel safer having another person in the car other than the driver

Gender	*n*	*D*	*N*	*A*
Male	129	60%	14%	26%
Female (**)	116	83%	12%	5%
Other	0	N/A	N/A	N/A

Users: One of the reasons I do not use UberPool or Lyft Line more often is that it is uncertain how long the trip is going to take

Income	*n*	*D*	*N*	*A*
<$50K	347	27%	22%	51%
$50K-$100K	278	34%	18%	48%
>$100K	127	24%	18%	58%

Non-users: One of the reasons I do not use UberPool or Lyft Line is that it is uncertain how long the trip is going to take

Income	*n*	*D*	*N*	*A*
<$50K	110	29%	18%	53%
$50K-$100K (*)	94	14%	18%	68%
>$100K	41	22%	12%	66%

All respondents: Sharing a ride with someone of a different ethnicity could make me uncomfortable

Race	n	*D*	*N*	*A*
White	702	77%	15%	9%
Black (**)	88	93%	5%	2%
Hispanic	74	82%	15%	3%
Asian (**)	91	89%	7%	4%
Other (**)	42	90%	7%	2%

All respondents: Pairing passengers from all social classes in shared rides is a good idea

Household Income	N	*D*	*N*	*A*
<$50K	457	9%	29%	62%
$50K-$100K	372	11%	26%	63%
>$100K (*)	168	15%	34%	51%
-	-	-	-	-
-	-	-	-	-

Legend: n: Number of Respondents; D: Disagree at some level; N: Neutral; A: Agree at some level.
(**)/(*) Difference in agreement with respect to the reference group (first in list for each question) is statistically different from zero at the 99% level (**) or 95% level (*) in a two-tailed t-test with unequal variances.
Source: Own authors' survey.

TABLE 6 Share of respondents who indicated a preference for more information about the fellow passenger when requesting a ride or for interaction norms, by prejudice group

	Passenger Ratings	Passenger Profile	Passenger Photo	Not to Interact	Norms of Interaction
% of non-prejudiced respondents who indicated a preference for… (n=838)	29.0%	31.3%	24.2%	29.0%	30.8%
% of prejudiced respondents who indicated a preference for… (n=159)	40.9%	44.7%	39.0%	45.3%	42.8%
Mean Difference	11.9%	13.4%	14.8%	16.3%	12.0%
P-value of a mean difference test[1]	0.005**	0.002**	0.0005**	0.0002**	0.005**

1 Two-tailed t-test assuming unequal variances.
Source: Authors' survey.