Demand for "Safe Spaces": Avoiding Harassment and Stigma *

Florence Kondylis† Arianna Legovini† Kate Vyborny‡
Astrid Zwager† Luiza Andrade†

April 23, 2020

[Click here for latest version]

Abstract

What are the costs to women of harassment on public transit? We randomize the price of a women-reserved "safe space" in Rio de Janeiro and crowd-source information on 22,000 rides. Women in the public space experience harassment once a week. A fourth of riders are willing to forgo 20% of the fare to ride in the "safe space". Randomly assigning riders to the "safe space" reduces physical harassment by 50%, implying a cost of $1.45 per incident. Implicit Association Tests show that women face a stigma for riding in the public space which may outweigh benefits of the safe space.

Keywords: sexual harassment, gender, public transit, mobility, revealed preferences, Implicit Association Test, stigma

*This draft benefited from comments from Peter Christensen, Erica Field, Gabriel Kreindler, John Loeser, Pedro Olinto, Martin Raiser, Dan Rogger, Sveta Milusheva, Girija Borker, and Dev Patel, and participants in seminars at ASSA 2020, Duke, the World Bank, INSEAD, ITU, Gottingen, and NEUDC. We thank the World Bank i2i fund, the Knowledge for Change program, and the World Bank Brazil Country Office for generous research funding. Rafael Dantas and Tuanni Borba superbly coordinated all aspects of data collection. Finally, we thank the staff at Premise and SuperVia for being superb research partners. This trial was registered in the 3IE database under ID-5a125fecae423 and Duke IRB D0910/2017-0401. The views expressed in this manuscript do not reflect the views of the World Bank. All errors are our own. A replication package and supplemental material are available at `https://github.com/worldbank/rio-safe-space`.

†Development Economics, World Bank

‡Duke University

1 Introduction

The #MeToo movement highlighted the pervasiveness of sexual harassment and violence against women worldwide. In a survey of women in 22 countries, over 50% reported being physically harassed in public and over 70% reported being followed (Livingston, 2015). These experiences of harassment are severe, and most women report fearing that street harassment would escalate into violence (Kearl, 2014). The risk of violence might altogether discourage women from market participation (Velásquez, 2019) or from choosing better schools (Borker, 2018).[1] While this literature documents the effects of crime on the extensive margin of women's market participation, it does not capture the recurring and potentially large costs women face when they choose to commute daily.

In response to the increased public awareness of the high prevalence of sexual harassment in the public space, the creation of women-reserved "safe spaces" has surged.[2] While these reserved spaces may provide an avenue for avoiding harassment (Aguilar et al., 2018), bystanders may *implicitly* view women outside the reserved space as provoking harassment, and assign the responsibility for harassment to the victim. By playing into latent prejudice, these reservation policies may thus induce a stigma against women in the public, non-reserved space, thus reinforcing those same norms that are deleterious to women's safety in the first place (e.g., *"women should not overstep their boundaries"; "to be safe, a woman should stick to her reserved space"*).

In this paper we document the costs to women of harassment on public transit in Rio de Janeiro, Brazil. We recruit 357 Brazilian women who commute daily to crowdsource data on 22,000 of their rides. We first elicit their revealed preferences for a women-reserved space. We then randomly assign riders across spaces to measure differences in the incidence of harass-

[1] Limited freedom of movement is a well documented mechanism for gender disparities in economic outcomes such as access to school and training (Muralidharan & Prakash, 2017; Cheema et al., 2017; Burde & Linden, 2013; Jacoby & Mansuri, 2015).

[2] Women-reserved spaces in public transit have been adopted by cities in Brazil, Mexico, Pakistan, India, Bangladesh, Iran, Egypt, the UAE, Israel, Belarus, the Philippines, Malaysia, Indonesia, South Korea, Japan, among others.

ment. We exploit within-commuter variation in opportunity costs and location generated by these experiments to provide a low-bound estimate of the cost of sexual harassment in public transit. We rule out differential crowding, property crime and general fear of crime, time of commute and sorting of perpetrators across spaces as determinants of women's demand for a women-reserved space. We then administer social norm surveys and Implicit Associations Tests on a random sample of men and women commuters to document a potential general equilibrium effect of reserved spaces: stigma against women who choose to ride in the public space.

Eliciting revealed preferences establishes that riders place a positive value on accessing a women-reserved space. 26% of riders are willing to forgo the equivalent of 20% of the transit fare to travel in the reserved space. Randomly assigning riders to ride in either the reserved space or the public space reveals that riders in the public space experience sexual harassment in 17% of rides, of which 15% are instances of physical harassment. This implies the average woman commuting in the public space is sexually harassed once or twice a week and physically harassed once a month. Riders assigned to the reserved space experience 50% lower rates of physical harassment relative to the public space. These results are corroborated by self-reports, as 60% of riders report avoiding harassment as the main advantage of the reserved space. These partial equilibrium estimates return a low-bound individual cost of avoiding physical harassment on public transit of approximately $1.45 per incident. This estimate implies that, over a whole year, experiences of physical harassment would cost an average rider in our sample the equivalent of 0.35% of the minimum wage in Brazil. This is an economically meaningful tax on women's earnings, as it is equivalent to a 1.7% increase in the gender pay gap, in a context where a woman earns 79.5 cents for every dollar a man earns (IBGE, 2019). Based on estimates of the supply elasticity of female labor in Brazil (Vick, 2017), such a wage penalty implies a 0.43-0.53% reduction in female labor supply.

We investigate whether these effects can be attributed to amenities provided by the reserved space such as reduced crowding, risk of other types of crimes, and presence of

men. Introducing a reserved space may have affected displacement or signaling. To formally document these forces, we deploy a second team of observers to record granular data on crowding and men's presence in the women's space by location and time. We also collect information on riders' risk perceptions. The data allow us to rule out systematic differences in crowding or the risk of other types of crime as alternative mechanisms. We also show that sorting of men across spaces does not seem to be driving the results: the share of male riders in one space does not affect occurrence of harassment in the other space. We show, however, that as compliance to the rule erodes, so does its protective value and women riders' willingness to pay for it.

We next consider a potential general equilibrium effect of the women-reserved space policy: a stigma against women riding in the public space. This stigma may reflect back on women's demand for the reserved space in equilibrium and could normalize harassment of women in the public space. Social norms can limit women's participation in market activities. For instance, family members may restrict women's mobility to safeguard their reputation of sexual "purity"; (perceived) social norms may restrict women's labour supply (Jayachandran, 2015, 2019; Field et al., 2016; Bursztyn et al., 2018). Accordingly, understanding the impact of introducing a safe space on attitudes towards women using the public space is important for policy.

We interview men and women commuters on the platform and administer 948 social norm surveys and 291 Implicit Association Tests (IATs) to establish whether women face a stigma for riding in the public space when they have the choice of a reserved "safe space". Results suggest that male and female respondents *implicitly* and *explicitly* associate women traveling in the public space with sexual provocation. We show that the IAT results are not driven by more general sexism: controlling for implicit bias against women in the workplace (*gender-career* IAT) has no effect on these results. Overall, male and female commuters seem to consider using the women-reserved space as the "proper" choice for a woman commuter. While riding in the reserved space is safer in relative terms, our estimates suggest that the cost

of stigma for women traveling in the public space may be as large as the benefits associated with riding in the reserved space. As we show that sorting across spaces becomes difficult at times of high congestion, these findings put in question the overall welfare implications of these reserved spaces.

This study makes three central contributions to the economics literature on crime and gender. First, we generate novel data to quantify the incidence of sexual harassment on transit.[3] While most studies focus on the prevalence of crime, getting at its incidence is essential if we are to capture the cost of a recurring, high-incidence crime such as sexual harassment in public transit (Swim et al., 2001). We set up a high-frequency data generation platform and crowdsource information on experiences of harassment at the ride level. Second, we contribute to a deep literature on the economic cost of crime. We innovate by merging two strands of the literature. Closest in spirit to our methodology are studies that employ a revealed preference approach to quantify the economic cost of crime through residential sorting, housing prices, and school choice (Gibbons, 2004; Cullen & Levitt, 1999; Linden & Rockoff, 2008; Besley & Mueller, 2012; Borker, 2018). By generating individual variation in opportunity cost and random assignment to different spaces on the public transit, we contribute to a strand of the literature that, so far, has relied on stated preferences to establish the cost of specific criminal incidents (Cohen et al., 2004; Aguilar et al., 2018). Third, we move beyond evaluating partial equilibrium effects of "safe space" policies and explore general equilibrium effects through the emergence of a stigma with a dedicated IAT. This relates to a literature that has highlighted identity as a mechanism that pushes groups to comply with stereotypes in equilibrium (Akerlof & Kranton, 2000).

The remainder of the paper proceeds as follows. Section 2 outlines our study context. Section 3 describes the various data generation efforts, while Section 4 presents descriptive findings from the data. Section 5 introduces the revealed preferences results. Section 6

[3]In addition, while a branch of the literature considers the role of various interventions in reducing the incidence of crime against women in the public space (Banerjee et al., 2012; Bisschop et al., 2017; Iyer et al., 2012; Cunningham & Shah, 2018), these studies do not isolate an effect on sexual harassment from other types of crimes.

explores mechanisms underlying riders' demand for the reserved space, and provides an estimate of the cost of harassment. Social norm survey and IAT results are presented in Section 6.4 to test for increased stigma against women riding in the public space. Section 7 provides estimates of the cost of harassment, and Section 8 concludes.

2 Study context

We study sexual harassment on the public transit system of Rio de Janeiro, Brazil. Sexual violence on the transit system is pervasive in Brazilian cities. A recent survey in São Paulo suggests that public transport is the most common place where women suffer harassment and 35% of female respondents reported ever being sexually harassed, while using public transport (Datafolha, 2015).

Issues of sexual harassment on the transit system have led Rio de Janeiro state government to pass legislation to reserve a space for women in its rail system. The 2006 law requires the train and metro operators to reserve one carriage in each train for women during rush hours (6-9AM and 5-8PM).[4]

Rio de Janeiro's public transit system connects many low-income families to economic opportunities: most low-income households reside in the periphery, while jobs are concentrated in the city center (Motte et al., 2016). Rio's metropolitan area has an extensive public transport system that includes bus, metro, a suburban rail, bus-rapid-transit and ferry system. Commutes are long, with a 95 minutes average transit time (Moovit, 2018).

In order to capture the behavior of households living in the periphery, and for whom commuting to opportunity is particularly critical, we focus on Rio's suburban rail system, the SuperVia. This system comprises seven lines that connect downtown Rio with its outskirts, including many low-income areas. All lines radiate out of the central station, Central do Brasil (cf. Figure A1 for a map of the SuperVia network). The SuperVia carries around 700,000 passengers a day, or 10% of all public transport trips in the Rio metropolitan area.

[4]Lei Nº 4.733, de 23 de Março de 2006.

Half of SuperVia's passengers are women [5], and one in six to eight carriages are reserved for women, depending on the train length. Thus only a fraction of all women riders could ride in reserved space. Male compliance with the reservation rule is enforced by platform officers who also ensure the overall safety of the boarding process. However, officers do not have policing power, and their presence varies substantially across stations: it is particularly low in stations located further from central station. This foreshadows substantial differences in compliance to the reservation rule across space and time.

3 Data

We generate two main types of data. First, we use a crowdsourcing app to task regular women and men commuters to repeatedly report on riding conditions. Second, we administer a platform survey and Implicit Association Tests on a random sample of male and female commuters. We now detail these data types. Appendix B describes the construction of the variables used in our analyses. Appendix C describes the measures the research team took to ensure the study followed ethics guidelines.

3.1 Crowd-sourced rider experiences

Women and men riders were recruited and incentivized to report on their commuting experiences through a smartphone application. The application allows us to vary the assigned location (reserved vs public space), pay-out, and data collection task in each of the rides. This setup is used to 1/ elicit women commuters' revealed preferences for a reserved space, and 2/ introduce exogenous variation in which space to ride. These are described in Sections 5 - 6. We use the same application to task male riders with the collection of data on transit conditions throughout the network. This allows us to capture granular variation in the ride environment, independent of women riders' choice of space during their commute.

[5]Source: SuperVia administrative data.

3.1.1 Rider reports

Recruitment

A total of 363 women commuters and 49 men commuters were recruited to participate in the study through online social media and networks, referrals, and flyers distributed at the train stations. The recruiting material invited respondents to download a smartphone application and respond to survey questions regarding their experience with the SuperVia. None of the recruitment material mentioned gender, harassment or the reserved space.

Recruitment occurred in two waves starting August 2015 and August 2016. After sign-up riders were offered both a demographic survey task and the crowdsourcing task. 72.5% of riders completed the demographic survey (Table A1). Riders reside along the SuperVia network all around the metropolitan area , spanning a mix of rich and poor areas (Figure A1). Women riders' demographic characteristics are presented in section 4. Women riders were then offered to participate in ride tasks, while men riders were asked to collect platform observations. We now describe these two work streams.

Ride task

Each woman rider is offered a series of tasks which entail riding the SuperVia and answering questions before, during and after each ride. Data was collected between September 2015 and February 2017. Figure 1 shows how the ride task is presented in the app and broken down into three sub-tasks: check-in (*Check-in na estação*), ride either the reserved or public space (*Escolhi viajar no vagão feminino/carro comum* and check-out (*Check-out da estação*). Total pay-out to complete a ride varies from \$4.50-\$4.70 per ride.[6][7] These rides can be completed any weekday between 6-9AM or 5-8PM, up to twice per day (once in the morning, once in the evening) and from any SuperVia line and station of their choice. Riders can open the app to check for available data collection tasks at any time and choose whether or not to

[6]This payment covers the SuperVia transit fare.

[7]Even though the sub-tasks are priced separately, riders must complete all three sub-tasks in the correct order to receive payment.

take up the offered tasks.

The setup is used to introduce variation in payments for the use of the different spaces and document ride experiences when riders are randomly assigned to ride across the different spaces. Women riders' pipeline is divided in two phases (Figure 1 shows how these are presented in the app):

1. *Revealed preference*: Riders choose whether to ride in the reserved or public space first at equal payoffs ($4.50; Panel (a), Figure 1), and later at differential payoffs ($4.50-$4.70; Panel (b), Figure 1) to vary the opportunity cost of riding in the reserved space. Each rider takes an average of 50 rides in this phase.[8]

2. *Random assignment to space*: Riders are assigned tasks that specify a specific space to ride in (public or women-reserved) for a fixed payoff ($4.70; Panel (c), Figure 1). At the end of their ride, they are asked questions about their current mental state and well-being as well as any experience with harassment during their ride. We further describe these measures in section 6. Each rider takes an average of 15 rides in this phase.

Each individual is assigned an individual pipeline of specific tasks and all riders are invited to participate in both phases. Table A2 summarizes the sequence of types of rides and their pay-outs. Riders are not aware of the number of total rides they will be offered, or of the conditions or payment variation of future rides, minimizing potential for gaming through strategic timing of when to ride. A rider's take up or refusal decisions does not affect the composition of their pipeline. More details on each phase of the experiment are provided in sections 5 - 6.

Several quality control measures are taken. Riders take a photograph of their check-in and check-out station. The app geo-tags and time-stamps each observation when a sub-task is started. Riders take a photo and record the car number on which they ride. The app

[8]To avoid framing in the revealed preference experiment, we refrain from recording riders' experiences of sexual harassment in this phase.

also included checks against riders changing the time settings on their phone. The different spaces are internally connected and riders are allowed to switch spaces after reporting on the space they boarded.[9]

Riders are paid for each ride shortly after completion, and can choose to discontinue participation at any time. As a result, some riders only experimented with the application for a few rides. Table A1, panel A, and Figure A7b show the number of riders that progress through each of the study stages. Appendix D presents robustness checks to attrition and concludes that attrition is unlikely to bias our estimates.

Survey questions

We administer two short surveys through the smartphone application. An initial demographic survey includes standard questions on age, employment, education, marital status, self-assessed socioeconomic status, home location and commuting patterns (timing, lines and frequency of riding SuperVia). Once a woman rider finishes her pipeline of ride tasks, she is invited to take an exit survey, which includes questions on topics that were not included in previous interactions to avoid priming effects. It includes a set of questions on riders' preference to ride and stated willingness to pay for the reserved space. Finally, we ask about the perceived risk of harassment under different conditions and perceptions of other riders using either space.[10]

3.1.2 Platform observations

Men riders recruited through the app served as platform observers and collected data on the crowding and enforcement of the gender reservation policy across the system through the same application. The task specifies where and when to collect the data. For this purpose, all SuperVia lines are divided into segments of several stations and further divided by half-hour

[9]Upon checking out riders are asked whether they switched spaces and depending on study phase report doing so on 4-6% of rides. We revisit this as a margin of adjustment in the results section.

[10]The complete questionnaires can be found online through this link.

blocks of the rush hour periods (6-9AM, 5-8PM). Over a period of about three months, the platform observers collected at least three observations from each such half hour-line segment combination in the direction of rush-hour traffic (i.e. in-bound in the morning, out-bound in the evening). Observers estimated the percentage of male riders in both public and reserved spaces, and report how many commuters can sit. We impute platform observation variables to rides using the mean observation for each of these station-time period bin.[11]

3.2 Social Norm Survey and Implicit Association Test

To measure other commuters' attitudes towards women traveling in the public space, we administer a social norm survey and implicit association tests (IAT) on a random sample of both male and female commuters. The survey includes questions on commuting behavior, stated preferences and willingness to pay to use the reserved space, perceptions about harassment and norms around female travel. Questions replicated the wording of the rider exit survey.

To select a representative sample of rush hour commuters, we use a simple sampling protocol based on ordering and counting individuals on the platform at the main station, Central do Brasil. Table A1, Panel B, summarizes patterns of response. A total of 1078 commuters were approached, 555 women and 523 men. Ninety percent (90.1%) of women and 85.7% of men responded to the platform survey (Table A4 column 1), with an overall response rate of 87.9% [12]. We use administrative data on the number of SuperVia riders by line to apply sample weights to obtain estimates that are representative of the average rider.

After agreeing to participate in the platform survey, respondents are invited to participate in a Implicit Association Test.[13] The IAT method and instruments are discussed in Section

[11] While women riders were also asked to record their ride conditions, their observation are likely affected by their choice or assignment of space. In contrast, platform observer data is collected by contributors who stay on the platform and observe both spaces simultaneously; thus it is not affected by individual preferences or behavior. We confirm that data collected by the platform observation team are strongly correlated with what riders themselves observe on their ride (Table A3).

[12] Among those who accepted to participate, 8% left mid interview to board their train. See Online Appendix for the full protocol.

[13] For respondents that agree to participate in the IAT we randomize whether the platform survey is taken

6.4. Participants in the IAT are offered a compensation of R$30.00, or about $7.50.[14] For the application of the IAT we set up a booth close to the platform where the test was taken on a laptop. The platform survey was conducted until the target of 300 finished IATs was reached.[15] Table A1, Panel B, shows the patterns of response to the IAT. Conditional on being invited to take the IAT, the response rate was 40.6%. Women are slightly less likely to accept than men (38% versus 43.5%), but this difference is imprecisely estimated (Table A4 column 2: P-value is 0.111). Women's stated use of the reserved space is not significantly correlated with response to the IAT (Table A4, column 3). Similarly, men who report that their family members usually use the reserved space are not more likely to respond to the IAT (Table A4, column 4).

3.3 Administrative Data

We obtained administrative data from the SuperVia as an alternative measure of crowding. The estimates are generated by SuperVia transport planners, based on simulations and data from the station fare gates. Figure A2 shows crowding reports from our platform observations are highly correlated with SuperVia administrative records.

4 Descriptives

4.1 Ride Environment

Overall, the train is densely packed throughout the rush-hour period (Figure A2). The beginning of each rush hour period is the most crowded and patterns are similar across data sources. Half of the SuperVia passengers are women[16], but only one in eight or one in six

before or after completion of the IAT to control for priming effects.

[14] 86 platform respondents were not invited to the IAT because they were illiterate, making completion of the task, requiring matching words and pictures, impractical, and 14 were excluded because of disruption due to a samba party on the train platform.

[15] 9 IAT's were discarded because the system was not able to compute the results, either due to the respondent appearing to provide random answers or application failure.

[16] This share of women riders is reported in SuperVia's operational briefs.

cars is designated as reserved space. The reserved space is at least as crowded as the public space (Figure A2).

Observations recorded by our platform observers confirm that, even though the reserved space is designated for women only, substantial numbers of men ride in the reserved space (Figure A3). The presence of officers enforcing the policy varies substantially by station, resulting in geographic variation in presence of male riders (A4). Moreover, the cars are connected internally; it is possible for men to move from public to reserved space after boarding, further complicating enforcement. Figure A3 shows that the average proportion of males in the reserved space is 29% compared to 58% in the public space. The difference in male presence across spaces at a given time and location also varies substantially (Figure A5).

4.2 Riders and their experiences

Table 1, Panel A, shows socio-economic characteristics of the riders and platform survey respondent. Column 1 reports characteristics of our crowdsourcing app users. Most participants are regular commuters: about 70% are employed, and the average participant rides the SuperVia 6.4 times a week. Unemployed participants are the minority, but are over-represented in the riders sample relative to the representative platform sample; this is likely because participation in the app served as a form of employment or subsidized search costs. The smartphone app also attracted a somewhat younger and more educated pool of participants than the average commuter. Stated use of the reserved space is slightly lower among crowdsourced riders than general female commuters, although both groups report taking close to half of their rides in the reserved space.

Riders and platform respondents both state that the risk of harassment is substantially higher in the public space: the perceived risk of either verbal or physical harassment is about twice as high in the public space as in the reserved space.

5 Do female riders value the women-reserved space?

5.1 Revealed Preference

We elicit revealed preferences from our sample of riders through the crowdsourcing app described above to estimate the value participants place on riding in the women-reserved space. In this setting, riders always receive a monetary compensation for reporting data about their rides. We add to this by offering a series of incentivized choices in which riders face a positive monetary opportunity cost for riding in the reserved space, relative to the public space.

Our design yields within-respondent variation in the choice of ride (reserved space vs public space), while retaining the simplicity and incentive compatibility of the single offer price method. Figures 1a and 1b illustrate this choice as it was presented to riders in the app. Riders start with a series of at least 5 rides for which they are offered a $4.50 pay-out to ride in either the public or the women-reserved space (Figure 1a). Next we introduce variation in opportunity costs for riding the reserved space by offering a higher payment to ride in the public space. This was flagged in the app to put salience on the price difference (Figure 1b).[17] Participants proceeded through a common fixed sequence of rides with varying price differentials ranging from $0 to $0.20, as graphed in Figure 2 and detailed in Table A2.[18] To limit framing in these first phase rides we do not survey experiences of harassment from riders at the end of these rides.

5.2 Results

We use crowdsourced data to estimate the effect of assigning an opportunity cost to ride in the reserved space on riders' demand for the reserved space. We start by estimating a

[17] Note that, if anything, adding salience on the price difference in this case provides a conservative measure of willingness to pay for the reserved space.

[18] We randomize whether the reserved or public space option is offered on top in the app. Table A5 shows that this order does not affect the results.

flexible event study specification. For an individual rider i on ride t, we estimate the following equation:

$$ChoseReservedSpace_{i,t} = \beta_{\tau_{i,t}} + \epsilon_{i,t} \tag{1}$$

Where *ChoseReservedSpace* indicates whether the rider chose to ride in the reserved space, and where each of the event study coefficients $\beta_{\tau_{i,t}}$ is a simple difference-in-differences estimator, using the period just before the opportunity cost rides start as the "before" period (zero cent opportunity cost rides), and the period of the event study coefficient as the "after" period (opportunity cost rides).

We also estimate a simple difference-in-differences specification as follows:

$$ChoseReservedSpace_{i,t} = \alpha + \beta d_{i,t} + \epsilon_{i,t} \tag{2}$$

In all ride-level specifications we weigh observations by $\frac{1}{N_i}$, the inverse of the number of rides taken by the individual rider throughout the revealed preference exercise; this accounts for variation in participation frequency, which was not fully controlled by the app.

We plot the estimates from models 1 and 2 for each premium in Figure 2, in which we restrict our sample to the sequence of ride common to all riders. The opportunity cost is displayed on the x-axis, and we estimate 2 independently at each opportunity cost level. We find a sharp jump, as the the probability of choosing to ride in the reserved space declines by about 20 percentage points just as the opportunity cost is introduced. This effect remains relatively stable all through the sequence, with no evidence of time trends either in the pre- or post-periods.[19]

We then estimate the treatment effect corresponding to this jump with the following equation:

$$ChoseReservedSpace_{i,t} = \alpha + \sum_{\ell=1}^{3} \beta_M \mathbf{1}[M_{i,t} = \ell] + \gamma_i + \epsilon_{i,t} \tag{3}$$

[19]We also present results over the full sample of rides in Figure A7, Panel (a), as well as the density of observations for each ride in the sequence in Panel (b). The sample restriction does not affect our conclusions.

Where *ChoseReservedSpace* indicates whether the rider chose to ride in the reserved space and M is the opportunity cost rider i faced during ride t to do so, with ℓ indexing the three different opportunity costs assigned; in the omitted category are the zero opportunity cost rides during which pay-out is equal regardless of space chosen. We include individual rider fixed effects γ_i, such that the effect of the opportunity cost is identified from within-rider variation across rides; standard errors are clustered at the rider level. Results are reported in Table 2, Panel A. In Figure 3 we report estimates from rider-level specifications, collapsing ride-level decisions into either binary variable (ever used the reserved space) or a frequency of use, and report estimates at each opportunity cost level.

At zero opportunity cost, approximately 80% of participants use the reserved space for some of their rides (Figure 3a). Looking at the extensive margin of use, we find that riders use the reserved space for 25% of these zero cent opportunity cost rides (Figure 3b). This suggests a preference for the reserved space beyond random sorting, as only 13-18% of the cars (one per train) are women-reserved.

We reproduce findings from the event study specification: introducing a positive opportunity cost for the reserved space reduces the proportion of rides taken in the reserved space by about 16.5 percentage points. The F-stats presented in the two lower panels of Table 2 indicate that, at these opportunity costs, demand for the reserved space is quite inelastic, as willingness to pay does not vary significantly across different opportunity costs (Table A6. We reproduce this finding in the event study specification, limiting the sample to the common sequence of offers all riders were offered to visualize results by opportunity cost level (Figure 2. This suggests that 20 cents per ride is a lower bound on riders' willingness to pay for the reserved space.[20]

Other margins of adjustment

Riders may respond to our offer of a higher payment to ride in the public space by adjusting

[20]In a subsequent part of the experiment, participants were assigned to a 60 cent opportunity cost. Unfortunately, a routing error in the app rendered these rides unusable.

their travel plans at other margins. We perform additional checks to verify that riders do not respond to the opportunity cost by changing route, travel time, or by switching across or within spaces (Panel A, Table A7). We find small imprecise effects of offering a assigning a positive opportunity cost on the reserved space across all these margins of adjustment. We explore these potential determinants of demand and estimate (3) controlling for ride conditions and pooling across opportunity costs:

$$\begin{aligned} ChoseReservedSpace_{i,t} = &\alpha + \beta_M \mathbf{1}[M_{i,t} > 0] + \beta_1 HighCongestion_t + \\ &\beta_2 FewMenInReservedSpace_t + \gamma_i + \epsilon_{i,t} \end{aligned} \tag{4}$$

where $M_{i,t}$ is the opportunity cost rider i faces to ride in the reserved space at ride t, and $Crowding$ and $FewMenInReservedSpace$ are characteristics of the ride environment measured by the platform observation team at $(time \times location)$ for ride t: the level of congestion and the prevalence of men in the women-reserved space.

Controlling for ride conditions and pooling across opportunity costs does not change the results reported above (Cols 1 and 2, Panel A, Table 2), suggesting that riders do not systematically respond to their assigned opportunity cost by adjusting their ride conditions.

Presence of men

How much does presence of men in the reserved space affect riders' willingness to pay for the reserved space? We exploit large variation in the presence of men in the women-reserved space to shed light on potential heterogeneity in riders' demand for the reserved space across compliance levels. We estimate a modified version of (4), in which we interact $FewMenInReservedSpace$ with our assignment to a positive opportunity cost to ride in the reserved space. When they face a zero cent opportunity cost, riders are 7 percentage point more likely to choose the reserved space when the reservation rule is well adhered to and fewer men are present in the reserved space; this represents a 28.8% increase in demand ($p-value < 0.000$; Panel B, Table 2). While this demand response is divided by three when

riders face an opportunity cost to ride in the reserved space ($\Delta\hat{\beta} = 0.023, p-value = 0.027$), this change represents a similar increase (29%) in demand relative to the demand for the reserved space when the opportunity cost is positive.

Finally, we acknowledge that compliance to the reservation rule and congestion are likely related. While we could not generate experimental variation to provide a causal interpretation of these co-movements, Figure A6 describes the relationship between crowding and (1) demand for the reserved space, and (2) the share of men in the women-reserved space.[21] We notice that, at low levels of congestion, the share of men in the reserved space is flat, at about 25%. As congestion passes the 0.4 load factor mark, which applies to 37% of rides, the proportion of men in the reserved space starts to increase, and demand for the reserved space drops accordingly. As the load factor passes 0.8, which is the case in 1.2% of rides, riders are simply boarding any car: this indicates that, at extreme levels of congestion, commuters are not able to effectively sort themselves across spaces.[22] Taken together, these results suggest that avoiding men is an important mechanism underlying women's demand for the reserved space. This motivated a second experiment in which we randomize riders across spaces to test whether the effect of presence of men on demand for the reserved space operates through the harassment channel.

[21] In November-December 2016, we worked with the SuperVia authorities to implement an experiment to deploy enforcement staff to experimentally vary enforcement of the reservation rule. However, due to limited numbers of staff, this failed to generate sufficient variation in the presence of men in the reserved space. Therefore we do not examine the effect of this intervention on downstream outcomes such as harassment. The data for this period are included in all our main analyses, and we include a dummy indicating being part of this pilot in all specifications. More details on the pilot are available upon request

[22] Comparing revealed and stated preferences for the same rider shows that eliciting stated preferences to ride the reserved space returns substantially higher estimates than eliciting revealed preferences (Figure A9). This could be due to differences in ability to elect the reserved car in thought experiment vs in real life: women who prefer the women-reserved space may not always be able to reach it due to crowding on the platform (Figure A6). Anecdotally, women in our focus group discussions reported congestion as the main reason for not using the reserved space.

6 Mechanisms: Why do women value the women-reserved space?

6.1 Avoiding harassment: Experimental assignment to the women-reserved space

Over 80% of the riders in our experiment report safety and avoiding harassment as main reasons for using the women-reserved space (Figure A8). To formally document this mechanism, we run an experiment in which we assign riders the task to ride in either the reserved space or the public space at random, and ask them to report on their ride experience through the app.

In contrast with the set up in the previous phase, riders are now offered a ride task for specific space for a fixed payment of $4.70 per ride through the same app.[23] Upon logging into the app, a participant could see only whether she had an offer on that day and, if so, which space she was assigned to ride in (Panel (c) of Figure 1). Each participant was offered several iterations of each car type in a random sequence and could not predict their sequence of rides. At the end of each ride, participants were asked to report experiences of harassment on the journey, including whether any stranger had "made comments that made you uncomfortable", "touched you intentionally in a way that made you feel uncomfortable", or "stared at you". Whenever a rider reported any harassment, the app directed her to resources available in the Rio area. Participants were also asked if they felt concerned about physical harassment and to report their emotional state on a scale of 1 to 10, overall and on specific items: happy, sad, tense, relaxed, frustrated, and satisfied. Measures taken to ensure human subject protection over the course of this experiment are discussed in Appendix C.

[23]Pay-out at this stage was fixed at at $4.70 per ride, the highest pay-out from the previous phase, to avoid discouragement (Table A2).

Results

We now estimate the impact of being randomly assigned to ride in the reserved space on riders' self-reported experiences of harassment and emotional state, relative to being assigned to ride in the public space. We estimate the following equation:

$$y_{i,t} = \alpha + \beta AssignedToReservedSpace_{i,t} + \gamma_i + \epsilon_{i,t} \tag{5}$$

Where $AssignedToReservedSpace$ indicates whether rider i was assigned to ride in the reserved space during ride t; all specifications include individual rider fixed effects α_i, and standard errors are clustered at the rider level. We weigh observations by $\frac{1}{N_i}$, the inverse of the number of rides taken by the individual rider throughout the assigned-ride exercise. Coefficient estimates are reported in Table 3.

Overall, results indicate that the incidence of harassment is high: riders assigned to the public space report experiencing some form of harassment (physical, verbal, or staring) in 17% of rides, or once a week on average, and physical harassment in 2.6% of rides. When randomly assigned to ride in the reserved space, riders are 2.6 percentage points less likely to report experiencing any harassment, or a 15.3% reduction on the mean of in the public space (cols 1-2, Panel A, Table 3). Columns 3-8 break this down by type of harassment. We observe that the effect is driven by a sharp reduction in the probability of experiencing physical harassment (1.3 percentage points, or a 50% reduction on the mean in the public space). The effects on verbal harassment and staring are smaller and imprecisely estimated.

Other margins of adjustment

Again, we consider that riders might respond to the assignment by adjusting their travel plans at other margins. We find that riders do not respond to the assignment by changing route or travel time. We do however find that riders assigned to the reserved car are slightly more likely to switch car after boarding or to move inside the space, although these effects

are small (Panel B, Table A7).

Sorting of perpetrators

Could sorting of men across spaces (partially) explain the shift in harassment across space, and riders' willingness to pay for the protective benefit the reserved space offers? We test for this possibility using our rich riding condition data by regressing the probability of harassment in one space on presence of men in the other space. Should male perpetrators sort across spaces, we should see that, even when the reserved and public spaces have the same proportion of men, harassment differs between the two cars. Results are presented in Table 3, $\beta_3 - \beta_4$ and Figure A10. The estimated effects are small and insignificantly different from zero, which is not consistent with sorting of perpetrators. In addition, if perpetrators sorted into the reserved space then we should expect that when more men are able to enter the reserved space the harassment levels would be lower in the public space; we show that the presence of men in the reserved space does not affect harassment in the public space, and vice versa (A10). However, we cannot test whether perpetrators sort between cars when the rule *is* well followed, because we do do not observe situations with few men in the public space (Figure A3). Finally, the lower incidence of harassment in the reserved space relative to the public space in equilibrium do not imply that reserving space only for women decreased harassment in the system overall.

6.2 The amenity value of avoiding men

We showed in Section 5 that compliance with the reservation rule is an important determinant of riders' demand for the reserved space. If avoiding harassment indeed shifts demand for the reserved space, we should observe that compliance to the reservation rule predicts harassment. We interact $AssignedToReservedSpace_{i,t}$ with a set of dummies indicating whether the presence of men in the reserved car at $(time \times location)$ t was above or below median compliance:

$$
\begin{aligned}
y_{i,t} = {} & \beta_1 AssignedToReservedSpace_{i,t} \times FewMenInReservedSpace_t \\
& + \beta_2 AssignedToPublicSpace_{i,t} \times FewMenInReservedSpace_t \\
& + \beta_3 AssignedToReservedSpace_{i,t} \times ManyMenInReservedSpace_t \\
& + \beta_4 AssignedToPublicSpace_{i,t} \times ManyMenInReservedSpace_t + \gamma_i + \epsilon_{i,t}
\end{aligned} \tag{6}
$$

Results are reported in Panel B of Table 3. Equation 6 does not include a constant, and the categories are mutually exclusive and exhaustive, so the difference in coefficients, $\beta_1 - \beta_2$, is the effect of being assigned to the reserved space when the reservation rule is being followed. We compare this to the effect when the rule is not followed, $\beta_3 - \beta_4$. The protective impact of the reserved space is largest when the reservation rule is more closely followed: being assigned to the reserved space then reduces the incidence of physical harassment by 1.9 percentage points (p-value=0.003) ($\Delta\hat{\beta}$ cols 3-4). This is a reduction of 68% over the mean harassment in the public space.[24] This effect is one third the size and imprecisely estimated when the reservation rule is not well followed.

To add granularity to these results we present the joint distribution of takeup of the reserved space and experiences of harassment across the distribution of presence of men in the reserved space relative to the public space (Figure 4). This graphic representation confirms our regression estimates: in the lower quintiles of the distribution, where presence of men is much higher in the public space relative to the reserved space, takeup of the reserved space is high and the incidence of harassment is substantially lower.

As presence of men equalizes across spaces, in the higher quintiles of the distribution, the protective value of the reserved space goes to zero. Despite this, takeup of the reserved space under positive opportunity cost remains positive. This suggests that, while they value

[24]Table A8 shows being randomly assigned to the reserved space also translates into improved subjective well being on some measures: it reduces fear of harassment during the ride, and riders are more likely to report feeling happy and less likely to report feeling sad and frustrated. None of the estimates survive multiple hypothesis testing.

the protective nature of the reserved space, women riders place a positive amenity value in riding in the reserved space that is not a function of the probability of harassment.

The results in Figure 4 showed that participants' willingness to pay (takeup at a positive opportunity cost) when there is no protective benefit of the reserved space is 70% of willingness to pay when there is a protective benefit.[25] Thus we consider 70% to be an upper bound of the amenity value riders derive from riding in the reserved space in excess of the protection it offers from harassment. In the next sections, we explore possible mechanisms for this amenity value which does not vary with the probability of harassment.

6.3 Crowding and crime as mechanisms for amenity value

Crowding

Women might prefer reserved space solely based on reduced crowding. However, data collected by the mapping team show that the women-reserved space is at least as crowded as the public space (Figure A6). Qualitative evidence supports this finding: in a focus group, all participants indicated the main disadvantage of the reserved space would be the level of crowding, and they would prefer to travel on it if it were less crowded. In an open-ended question on the disadvantages of the reserved space, 20% of riders reported that the car was too crowded or there were too few cars (not reported).

Fear of other crimes

Further, women might elect to ride in the reserved space to avoid exposure to other crimes. Qualitative work suggests this is not the case: women in the focus group discussion said that, while they fear attacks and stray bullets on the train in general, they do not feel that riding in the women-reserved changes the odds of this type of violence, relative to the public space.

[25] This may in part occur because participants are uncertain at the time of boarding about how well the reservation rule will be enforced for the duration of their ride; they may board the women's car in the hope it will be enforced.

We formally investigate whether a rider's risk perception mediates women's preference for the reserved space. In practice, we break down the results from the revealed preference rides by self-reported perceived risk of harassment vs non-sexual crime (e.g., robbery). We interact the assignment to a positive opportunity cost of riding in the reserved space with a rider's self-reported risk perception in (4). The results are reported in Panels A and B, Table 4. The bottom panel reports statistical tests of coefficient equality across the assignment to positive or zero opportunity cost and a rider's level risk perception. Women who are most concerned about physical or verbal forms of sexual harassment are 35-50% more likely to take up the reserved space during zero cent opportunity cost rides ($p - values < 0.1$; cols 1-6, Panels A and B, Table 4). However, this effect goes to zero when riding the reserved car requires forgoing a payment: while riders' who perceive a higher chance of physical and verbal harassment are more likely to use the reserved space, they are not more likely to forgo a payment to ride in the reserved space than riders who are less concerned about physical or verbal harassment.

In contrast, we do not find robust evidence that riders' perceived risk of a non-sexual crime (robbery) affects their demand for the reserved space ($p - values > 0.3$, cols 7-9, Panels A and B, Table 4).

6.4 Avoiding stigma as mechanism for amenity value

Another possible explanation for the "amenity value" of the reserved car, even absent any protection from harassment, is that women might face a social stigma for choosing the public space when a reserved space option is available. This mechanism could explain sustained takeup of the reserved space even when presence of men equalizes across spaces and the reserved space no longer provides any protection.

To investigate the presence of such stigma empirically, we design a social norms survey and a pair of Implicit Association Tests to document the attitudes women face on their daily commute (Section 3). To capture the norms female commuters face, we administer these

instruments on a representative survey of male and female commuters sampled from the platform.[26]

Social norms survey

The majority of commuters blame women for the harassment or not doing enough to avoid it. Most agree with at least one of the statements assigning responsibility to women for avoiding harassment or blaming them for harassment experienced on the public space (Table A9). About half of the women think women in either space are no different. However, most women think that men will perceive women in the public space as more provocative. The difference between own belief and perception about the belief of others is strikingly different for men and women as shown in Figure A11.

IAT

To assess commuters' implicit attitudes towards women riding in the public and reserved spaces, we designed two IAT instruments. These instruments test the strength of association between the reserved space and safety ("$Safety$"), and between the public space and provocation ("*Advances*"), respectively. In both instruments, the participants are first asked to classify pictures of train carriages. Pictures (stimuli) were taken to distinctly show the car type (women-reserved or public) but to be very similar on other characteristics, such as crowding and lighting. In the "$Safety$" IAT, respondents must then associate those stimuli with words connoting a greater to lesser sense of safety, such as "afraid" or "worried" versus "relaxed" or "oblivious". In the "*Advances*" IAT, participants were asked to sort the stimuli into categories connoting degrees of openness to sexual advances from men, such as "seductive" and "provocative", in contrast to "prissy" and "saintly".

The IAT results are summarized in a D-score, with a positive score suggesting a stereotypical association (reserved space with safety, public space with openness to advances).

[26]The full instruments and details of recruitment are provided in online supplemental material.

More details on the IAT methodology and how it was adapted to our study context are provided in Appendix E.[27]

IAT results

IAT results reveal large and positive associations between reservation and safety and between public space and provocation. Figure 5 shows the distribution of IAT scores for both instruments. The IAT D-scores can theoretically range from -2 to +2, with zero indicating no association in either direction. In interpreting magnitudes, we follow Greenwald et al. (2003) and use the Cohen's d benchmarks of 0.2, 0.5 and 0.8 to denote small, medium and large effect sizes. The mean D-scores on the "advances" and "safety" IAT instruments are 0.243 and 0.181, respectively; both are significantly greater than zero ($p < 0.000$). The magnitude of our results is in line with results on traditional gender norms. For comparison Nosek et al. (2009) find IAT D-scores for respondents' association of gender with STEM fields ranging between 0.25-0.65 in online samples across countries, and Beaman et al. (2009) report an IAT D-score of 0.11 in Indian respondents' association of gender and leadership roles.

We next examine differences in IAT D-score between the safety and openness to advances IAT, and between men and women. We estimate:

$$\begin{aligned} Score_{i,j} = \beta_0 + \beta_1 AdvancesIAT_j + \beta_2 FemaleRespondent_i \\ + \beta_3 AdvancesIAT_j \times FemaleRespondent_i + \epsilon_{i,j} \end{aligned} \tag{7}$$

Where the unit of observation is the respondent-instrument (so there are two observations per respondent, one for safety and one for advances); $Score_{ij}$ is the IAT score for respondent i on instrument j, calculated as detailed in Greenwald et al. (2003); $AdvancesIAT_j$ is a dummy for whether instrument j is the *Advances* instrument, while the $Safety$ IAT is the omitted category; $FemaleRespondent_i$ is a dummy for whether the respondent i is female;

[27]Supplemental material, including the full instruments, is available at `https://github.com/worldbank/rio-safe-space/tree/master/Supplemental%20Material`.

and $\epsilon_{i,j}$ is a random error term, clustered at the level of the respondent i. The coefficients of interest are β_1, which tests whether respondents associate reserved space choice with openness to advances more or less than with seeking safety, and β_3, which tests whether this difference in associations is stronger or weaker for female respondents. Results are reported in Table A10.

We find that participants may associate women's choice of car more with sexual openness than with concern for safety. However, male participants show less association between public space users and openness to sexual advances than female participants do. The results are robust to train platform fixed effects (Column 3). In addition, these IAT results are not driven by a more general gender bias against women working outside the home. Controlling for respondents' D-score on the gender-career IAT does not change our results (Columns 4-6).[28]

7 Cost of harassment

We now interpret our empirical results to provide an estimate of the cost of harassment for those women who have chosen to commute daily. In our context, women riders face a choice: riding in the public space or riding the reserved space. Each space offers different levels amenities values along some characteristics. Some are time-varying, such as presence of men and safety from sexual harassment, while some are constant, such as stigma and accessibility, etc.[29] Our revealed preference experiment introduced an opportunity cost M to ride in the reserved space. We model the relationship between rider's i willingness to pay to ride in the reserved space, their characteristics and the ride conditions in each space as:

[28] A positive score on the gender-career IAT indicates that the respondent associates women with home and men with career more easily than the reverse. The gender-career score is significantly correlated with the scores on our IATs, as expected. However, the point estimates on $AdvancesIAT$ is not affected, showing that our results are not driven by this generic association.

[29] As described above, we do not observe significant differences in crowding across spaces at a given time. Hence we do not consider crowding as an attribute endogeneously determined by riders' preferences in this model.

$$WTP_{i,t}^{Reserved} = (\alpha_i^{Reserved} - \alpha_i^{Public}) + (X_t^{Reserved} - X_t^{Public})'\beta + \epsilon_{i,t}$$

where α_i^{Space} captures the constant amenity value of riding in the *Space* car for rider i, $X_{i,t}^{Space}$ is a vector of individual and ride characteristics of interest for rider i commuting in the *Space* car at ride t, and $\epsilon_{i,t}$ is an error term, noting that $\epsilon_{i,t} \geq 0$ since our design presumes $WTP_{i,t}^{Reserved} \geq 0$.

While we do not directly observe riders' WTP, this expression yields a decision rule which leads to a general version of our main estimating equations (3) and (4):

$$\begin{aligned} ChoseReservedSpace_{i,t} &= \mathbf{1}[WTP_{i,t}^{Reserved} \geq M] \\ = \mathbf{1}[(\alpha^{Reserved} - \alpha^{Public}) &+ (X_{i,t}^{Reserved} - X_{i,t}^{Public})'\beta - M + \epsilon_{i,t} \geq 0] \end{aligned} \tag{8}$$

Generating experimental variation in the opportunity cost of riding in the reserved space M allowed us to determine a positive amenity value of riding in the reserved space. Combining natural and experimental variations in ride conditions with this change in opportunity cost allowed us to identify demand shifters.[30]

While we do not observe incidence of harassment in our WTP experiment, we combine these estimations with results from our second experiment, in which riders were randomly assigned to ride in either public or reserved spaces and reported experiences of harassment, to back out a cost of harassment. We take two approaches.

The first approach provides a benchmark for the cost of harassment by scaling up the value riders place on the reserved space, accounting for the fact that it only provides partial protection:

$$COST_{harassment} = \frac{\mathbf{E}[WTP_{i,t}^{Reserved}]}{\mathbf{E}[Harassment_{i,t}^{Reserved} - Harassment_{i,t}^{Public}]} \tag{9}$$

[30]The availability of reserved space engenders search frictions that we cannot separately estimate in our experiment. As such, we under-estimate the true value riders place in riding in the reserved space.

i.e. row (f) = (b) / (e) in Table 5. Column (1) assumes as a benchmark that takeup of the reserved space can be attributed to avoiding harassment. Since physical harassment drops by about half when a participant moves to the reserved space (row e), Column (1) row (f.1) implies that the cost of harassment is twice the value participants place on a ride on the reserved space. This adds up to approximately $1.45 per incident and $12 per year, or about 1.7% of the gender wage gap. Based on estimates of the supply elasticity of female labor in Brazil (Vick, 2017), it would imply a 0.43-0.53% decrease in female labor supply. Column (2) shows the same cost estimates for the top quintile of the distribution of presence of men in the reserved space; the results are similar.

By relating $WTP^{Reserved}$ directly to the protective effect of the reserved space estimated in (5), this benchmark measure captures the cost of harassment gross of other differences in amenities across spaces as expressed in (8). First, our empirical results allow us to rule out an economically and statistically significant β, as crowding and fear of other crimes do not significantly explain variations in demand for the reserved space (Table 3). The only significant varying condition we estimate on $WTP^{Reserved}$ was presence of men, which we assume operates through harassment. The fact that our experiment targets regular commuters with rigid habits allow us to rule out very large $\epsilon_{i,t}$ across rides. At the same time, we also noticed that $WTP^{Reserved}$ did not go to zero even when presence of men equalized across spaces. These results suggest that the amenity value riders place in the reserved space includes a non-varying component. Results from social norm surveys and IATs suggest stigma as a plausible underlying mechanism. Hence, we conclude that this first approach returns a cost of harassment gross of the cost of stigma.

We propose a second approach to estimate a measure of the cost of harassment net of stigma, exploiting within reserved car variation in presence of men and the resulting variation in protective value against harassment (Figure 4) to use presence of men as an instrument

for harassment. We compute:

$$COST_{harassment} = \frac{\mathbf{E}[WTP_{i,t}^{Reserved, few\ men} - WTP_{i,t}^{Reserved, many\ men}]}{\mathbf{E}[Harassment_{i,t}^{Reserved, few\ men} - Harassment_{i,t}^{Reserved, many\ men}]} \quad (10)$$

This approach allows us to difference out the $(\alpha_{Reserved} - \alpha_{Public})$ term in (8). For this IV estimate to be consistent we need a first stage ($\text{Cov}(Harassment, Men_t^{Reserved} - Men_t^{Public}) \neq 0$; Figure 4 and Table 3) and we need to assume exogeneity of the instrument ($\text{Cov}(\epsilon_{i,t}, Men_t^{Reserved} - Men_t^{Public}) = 0$).

These results likely provide a lower bound on the cost of harassment. Indeed, optimizing ride conditions is hard in this setting, and presence of men in the reserved space does not precisely feature in commuters' observation set when they decide which space to ride in. This implies our reduced form estimate of presence of men on takeup of the reserved space is attenuated, leading us to underestimate the cost of harassment. This lower bound estimate suggests that at least one sixth of the value women place on the protective space can be attributed to harassment, suggesting that demand for the reserved space is equally driven by a reduction in harassment and an increase in stigma.

8 Discussion

In this paper, we use a women-reserved "safe space" policy in Rio de Janeiro's public transit to investigate the cost and incidence of harassment and the drivers of the demand for a women-reserved space. We formally document two drivers of this demand: avoiding men and avoiding stigma, while ruling out other determinants such as crowding, general crime, and sorting of perpetrators across space.

We contribute to the literature on crime and gender by innovating on access to reporting by providing women a secure platform to report their experiences, experimentally varying tasks to measure differences in the incidence of harassment in public and reserved space, and experimentally varying payouts to measure women's willingness to pay for reserved space.

We use high-frequency metro data to understand congestion patterns. Because we construct a panel data of riders' choices under different commuting conditions, we can draw a complex picture of their preferences and behavior.

Multiple rounds of experiments with regular women commuters in Rio de Janeiro show that harassment is shockingly common on the public transit system. We find that a woman commuter traveling in the public space experiences harassment on average once a week. Riding in the reserved space reduces the incidence of physical harassment by 50%. We observe however that this protective effect goes to zero as compliance to the rule erodes at times of high congestion, which applies to about 40% of the rides we record. Combining these results with results from a revealed preference experiment we estimate that harassment imposes a meaningful tax on these women who commute every day, equivalent to 1.7% of the gender wage gap and implying a 0.43-0.53% decrease in female labor supply (Vick, 2017).

We go beyond these partial-equilibrium results and interview other women and men commuters on the platform to record their stated and implicit attitudes towards women riding in the public space. Dedicated social norms survey and IATs reveal that women face a stigma for riding in the public space: women are socially rewarded or punished for making the appropriate choice and doing what they can to avoid exposure to men.

Taken together, our estimates do not allow us to reject that the cost of stigma associated with travelling in the public space may be as large as the cost of harassment. Creating a reserved space may implicitly place the responsibility on women to protect themselves against harassment. This calls for more evidence on the effects of reserved "safe spaces" on women's welfare.

References

Aguilar, A., Gutiérrez, E., & Villagrán, P. S. (2018). Benefits and Unintended Consequences of Gender Segregation in Public Transportation: Evidence from Mexico City's Subway System. (pp. 1–37).

Akerlof, G. A. & Kranton, R. E. (2000). Economics and identity. *The Quarterly Journal of Economics*, 115(3), 715–753.

Anderson, M. L. (2008). Multiple Inference and Gender Differences in the Effects of Early Intervention: A Reevaluation of the Abecedarian, Perry Preschool, and Early Training Projects. *Journal of the American Statistical Association*, 103(484), 1481–1495.

Banerjee, A., Chattopadhyay, R., Duflo, E., Keniston, D., & Singh, N. (2012). Improving police performance in Rajasthan, India: Experimental evidence on incentives, managerial autonomy and training. *NBER Working Paper 17912*.

Beaman, L., Chattopadhyay, R., Duflo, E., Pande, R., & Topalova, P. (2009). Powerful Women: Does Exposure Reduce Bias. *Quarterly Journal of Economics*, 4(124).

Benjamini, Y. & Hochberg, Y. (1995). Controlling the False Discovery Rate: A Practical and Powerful Approach to Multiple Testing. *Journal of the Royal Statistical Society*, 57(1), 289–300.

Besley, T. & Mueller, H. (2012). Estimating the peace divdend: the impact of violence on house prices in Northern Ireland. *American Economic Review*.

Bisschop, P., Kastoryano, S., & Klaauw, B. V. D. (2017). Street Prostitution Zones and Crime. *American Economic Journal: Economic Policy*, 9(4), 28–63.

Borker, G. (2018). Safety First: Perceived Risk of Street Harassment and Educational Choices of Women. (January).

Burde, D. & Linden, L. L. (2013). Bringing Education to Afghan Girls: A Randomized Controlled Trial of Village-Based Schools. *American Economic Journal: Applied Economics*, 5(3), 27–40.

Bursztyn, L., González, A. L., & Yanagizawa-Drott, D. (2018). *Misperceived social norms: Female labor force participation in Saudi Arabia*. Technical report, National Bureau of Economic Research.

Cheema, A., Khwaja, A. I., Naseer, F., & Shapiro, J. (2017). Crossing Boundaries: Experimental Evidence on Access Constraints for Women. *CERP Working paper*.

Cohen, M., Rust, R., Steen, S., & Tidd, S. (2004). Willingness-to-pay for crime control programs. *Criminology*, 42(1).

Cullen, J. B. & Levitt, S. D. (1999). Crime, Urban Flight, and the Consequences for Cities. *Review of Economics and Statistics*, 81(May), 159–169.

Cunningham, S. & Shah, M. (2018). Decriminalizing Indoor Prostitution: Implications for Sexual Violence and Public Health. *Review of Economic Studies*, 85, 1683–1715.

Datafolha (2015). Assédio sexual.

Field, E., Schaner, S., & Moore, C. T. (2016). On Her Account: Can Strengthening Women ' s Financial Control Boost Female Labor Supply?

Gibbons, S. (2004). The Costs of Urban Property Crime. *Economic Journal*.

Greenwald, A. G., Nosek, B. A., & Banaji, M. R. (2003). Understanding and Using the Implicit Association Test: I. An Improved Scoring Algorithm. *Journal of Personality and Social Psychology*, 85(2), 197–216.

IBGE (2019). Em 2018, mulher recebia 79,5% do rendimento do homem. Accessed: 2019-05-15.

Iyer, L., Mani, A., Mishra, P., & Topalova, P. (2012). The Power of Political Voice: Women's Political Representation and Crime in India. *American Economic Journal: Applied Economics*, 4(4), 165–193.

Jacoby, H. G. & Mansuri, G. (2015). Crossing boundaries: How social hierarchy impedes economic mobility. *Journal of Economic Behavior & Organization*, 117(C), 135–154.

Jayachandran, S. (2015). The Roots of Gender Inequality in Developing Countries. *Annual Review of Economics*, (7), 63–88.

Jayachandran, S. (2019). Social Norms as a Barrier to Women's Employment in Developing Countries. *Working Paper*.

Kearl, H. (2014). *Unsafe and Harassed in Public Spaces: A National Street Harassment Report*. Technical report.

Linden, B. L. & Rockoff, J. E. (2008). Estimates of the Impact of Crime Risk on Property Values from Megan's Laws. *American Economic Review*, 98(3), 1103–1127.

Livingston, B. (2015). *Cornell International Survey on Street Harassment*. Technical report.

Moovit (2018). Facts and usage statistics about public transit in rio de janeiro region, brazil.

Motte, B., Aguilera, A., Bonin, O., & Nassi, C. D. (2016). Commuting patterns in the metropolitan region of Rio de Janeiro. What differences between formal and informal jobs? *Journal of Transport Geography*, 51, 59–69.

Muralidharan, K. & Prakash, N. (2017). Cycling to school: Increasing secondary school enrollment for girls in India. *American Economic Journal: Applied Economics*, 9(3), 321–350.

Nosek, B. A., Smyth, F. L., Sriram, N., Lindner, N. M., Devos, T., Ayala, A., Bar-anan, Y., Olli, E., Park, J., Schnabel, K., Shiomura, K., Tulbure, B. T., Wiers, R. W., Akrami,

N., Ekehammar, B., Vianello, M., Banaji, M. R., & Greenwald, A. G. (2009). National differences in gender – science stereotypes predict national sex differences in science and math achievement. 106(26), 10593–10597.

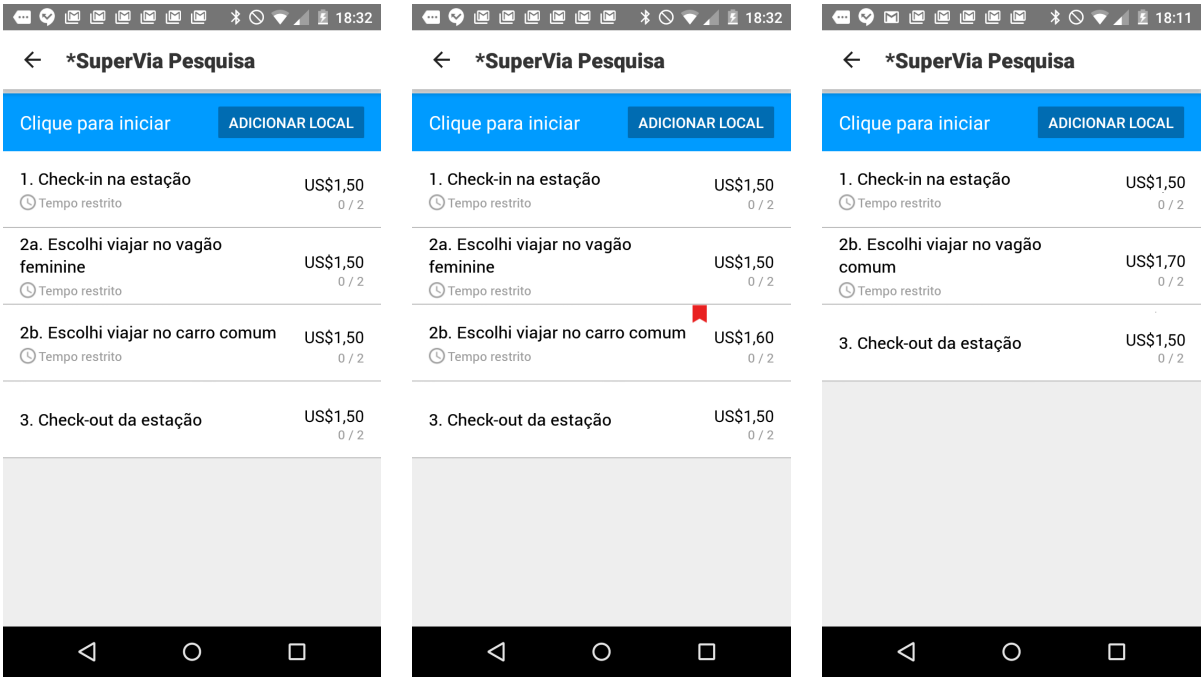
Swim, J. K., Hyers, L. L., Cohen, L. L., & Ferguson, M. J. (2001). Everyday Sexism: Evidence for Its Incidence, Nature, and Psychological Impact From Three Daily Diary Studies. *Journal of Social Issues*, 57(1), 31–53.

Velásquez, A. (2019). The economic burden of crime: Evidence from mexico. *Journal of Human Resources*, (pp. 0716–8072r2).

Vick, B. (2017). Measuring links between labor monopsony and the gender pay gap in Brazil. *IZA Journal of Development and Migration*, 7(10).

Figures

Figure 1: Crowdsourcing app interface across different phases of the study

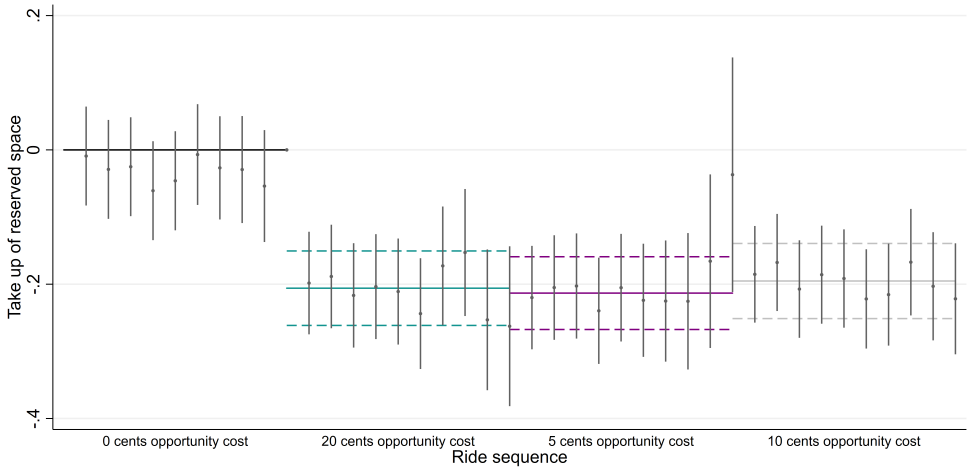


(a) Revealed preference: zero cent opportunity cost

(b) Revealed preference: positive opportunity cost

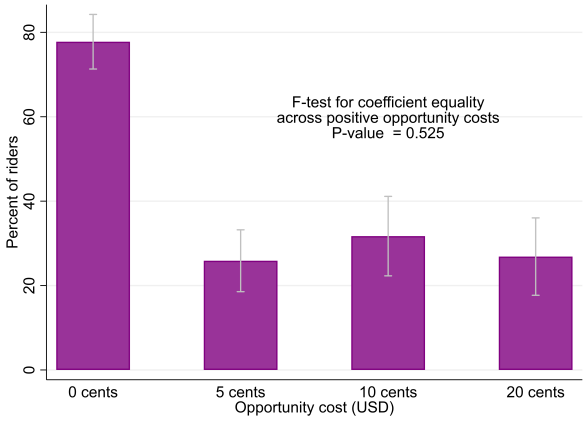
(c) Randomized assignment to space

Figure 2: Rides sequence and take-up of reserved space - Take up of reserved space over common ride sequence

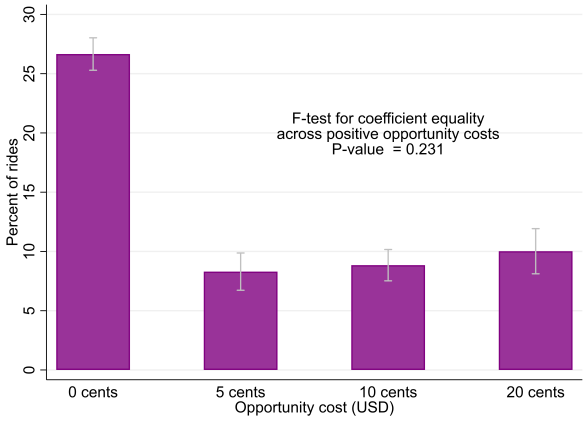


Notes: Sample includes all riders who started willingness to pay rides, and includes only the last ten rides each user took for each premium level. Displayed values are point estimates and 95% confidence intervals from a regression of take-up of reserved space on dummies for order in which the rides happened. Omitted ride (take up = 0) is the last ride with no opportunity cost.

Figure 3: Take-up of reserved space by opportunity cost



(a) Percent of riders who ever use the reserved space



(b) Percent of rides in the reserved space

Notes: Displayed percentages are predictions from a regression of take-up of the reserved space on dummies for the different opportunity cost levels. Both figures only include rides from the revealed preference phase of the 261 riders who completed revealed preference rides. Standard errors in parentheses, clustered at rider level. Observations weighted by the inverse of the number of rides taken by the individual rider. Figure (a) observations are at rider / opportunity cost level. Figure (b) observations are at the ride level, comprising 15,612 rides. The regression represented in Figure (b) includes rider fixed effects.

Figure 4: Joint distribution of takeup and harassment by presence of men

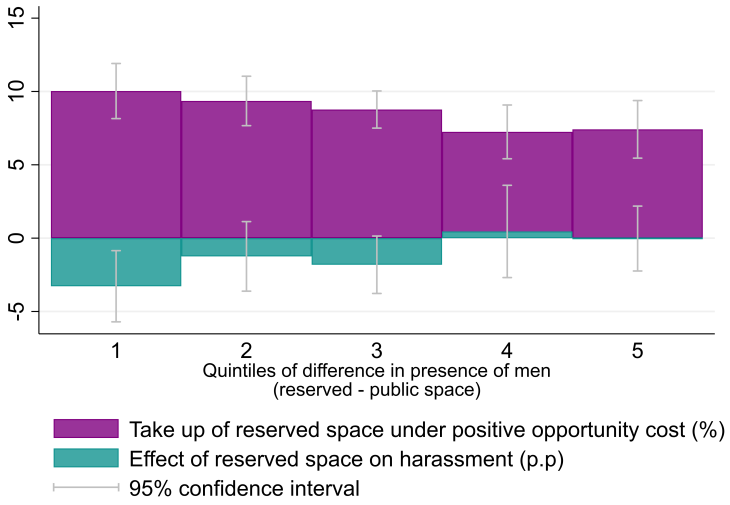
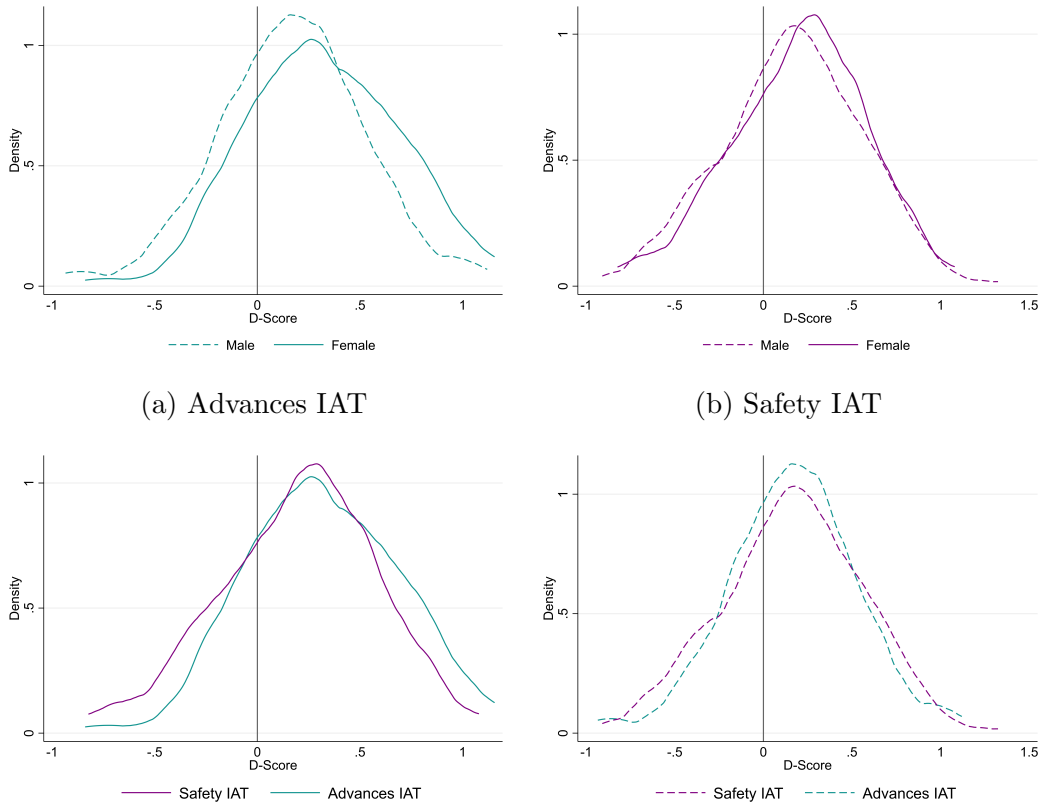


Figure 5: IAT D-Score distribution by test type and gender



(a) Advances IAT

(b) Safety IAT

(c) Female respondents

(d) Male respondents

Notes: Unit of observations is one IAT respondent. Sample includes all respondents who have valid scores for both advances and safety instruments.

Tables

Table 1: Sample description

	Riders Mean/SE (1)	Platform survey: female Mean/SE (2)	Platform survey: male Mean/SE (3)	Difference (2) - (1) (4)	Difference (2) - (3) (5)
Panel A: Demographic variables					
Respondent is employed	0.681	0.913	0.927	0.232***	-0.0150
	(0.025)	(0.018)	(0.017)		
Age	32.58	37.22	36.41	4.642***	0.808
	(0.619)	(0.665)	(0.763)		
Years of schooling	12.93	11.31	11.01	-1.625***	0.304
	(0.187)	(0.277)	(0.241)		
Number of rides in a typical week	6.055	8.467	8.934	2.412***	-0.467*
	(0.260)	(0.169)	(0.183)		
Crime rate at rider home station	1351	1233	1178	-118.772*	54.85
	(38.152)	(48.298)	(42.969)		
Violent crimes at rider home station	45.30	47.77	46.91	2.473**	0.853
	(0.639)	(0.785)	(0.717)		
Crimes against property at rider home station	260.3	228.9	214.8	-31.397**	14.08
	(9.225)	(11.796)	(10.558)		
Panel B: Self-reported risk of harassment (number of occurrences in a year)					
Physical, reserved space	12.35	25.86	28.50	13.502***	-2.639
	(2.578)	(4.035)	(4.419)		
Physical, public space	21.14	62.75	64.13	41.615***	-1.382
	(3.555)	(5.026)	(5.317)		
Verbal, reserved space	22.95	39.80	39.64	16.849***	0.165
	(3.644)	(4.622)	(4.906)		
Verbal, public space	40.08	84.47	82.97	44.393***	1.5
	(4.682)	(5.335)	(5.606)		
Panel C: Self-reported share of reserved space rides under hypothetical scenarios					
Status quo	0.472	0.551	-	0.079***	-
	(0.017)	(0.022)	-		
Current scenario, 30 cents opportunity cost	0.374	0.466	-	0.092**	-
	(0.023)	(0.040)	-		
Current scenario, 65 cents opportunity cost	0.278	0.374	-	0.096**	-
	(0.021)	(0.040)	-		
No men on reserved space, 30 cents opportunity cost	0.514	0.577	-	0.0630	-
	(0.025)	(0.040)	-		
No men on reserved space, 65 cents opportunity cost	0.385	0.511	-	0.125***	-
	(0.023)	(0.042)	-		

Notes: Unit of observation is one rider in column (1) and one platform survey respondent in columns (2) and (3). Sampling weights are applied to platform survey observations. Standard errors in parentheses, clustered at rider level. For risk of harassment questions, female respondents were asked to imagine a rider similar to themselves who takes the same commuting route, while male respondents were asked to imagine an average female rider who takes the same commuting route. Crime data from Instituto de Seguranca Publica do Rio de Janeiro is reported as number of crimes per 100k residents in the area. * $p < .1$, ** $p < .05$, *** $p < .01$

Table 2: Revealed preferences, overall and by ride condition

	Dependent variable: Chose reserved space	
	(1)	(2)
Panel A: Overall		
Positive opportunity cost	-0.165***	-0.164***
	(0.010)	(0.010)
High crowding		-0.009
		(0.012)
Few men in reserved space		0.044***
		(0.009)
Constant	0.247***	0.225***
	(0.005)	(0.007)
Mean dependent variable		
Zero opportunity cost	0.243	
	(0.014)	
Panel B: Heterogeneous effects by male presence in reserved space		
Many men in reserved space × zero opportunity cost	0.125***	0.125***
	(0.008)	(0.008)
Many men in reserved space × positive opportunity cost	-0.015***	-0.015***
	(0.004)	(0.004)
Few men in reserved space × zero opportunity cost	0.194***	0.194***
	(0.012)	(0.012)
Few men in reserved space × positive opportunity cost	0.008	0.007
	(0.009)	(0.009)
High crowding		-0.008
		(0.012)
Mean dependent variable		
Zero opportunity cost × Few men in reserved space	0.294	
	(0.019)	
Zero opportunity cost × Many men in reserved space	0.191	
	(0.015)	
Observations	16887	16887
Riders	363	363
Rider fixed effect	Yes	Yes
Post-estimate tests for heterogeneous effects		
By opportunity cost: zero opportunity cost - positive opportunity cost		
$\Delta\hat{\beta}$ when few men in reserved space	0.186	0.186
P-value	0.000	0.000
$\Delta\hat{\beta}$ when many men in reserved space	0.140	0.140
P-value	0.000	0.000
By male presence in reserved space: few men - many men in reserved space		
$\Delta\hat{\beta}$ when zero opportunity cost	0.070	0.069
P-value	0.000	0.000
$\Delta\hat{\beta}$ when positive opportunity cost	0.023	0.022
P-value	0.027	0.034

Notes: A ride is the unit of observation. Observations weighted by the inverse of the number of rides taken by the individual rider. Standard errors in parentheses, clustered at rider level. * $p < .1$, ** $p < .05$, *** $p < .01$

Table 3: Impact of randomized assignment of space on reported harassment, overall and by ride condition

	Dependent variable:							
	Any harassment		Physical harassment		Verbal harassment		Staring	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Overall impact of randomized assignment								
Assigned to reserved space	-0.026**	-0.026**	-0.013***	-0.013***	-0.008	-0.008	-0.011	-0.011
	(0.013)	(0.013)	(0.005)	(0.005)	(0.007)	(0.007)	(0.012)	(0.012)
High crowding		0.004		-0.010		0.002		-0.001
		(0.029)		(0.013)		(0.011)		(0.027)
Few men in reserved space		-0.005		0.007		0.006		-0.018
		(0.018)		(0.009)		(0.007)		(0.015)
Constant	0.170***	0.172***	0.032***	0.030***	0.059***	0.056***	0.127***	0.136***
	(0.006)	(0.012)	(0.002)	(0.005)	(0.003)	(0.005)	(0.006)	(0.010)
Mean dependent variable								
Assigned to public space	0.176		0.026		0.067		0.13	
	(0.013)		(0.004)		(0.009)		(0.013)	
Panel B: Impact of randomized assignment by presence of men in reserved space								
Few men in reserved space × assigned to reserved space	-0.016	-0.016	-0.004	-0.004	-0.002	-0.002	-0.018	-0.018
	(0.014)	(0.014)	(0.005)	(0.005)	(0.006)	(0.006)	(0.013)	(0.013)
Few men in reserved space × assigned to public space	0.013	0.013	0.015**	0.015**	0.010	0.010	-0.003	-0.003
	(0.014)	(0.014)	(0.007)	(0.007)	(0.006)	(0.006)	(0.012)	(0.012)
Many men in reserved space × assigned to reserved space	-0.008	-0.008	-0.005	-0.004	-0.004	-0.004	0.004	0.005
	(0.010)	(0.011)	(0.005)	(0.005)	(0.006)	(0.006)	(0.009)	(0.010)
Many men in reserved space × assigned to public space	0.016	0.016	0.000	0.002	0.000	-0.000	0.011	0.011
	(0.012)	(0.013)	(0.005)	(0.005)	(0.006)	(0.007)	(0.011)	(0.011)
High crowding		0.003		-0.011		0.002		-0.002
		(0.030)		(0.014)		(0.011)		(0.029)
Mean dependent variable								
Assigned to public space × Few men in reserved space	0.145		0.028		0.057		0.099	
	(0.023)		(0.007)		(0.014)		(0.02)	
Assigned to public space × Many men in reserved space	0.206		0.025		0.077		0.16	
	(0.023)		(0.006)		(0.019)		(0.021)	
Observations	3688	3688	3688	3688	3688	3688	3688	3688
Riders	258	258	258	258	258	258	258	258
Rider fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Post-estimate tests for heterogeneous effects								
Impact on harassment when few men in reserved space: reserved space - public space								
$\Delta\hat{\beta}$	-0.029	-0.029	-0.019	-0.019	-0.012	-0.012	-0.015	-0.015
P-value	0.082	0.083	0.003	0.003	0.187	0.188	0.341	0.341
Impact on harassment when many men in reserved space: reserved space - public space								
$\Delta\hat{\beta}$	-0.024	-0.024	-0.006	-0.006	-0.004	-0.004	-0.006	-0.006
P-value	0.184	0.184	0.408	0.411	0.733	0.733	0.693	0.694

Notes: Unit of observation is one ride. Sample includes randomized assignment of space rides for riders who started such rides. Rides with no corresponding platform audits were dropped. Observations weighted by the inverse of the number of rides taken by the individual rider. Standard errors in parentheses, clustered at rider level. * $p < .1$, ** $p < .05$, *** $p < .01$.

Table 4: Revealed preferences by rider risk perception

	Dependent variable: Chose reserved space								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel A: By risk type, zero opportunity cost									
High risk perceiver	0.107***	0.097***	0.099***	0.072**	0.065**	0.071**	-0.009	-0.022	-0.016
	(0.036)	(0.035)	(0.034)	(0.033)	(0.033)	(0.033)	(0.047)	(0.048)	(0.048)
High crowding			0.015			0.027			0.045
			(0.045)			(0.042)			(0.062)
Few men in reserved space			0.092***			0.093***			0.083**
			(0.025)			(0.024)			(0.036)
Constant	0.245***	0.249***	0.200***	0.248***	0.251***	0.200***	0.299***	0.304***	0.254***
	(0.017)	(0.017)	(0.023)	(0.019)	(0.019)	(0.023)	(0.028)	(0.026)	(0.032)
Mean dependent variable									
Low risk perceiver		0.245			0.248			0.299	
		(0.009)			(0.01)			(0.015)	
Riders	206	206	206	203	203	203	111	111	111
Line fixed effects	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Panel B: By risk type and opportunity cost									
Low risk perceiver × zero opportunity cost	0.250***	0.225***	0.230***	0.246***	0.222***	0.225***	0.308***	0.298***	0.300***
	(0.018)	(0.019)	(0.019)	(0.020)	(0.020)	(0.020)	(0.030)	(0.036)	(0.036)
Low risk perceiver × positive opportunity cost	0.090***	0.067***	0.064***	0.085***	0.062***	0.057***	0.122***	0.115***	0.120***
	(0.015)	(0.013)	(0.013)	(0.016)	(0.013)	(0.013)	(0.022)	(0.034)	(0.034)
High risk perceiver × zero opportunity cost	0.335***	0.299***	0.312***	0.311***	0.279***	0.293***	0.263***	0.252***	0.257***
	(0.030)	(0.033)	(0.033)	(0.026)	(0.030)	(0.030)	(0.034)	(0.049)	(0.050)
High risk perceiver × positive opportunity cost	0.079***	0.051**	0.053***	0.091***	0.063***	0.069***	0.138***	0.115***	0.094**
	(0.015)	(0.020)	(0.020)	(0.017)	(0.021)	(0.022)	(0.029)	(0.043)	(0.041)
High crowding			-0.027			-0.027			-0.002
			(0.025)			(0.025)			(0.028)
Observations	13211	13211	12542	13185	13185	12520	7656	7656	7304
Riders	206	206	206	203	203	203	111	111	111
Line fixed effects	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Type of perceived risk	Physical harassment	Physical harassment	Physical harassment	Verbal harassment	Verbal harassment	Verbal harassment	Robbery	Robbery	Robbery
Post-estimate tests for heterogeneous effects									
By opportunity cost: zero opportunity cost - positive opportunity cost									
$\Delta\hat{\beta}$ for high risk perceivers	0.255	0.248	0.259	0.220	0.216	0.224	0.125	0.137	0.163
P-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
$\Delta\hat{\beta}$ for low risk perceivers	0.159	0.158	0.166	0.162	0.160	0.169	0.186	0.183	0.180
P-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
By risk perception: high risk - low risk perceivers									
$\Delta\hat{\beta}$ when zero opportunity cost	0.085	0.075	0.082	0.064	0.057	0.068	-0.045	-0.046	-0.043
P-value	0.017	0.037	0.022	0.050	0.082	0.039	0.325	0.310	0.341
$\Delta\hat{\beta}$ when positive opportunity cost	-0.011	-0.015	-0.011	0.006	0.001	0.012	0.016	0.000	-0.026
P-value	0.614	0.461	0.578	0.797	0.975	0.610	0.656	0.999	0.431

Notes: Unit of observation is one ride. Sample includes rides for riders who completed the exit survey, which included questions on perceived risk. Columns 7-9 include observations for participants who completed a version of the exit survey including perceived risk of robbery (added in a second wave of data collection). Panel A include includes only zero cent opportunity cost rides. Panel B includes all revealed preference rides. Observations weighted by the inverse of the number of rides taken by the individual rider. Standard errors in parentheses, clustered at rider level. * $p < .1$, ** $p < .05$, *** $p < .01$

Table 5: Back-of-envelope estimates of cost of harassment

	Overall	Men in reserved space		Lower bound cost
		Few men (Q1)	Many men (Q5)	Q1 - Q5
	(1)	(2)	(3)	(4)
a) Take up of reserved space on rides with positive opportunity cost ride	9.21 %	10.01 %	7.43 %	2.58 %
b) Average willingness to pay for reserved space	$ 0.018	$ 0.020	$ 0.015	$ 0.005
c) Average occurrence of physical harassment in public space (% of rides)	2.64 %	4.63 %	1.71 %	4.63 %
d) Change in physical harassment when riding reserved space (p.p.)	-1.268	-3.279	-0.028	-3.251
e) Percent change in physical harassment when riding reserved space	-48.1 %	-70.9 %	-1.6 %	-69.2 %
f) Cost of harassment				
f.1) Per ride	$ 0.038	$ 0.028		$ 0.007
f.2) Per incident	$ 1.453	$ 0.611		$ 0.161
f.3) Per year	$ 12.06	$ 8.896		$ 2.346
f.4) Percent of minimum wage	0.35 %	0.26 %		0.07 %
f.5) Percent of gender wage gap	1.70 %	1.26 %		0.33 %

Notes: (a) Sample includes only rides from the revealed preference phase of the 261 riders who completed this phase. (b) = $(a) \times 0.20$. We cannot reject that responses to all premia are equal, so participants who show positive willingness to pay on a given ride are assumed to have at least 20 cents willingness to pay for those rides. (c) Corresponds to the mean dependent variable when assigned to public space in columns (3) and (4) of table 3. (d) Column (1) is the coefficient for being assigned to reserved space in panel A, column (3) of table 3; columns (2) and (3) show the $\Delta\hat{\beta}$ when there is a large difference (top quintile) in number of men in reserved space minus women's space; and column (3) when there is a small difference (bottom quintile). Column (4) (a)-(e) show the difference in takeup and protective value against harassment when there is a large versus a small difference in men from moving to the reserved space, i.e. (2) - (3). (e) = $\frac{(d)}{(c)}$. (f.1) = $(b) \times \frac{-100}{(e)}$. (f.2) = $(b) \times \frac{-100}{(c)}$. (f.3) = $(f.1) \times 6.05 \times 52$, where 6.05 is the average number of self-reported weekly rides according to the demographic survey. (f.4) = $\frac{(f.3)}{3455}$, where 3455 is the 2017 annual minimum wage in USD. Source: `https://riotimesonline.com/brazil-news/rio-business/brazils-government-raises-2017-monthly-minimum-wage-to-r937/`. Accessed on Jan 2, 2020.

A Supplementary figures and tables

Figure A1: SuperVia lines and riders home location

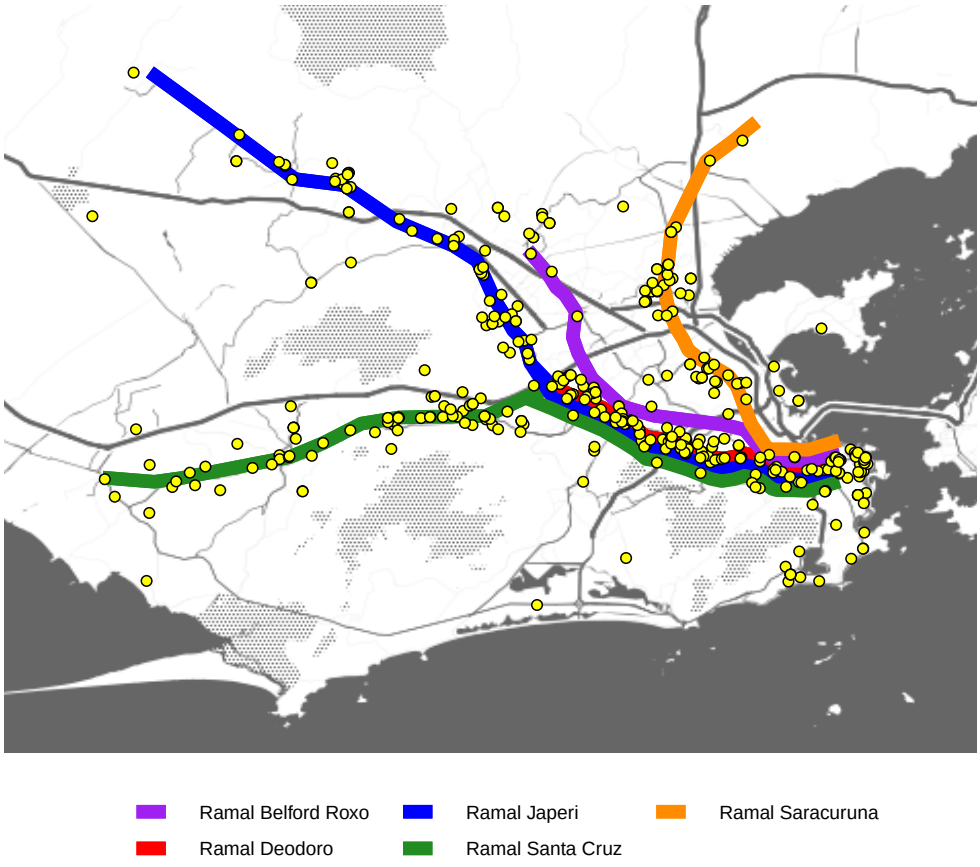
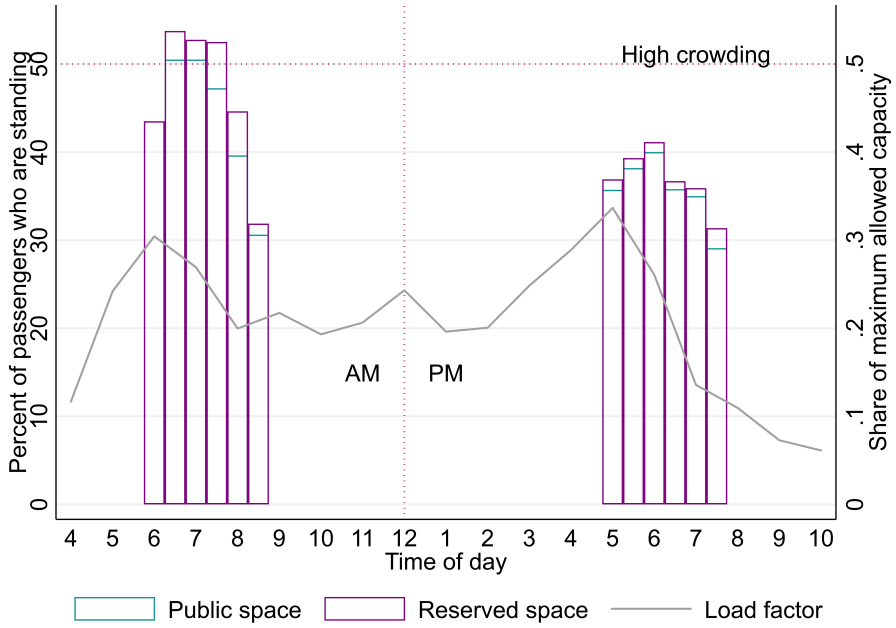
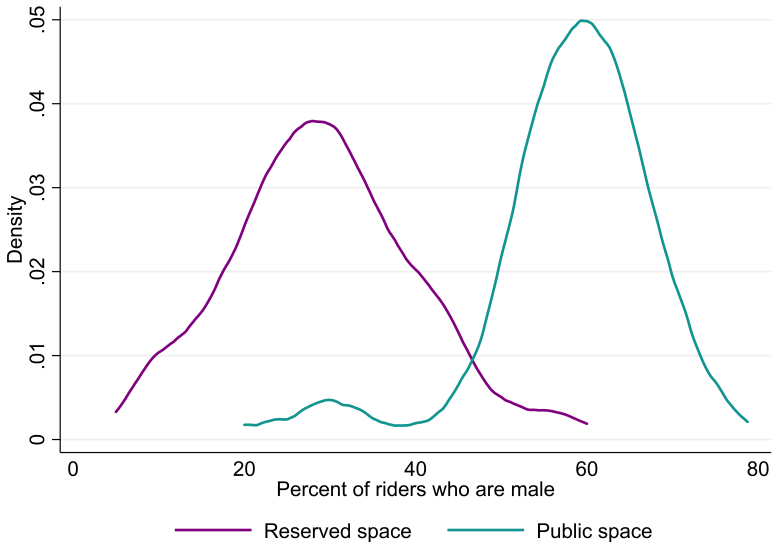


Figure A2: Congestion in the system by time window



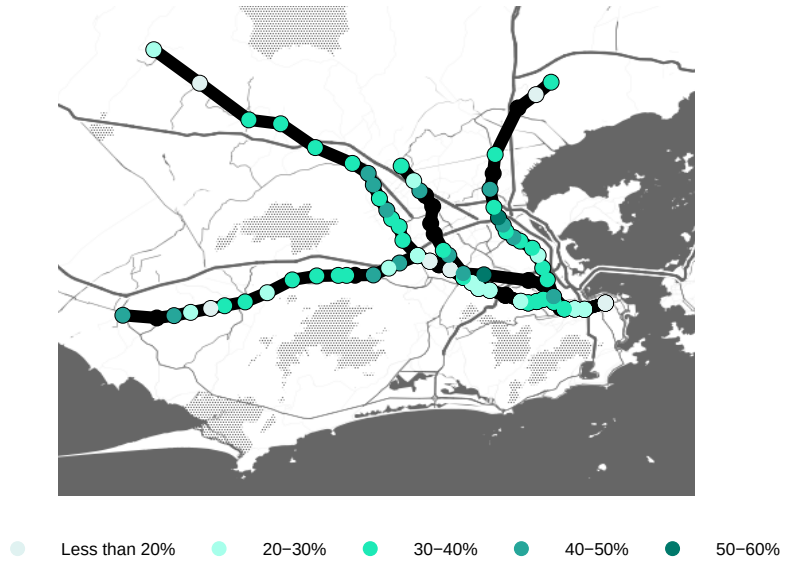
Notes: The platform reports observations from the rider study correspond to rush hour windows, when riders could submit ride observations for the study.

Figure A3: Presence of male riders by space



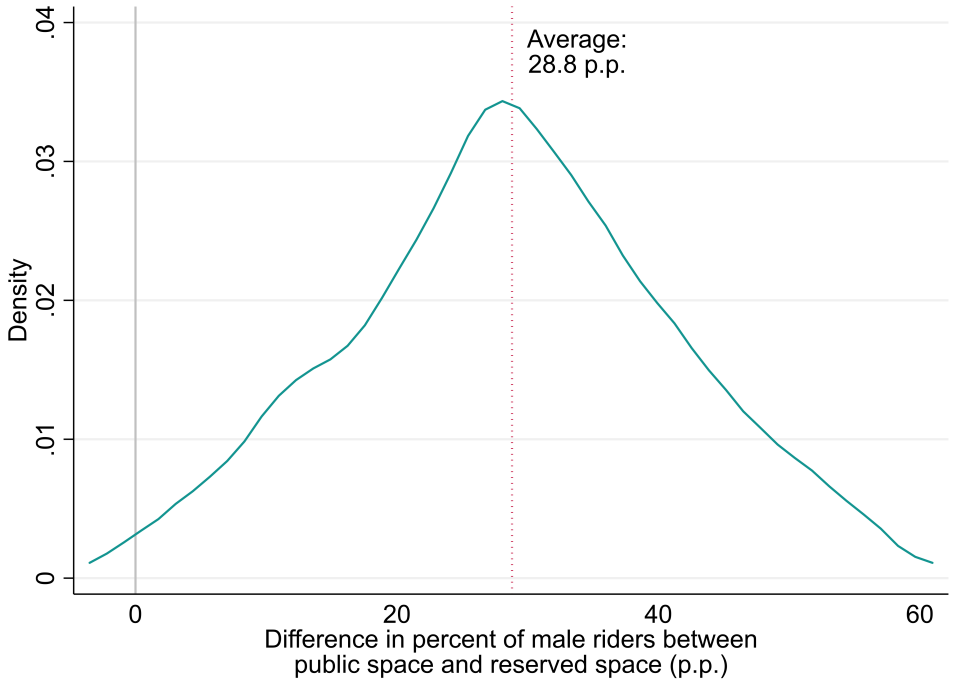
Source: Platform observations.

Figure A4: Presence of male riders in reserved space over stations



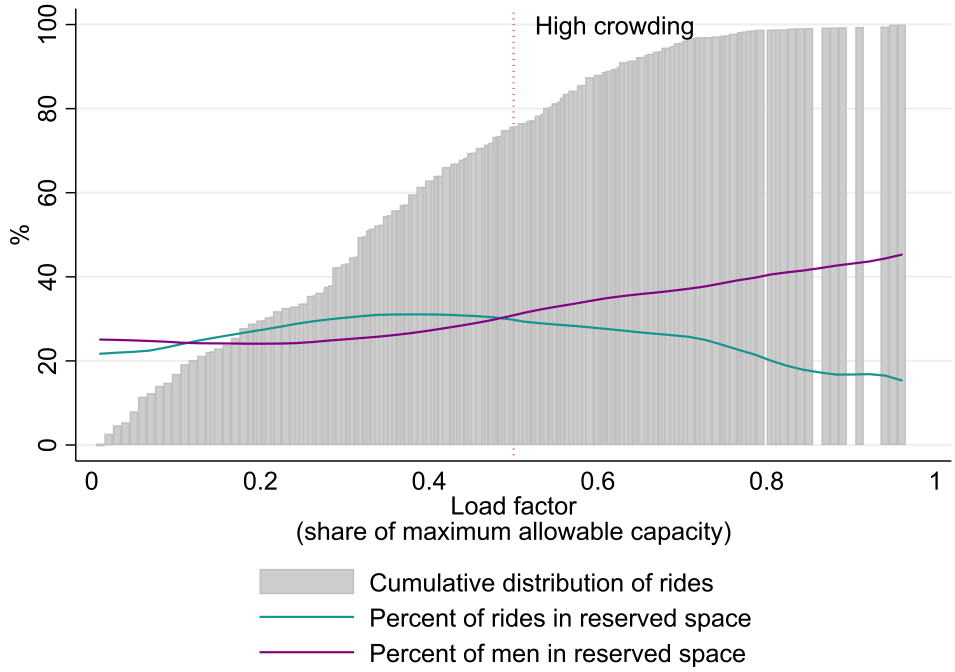
Source: Platform observations.

Figure A5: Difference in presence of male riders between spaces



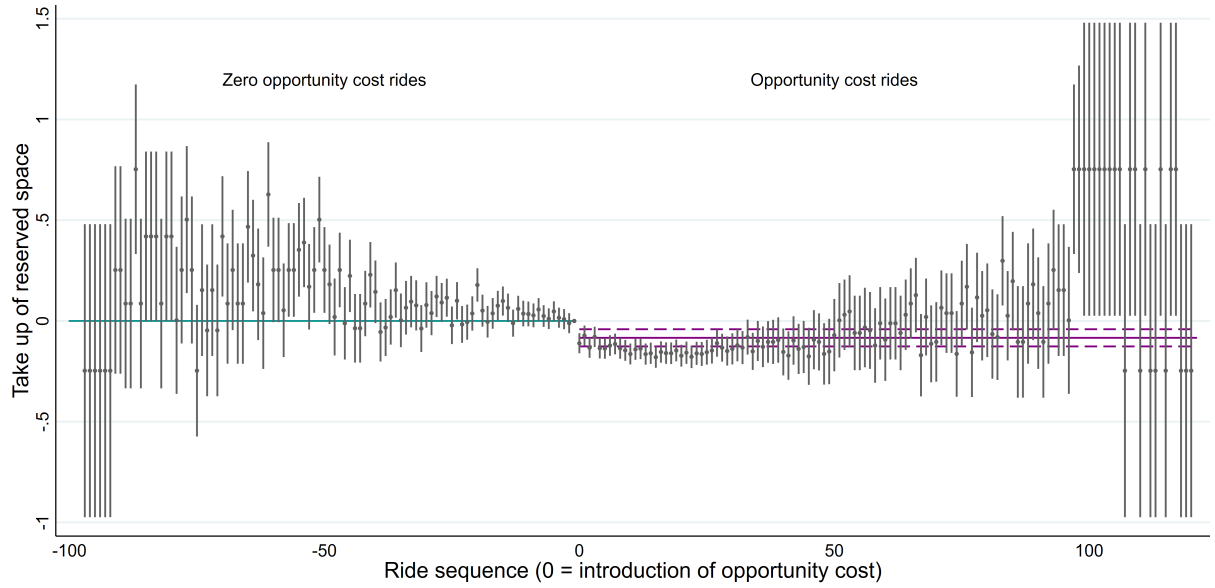
Source: Platform observations.

Figure A6: Correlation between take-up of reserved space and presence of male riders

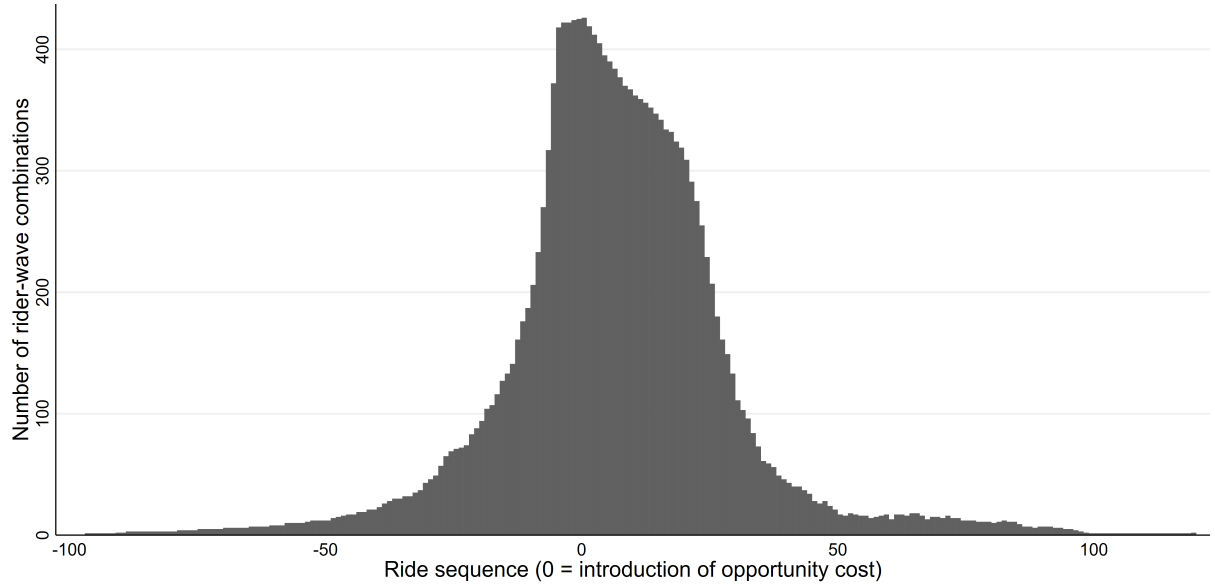


Notes: Sample is restricted to zero cent opportunity cost rides of riders who moved on to positive opportunity cost rides.

Figure A7: Rides sequence and take-up of reserved space



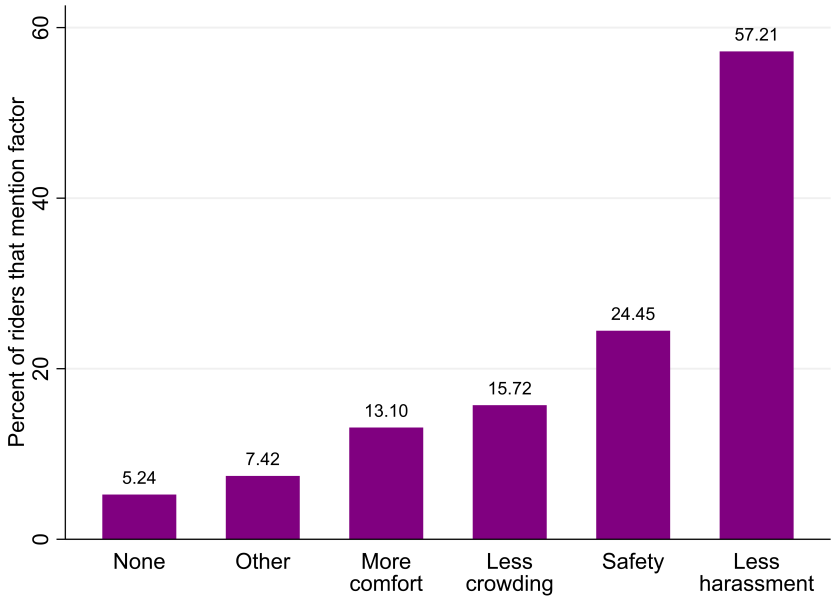
(a) Take up of reserved space compared to last zero cent opportunity cost ride



(b) Number of observations

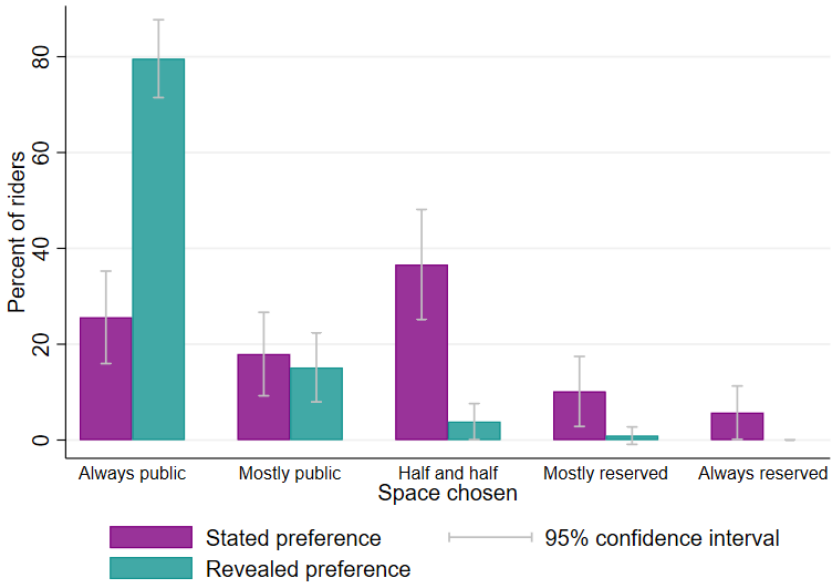
Notes: Sample includes all willingness to pay rides. Displayed values are point estimates and 95% confidence intervals from a regression of take-up of reserved space on dummies the for order in which the rides happened. Omitted ride (take up = 0) is the last ride with no opportunity cost. The ride sequence is defined relative to this ride because not all riders took the same number of rides before moving on to positive opportunity cost rides.

Figure A8: Advantages of reserved space: unprompted responses from participants of rider crowdsourcing



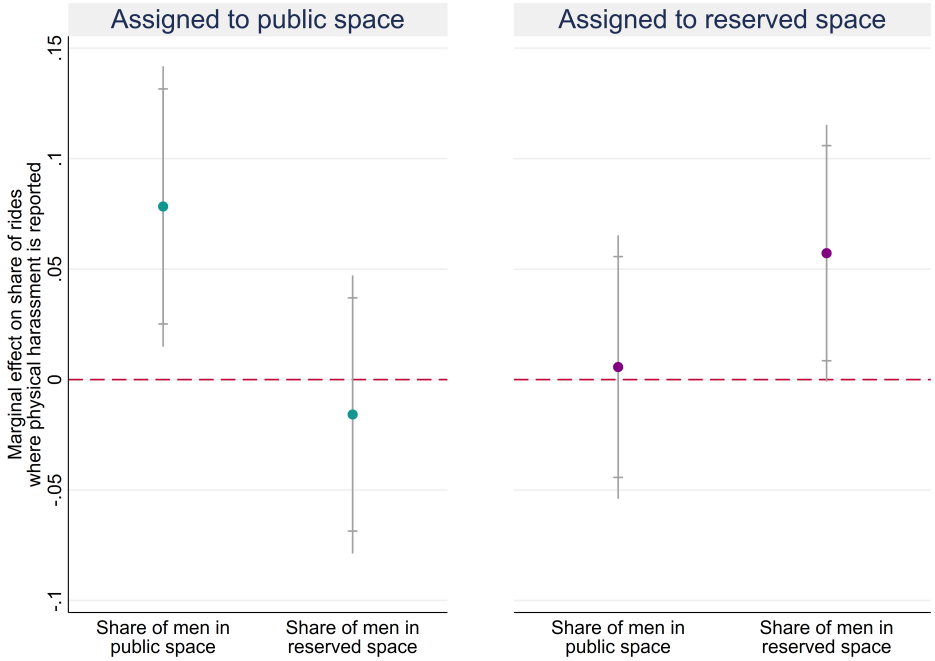
Source: Rider exit survey.

Figure A9: Take-up of women-reserved space with positive opportunity cost: stated and revealed preferences



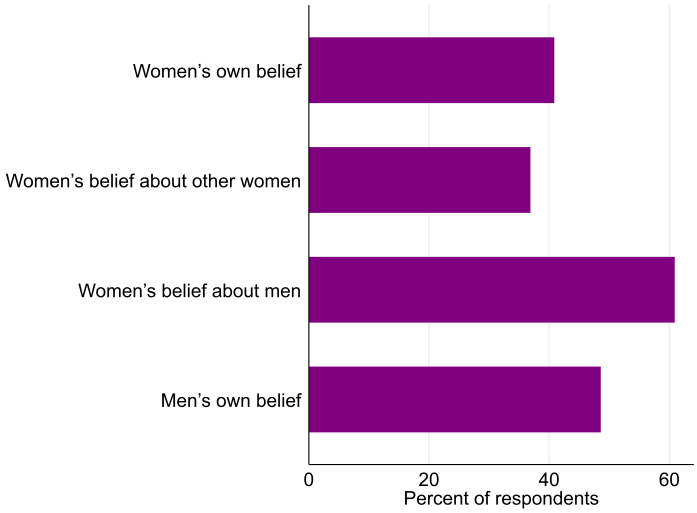
Source: Rider exit survey.

Figure A10: Sorting of men between spaces



Note: Sample includes randomized car assignment rides of users with corresponding platform observations, and excludes 3 riders who are outliers on number of harassment occurrences reported. Values shown are point estimates and 90% and 95% confidence intervals for a regression of occurrence of physical harassment on male presence in both spaces at the time of check-in. Regressions control for high crowding and include Supervia line fixed effects. Standard errors are clustered at rider level and observations weighted by the inverse of the number of rides taken by the individual rider.

Figure A11: First and second order beliefs: percent of respondents who believe women who ride the public space are more open to advances than those who ride the women-reserved space



Note: Variables from platform survey. Sampling weights applied.

Table A1: Sample size description

	Number of riders	% of riders	Total number of rides	Average number of rides per rider
Panel A: Rider reports				
Demographic survey answered	263	72.5		
Rides phase started				
1. Revealed preference	363	100.0	17,764	49
2. Random assignment to reserved space	260	71.6	3,896	15
Exit survey answered	229	63.1		
Panel B: Platform survey and IAT				
	Women	Response rate (%)	Men	Response rate (%)
Platform survey				
Approached	555		523	
Accepted	500	90.1[1]	448	85.7
Finished	448	89.6[2]	423	94.4
IAT				
Approached	429	85.8	391	87.3
Accepted	163	38.0[1]	170	43.5
Finished	145	89.0[2]	146	85.9

Notes: On Panel A, the percent of riders is calculated among riders who started the revealed preference phase. [1] Among those approached. [2] Among those who accepted.

Table A2: Individual pipeline of rides and payments per for riding public and reserved space per rides phase

Ride phase	Payment for public space task (USD)	Payment for reserved space task (USD)	Median number of rides
Phase 1 - Revealed preference			37
Ride block 1	4.50	4.50	
Ride block 2	4.70	4.50	
Ride block 3	4.55	4.50	
Ride block 4	4.60	4.50	
Ride block 5	4.55	4.50	
Phase 2 - Random assignment to space			11
Ride block 6	4.70	4.70	

Note: The order in which the ride blocks were offered was the same for all riders. The number of rides per block for blocks 1-5 were scheduled to be 5 rides each, however in practice there is some variation in actual number of rides taken in each block. The assignment of tasks by the app was done on a daily basis, riders are only moved to the next block at the end of that day and once quality checks are performed. In addition, some riders dropped out before finishing a block. Sampling weights are applied in the analysis to adjust for this variation in number of rides.

Table A3: Correlation between platform observations data and rider reports

Platform observations	Rider reports Share of men in reserved space (1)	 High crowding (2)
Average share of men in reserved space	0.629*** (0.056)	
High crowding		0.239*** (0.029)
Constant	0.161*** (0.018)	0.490*** (0.018)
Observations	4795	20575
Riders	324	363

Notes: Unit of observation is one ride. Sample includes all rides and riders with matching platform observations across all study phases. Rider report variables are collected for each ride and reported only with respect to the space chosen by the rider. As a result, column (1) is restricted to reserved space rides. Platform observations are taken on different days, then aggregated by time and line segment to be merged with rides. Standard errors in parentheses, clustered at rider level. *** p < .01; ** p < .05; * p < .1.

Table A4: Response to platform survey and IAT

	Dependent variable:			
	Responds platform survey	Responds IAT		
	(1)	(2)	(3)	(4)
Female respondent	0.045** (0.020)	-0.055 (0.034)		
Usually chooses reserved space			-0.036 (0.050)	
Female family members use reserved space				-0.013 (0.067)
Observations	1078	820	393	238
Sample	All	All	Females	Males
Platform FE	Yes	Yes	Yes	Yes
F-test for platform dummies (p-value)	0.000	0.000	0.000	0.436
Sample mean	0.879	0.406	0.380	0.435

Notes: Unit of observation is one participant. Sample in column 1 includes all individuals invited to the platform survey. Sample in column 2 includes all individuals who were invited to participate in IAT. Samples in columns 3 and 4 include individuals who were invited to participate in IAT and finished the platform survey. Robust standard errors in parentheses. *** p < .01; ** p < .05; * p < .1.

Table A5: Test for order effects in on screen presentation of public / reserved space

	Dependent variable: Chose reserved space	
	(1)	(2)
Reserved space shown first	0.004	-0.004
	(0.010)	(0.017)
Positive opportunity cost		0.019
		(0.019)
Reserved space shown first × Positive opportunity cost		0.008
		(0.020)
Constant	0.069***	0.050***
	(0.011)	(0.015)
Observations	6079	6079
Riders	273	273

Notes: Unit of observation is one ride. Sample includes revealed preference rides of riders recruited in the first wave. Observations weighted by the inverse of the number of rides taken by the individual rider. Standard errors in parentheses, clustered at rider level. *** $p < .01$; ** $p < .05$; * $p < .1$.

Table A6: Demand elasticity

	Dependent variable: Chose reserved space	
	(1)	(2)
Opportunity cost: 5 cents	-18.360***	-51.896***
	(1.340)	(4.921)
Opportunity cost: 10 cents	-17.815***	-46.061***
	(1.286)	(5.562)
Opportunity cost: 20 cents	-16.639***	-50.913***
	(1.439)	(5.565)
Constant	26.658***	77.776***
	(0.698)	(3.286)
(Omitted category: Zero opportunity cost)		
Observations	15612	879
Level of observation	Ride	Rider-OC
F-test for coefficient equality across positive OC		
Test statistic	1.474	0.647
P-value	0.231	0.525
F-test for demand elasticity equality across positive OC		
Test statistic	93.509	47.307
P-value	0.000	0.000

Notes: Sample include rides from the revealed preference phase of the 261 riders who completed revealed preference rides. Standard errors in parentheses, clustered at rider level. Observations weighted by the inverse of the number of rides taken by the individual rider. Column (1) includes rider fixed effects. The F-test for demand elasticity tests that $\frac{\beta_{5cents}}{5} = \frac{\beta_{10cents}}{10} = \frac{\beta_{20cents}}{20}$. *** p < .01; ** p < .05; * p < .1.

Table A7: Adjustment on other margins

	Dependent variable:					
	Wait min	Against traffic	Switched spaces	Moved within space	Time - AM	Time - PM
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Revealed preference rides						
Positive opportunity cost	-0.161	0.002	-0.008	-0.002	-0.037	-0.049*
	(0.252)	(0.009)	(0.008)	(0.011)	(0.028)	(0.026)
Observations	17230	17594	10879	17764	9409	8355
Riders	363	363	361	363	354	356
Uncontrolled mean when zero opportunity cost	7.703	0.243	0.055	0.502	7.396	18.081
	(0.287)	(0.016)	(0.011)	(0.019)	(0.046)	(0.038)
Panel B: Randomized assignment of space						
Assigned public space	0.054	0.002	0.015*	0.039**	-0.034	-0.013
	(0.361)	(0.012)	(0.008)	(0.016)	(0.025)	(0.034)
Observations	3794	3840	3791	3013	2052	1844
Riders	260	260	258	178	240	251
Uncontrolled mean when zero opportunity cost	7.204	0.261	0.050	0.491	7.352	17.991
	(0.399)	(0.023)	(0.009)	(0.032)	(0.054)	(0.05)

Notes: All specifications include rider fixed effects. Unit of observation is one ride. Sample in panel A includes all riders who completed at least one opportunity cost ride. Observations weighted by the inverse of the number of rides taken by the individual rider. Standard errors in parentheses, clustered at rider level. *** $p < .01$; ** $p < .05$; * $p < .1$.

Table A8: Impact of randomized assignment of car on fear and subjective well-being, overall and by ride condition

	Dependent variable: Above median on self-reported scale								
	Afraid of harassment	Overall wellbeing	Happy	Sad	Tense	Relaxed	Frustrated	Satisfied	Vs before
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel A: Overall impact of randomized assignment									
Assigned to reserved space	-0.019	0.046**	0.044**	-0.048**	0.003	0.012	-0.036*	0.022	-0.006
	(0.017)	(0.023)	(0.020)	(0.022)	(0.023)	(0.025)	(0.020)	(0.019)	(0.015)
High crowding	-0.008	0.028	0.012	-0.081*	-0.054	0.008	-0.059	0.008	0.021
	(0.038)	(0.033)	(0.038)	(0.043)	(0.044)	(0.046)	(0.048)	(0.033)	(0.023)
Few men in reserved space	-0.020	-0.021	-0.017	-0.016	0.030	-0.029	0.002	0.003	0.029
	(0.019)	(0.027)	(0.029)	(0.021)	(0.028)	(0.026)	(0.019)	(0.026)	(0.018)
Mean dependent variable									
Assigned to public space	0.210	0.295	0.330	0.466	0.419	0.474	0.483	0.415	0.138
	(0.013)	(0.014)	(0.015)	(0.016)	(0.015)	(0.016)	(0.016)	(0.015)	(0.01)
Panel B: Heterogeneous effects by male presence reserved space									
Many men in reserved space × assigned to public space	0.170***	0.311***	0.363***	0.213***	0.065***	0.387***	0.170***	0.514***	0.487***
	(0.015)	(0.021)	(0.021)	(0.022)	(0.023)	(0.023)	(0.021)	(0.019)	(0.016)
Many men in reserved space × assigned to reserved space	0.179***	0.325***	0.400***	0.157***	0.093***	0.413***	0.131***	0.556***	0.489***
	(0.013)	(0.015)	(0.016)	(0.012)	(0.018)	(0.017)	(0.013)	(0.016)	(0.009)
Few men in reserved space × assigned to public space	0.173***	0.263***	0.340***	0.191***	0.116***	0.370***	0.170***	0.534***	0.522***
	(0.020)	(0.027)	(0.024)	(0.023)	(0.025)	(0.026)	(0.022)	(0.022)	(0.016)
Few men in reserved space × assigned to reserved space	0.133***	0.333***	0.389***	0.149***	0.100***	0.371***	0.137***	0.540***	0.511***
	(0.012)	(0.018)	(0.019)	(0.013)	(0.021)	(0.020)	(0.015)	(0.019)	(0.012)
High crowding	-0.010	0.029	0.012	-0.080*	-0.056	0.007	-0.059	0.007	0.021
	(0.038)	(0.033)	(0.038)	(0.043)	(0.044)	(0.046)	(0.048)	(0.034)	(0.023)
Mean dependent variable									
Assigned to public space × Few men in reserved space	0.184	0.296	0.363	0.431	0.399	0.463	0.462	0.458	0.139
	(0.019)	(0.02)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.015)
Assigned to public space × Many men in reserved space	0.241	0.294	0.292	0.507	0.442	0.487	0.507	0.363	0.137
	(0.019)	(0.019)	(0.02)	(0.022)	(0.021)	(0.022)	(0.022)	(0.021)	(0.014)
Observations	3688	3589	3589	3589	3589	3589	3589	3589	3589
Riders	258	257	257	257	257	257	257	257	257
Rider fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Post-estimate tests for heterogeneous effects									
By assigned space: assigned reserved space - assigned public space									
$\Delta\hat{\beta}$ when few men in reserved space	-0.040	0.070	0.049	-0.041	-0.016	0.001	-0.033	0.006	-0.011
P-value	0.036	0.037	0.096	0.119	0.600	0.980	0.255	0.828	0.564
$\Delta\hat{\beta}$ when many men in reserved space	0.008	0.014	0.037	-0.057	0.028	0.026	-0.039	0.043	0.002
P-value	0.698	0.546	0.113	0.032	0.338	0.371	0.170	0.067	0.915
By male presence in reserved space: few men - many men in reserved space									
$\Delta\hat{\beta}$ when assigned reserved space	-0.046	0.008	-0.011	-0.007	0.007	-0.042	0.005	-0.016	0.022
P-value	0.049	0.801	0.752	0.756	0.856	0.229	0.842	0.626	0.286
$\Delta\hat{\beta}$ when assigned public space	0.002	-0.048	-0.023	-0.023	0.051	-0.017	-0.000	0.020	0.035
P-value	0.910	0.163	0.505	0.422	0.090	0.585	0.989	0.478	0.125

Notes: Unit of observation is the ride. Sample includes randomized car assignment rides for riders who started such rides, and rides with corresponding platform audits. Observations weighted by the inverse of the number of rides taken by the individual rider. Standard errors in parentheses, clustered at rider level. None of the estimates are precisely estimated using Q-values calculated as in Benjamini & Hochberg (1995) with code developed by Anderson (2008). * $p < .1$, ** $p < .05$, *** $p < .01$.

Table A9: Social norms survey

	Female respondent Mean/SE (1)	Male respondent Mean/SE (2)	Difference (1)-(2) (3)
Women in mixed car are more likely to accept advances	0.408	0.486	-0.077
	(0.041)	(0.042)	
Women invite advances then change mind	0.314	0.347	-0.033
	(0.037)	(0.041)	
Women on reserved space are less likely to invite advances then change mind	0.294	0.362	-0.068
	(0.037)	(0.040)	
Physical harassment is frequent on public space	0.472	0.472	-0.000
	(0.038)	(0.039)	
Ever chose not to go somewhere due to lack of safety or harassment on Supervia[1]	0.440	0.510	-0.070
	(0.037)	(0.039)	
Bystanders rarely intervene when witnessing harassment on public space	0.671	0.458	0.214***
	(0.035)	(0.039)	
Bystanders rarely intervene when witnessing harassment on reserved space	0.641	0.506	0.135**
	(0.036)	(0.039)	
Women are partly at fault if harassed on public space	0.217	0.199	0.018
	(0.031)	(0.030)	

Notes: Unit of observation is one respondent. Survey modules were randomly allocated to subsets of platform survey participants to minimize survey length. The number of female respondents for each question varies between 250 and 303. The number of males respondents is between 235 and 302. Sampling weights applied. Robust standard errors in parentheses. [1] Women were asked about their past experiences, while men were asked about their female relatives.

Table A10: IAT results

	Dependent variable: Dependent variable: IAT D-Score					
	(1)	(2)	(3)	(4)	(5)	(6)
Provokes advances instrument	0.065*	0.110***	0.110***	0.059*	0.105***	0.105***
	(0.035)	(0.038)	(0.039)	(0.035)	(0.038)	(0.039)
Provokes advances instrument × Male respondent		-0.090	-0.090		-0.093	-0.093
		(0.070)	(0.070)		(0.070)	(0.071)
Male respondent		-0.046	-0.036		-0.022	-0.020
		(0.055)	(0.051)		(0.052)	(0.049)
Employed			0.082			0.048
			(0.075)			(0.059)
Young (18-25 years-old)			0.059			0.058
			(0.044)			(0.043)
Low education (middle school or less)			-0.103**			-0.076
			(0.044)			(0.046)
D-Score on Gender-Career IAT				0.225***	0.208***	0.179***
				(0.059)	(0.064)	(0.062)
Constant	0.166***	0.189***	-0.348***	0.106***	0.122***	-0.424***
	(0.027)	(0.040)	(0.076)	(0.030)	(0.041)	(0.074)
Observations	588	588	588	582	582	582
Respondents	294	294	294	291	291	291
Platform Fixed Effect	No	No	Yes	No	No	Yes
Post-estimate test for difference between instruments among men						
$\hat{\beta}_{\text{Provokes advances}\times\text{Male respondent}} + \hat{\beta}_{\text{Provokes Advances}}$		0.020	0.020		0.012	0.012
P-value		0.733	0.735		0.836	0.837

Notes: The dependent variable is the IAT D-score as calculated by Greenwald et al. (2003). Omitted category is safety instrument in columns (1) and (4); safety instrument, female respondent in columns (2) and (5); and safety instrument, female respondent, more than 25 years-old, unemployed, with high school or college degree in columns (3) and (6). Unit of observation is a respondent-instrument pair, so that there are two observations per respondent, one for the provokes advances instrument and one for the safety instrument. Columns (1)-(3) include all respondents who took both the Advances and the Safety tests. Columns (4)-(6) Include only respondents who finished all the tests. All specifications include sampling weights. Standard errors in parentheses, clustered at participant level. *** p < .01; ** p < .05; * p < .1.

B Data

UNDER CONSTRUCTION

Variable	Definition
Source: Revealed preferences rides only	
Opportunity cost of riding the public space (USD)	Difference between pay off for riding the public and the reserved space. Possible levels: 0 cents, 5 cents, 10 cents, 20 cents
Positive opportunity cost	= 1 if opportunity cost of riding the public space is more than zero
Chose reserved space	= 1 if rider takes up the reserved space during ride
Reserved space shown first	= 1 if reserved space is displayed on top of the screen during ride check-in
Share of men in reserved space at check-in	Rider report from the platform before check-in
Source: Randomized car assignment rides only	
Assigned reserved space	= 1 if rider is assigned the reserved space for a given ride
Assigned public space	= 1 if rider is assigned the public space for a given ride
Rider experienced verbal harassment during ride	= 1 if rider reports that a stranger made comments during the ride that made them uncomfortable
Rider was stared at during ride	= 1 if rider reports being stared by a stranger during the ride in a way that made them feel uncomfortable
Rider experienced physical harassment during ride	= 1 if rider reports being touched intentionally by a stranger during the ride in a way that made them feel uncomfortable
Rider experienced harassment during ride	= 1 if any of the three previous variables is 1
Switched spaces	= 1 if rider moved from reserved to public space, of vice-versa, during a ride
High level of overall well-being	= 1 if above median on well-being self-reported scale (1 is the worst, 10 is the best)
High level of happiness	= 1 if above median on self-reported scale
High level of sadness	= 1 if above median on self-reported scale
High level of tension	= 1 if above median on self-reported scale
High level of relaxation	= 1 if above median on self-reported scale
High level of frustration	= 1 if above median on self-reported scale
High level of satisfaction	= 1 if above median on self-reported scale
High level of well-being compared to before	= 1 if above median on self-reported scale
Source: All rides	
Against traffic	= 1 if rider is going in direction to the Central Station at the evening or away from it in the morning
Time - AM	= 1 if ride check-in happened during the morning
Time - PM	= 1 if ride check-in happened during the evening
Afraid of harassment	= 1 if rider reports, at check-out, being that a stranger might touch them intentionally during the ride in an inappropriate way
Many men in reserved space	= 1 if average share of men in reserved space reported in platform observations for the ride's time interval and check-in station is above the median
Few men in reserved space	= 1 if average share of men in reserved space reported in platform observations for the ride's time interval and check-in station is below the median
High crowding	= 1 if average share of rider's standing reported in platform observations at ride's time interval and check-in station is above the median
Time task opened	Local time at which the rider started check-in task

Variable	Definition
Source: Platform observations	
Share of men in reserved space	
Share of men in public space	
Difference in presence of male riders between spaces	Share of men in public space - share of men in reserved space
Source: Administrative data	
Average ride load factor	
Crime rate at user home station	
Violent crimes at home station	
Crimes against property at home station	
Source: Demographic survey	
Number of Supervia rides in typical a week	
Years of schooling	Number of years equivalent to rider's highest level of education at when demographic survey was responded
Age	Median age in years of the rider's age category when demographic survey was responded
Low education	= 1 if rider's higher lever of education is middle school or lower
Young	= 1 if rider was between 18 and 25 year-old when responded to demographic survey
Single	= 1 if rider was not married when responded to demographic survey
Employed	= 1 if rider had part-time or full-time job when responded to demographic survey
High self-reported socio-economic status	= 1 if rider reported being a member of classes A or B
Source: Exit survey	
Advantages of reserved space: None	= 1 if rider's answer to open-ended question about advantages of reserved space was 'None'
Advantages of reserved space: More comfort	= 1 if rider's answer to open-ended question about advantages of reserved space mention feeling more comfortable
Advantages of reserved space: Less harassment	= 1 if rider's answer to open-ended question about advantages of reserved space mentioned less harassment
Advantages of reserved space: Less crowding	= 1 if rider's answer to open-ended question about advantages of reserved space mentioned less crowding
Advantages of reserved space: Safety	= 1 if rider's answer to open-ended question about advantages of reserved space mentioned feeling safer
Advantages of reserved space: Other	= 1 if rider's answer to open-ended question about advantages of reserved space included factors that were not categorized
Yearly occurrences of verbal harassment when riding public space	
Yearly occurrences of verbal harassment when riding reserved space	
Yearly occurrences of physical harassment when riding public space	
Yearly occurrences of physical harassment when riding reserved space	
Share of reserved space rides under status quo	
Share of reserved space rides under current scenario if 30 cents opportunity cost	
Share of reserved space rides under current scenario if 65 cents opportunity cost	
Share of reserved space rides under if no men could ride the reserved space and under 30 cents opportunity cost	

C Ethics

The Duke University IRB reviewed and approved the protocol for all components of fieldwork (IRB number D0190). We took several measures to avoid placing any undue burden or risk on participants.

First, we recruited a sample of women most of whom ride the SuperVia on a regular basis regardless of the study. The total payment was roughly double the cost of a ticket on SuperVia. Thus the payment after covering the cost of the ticket and the time taken to ride would be worth relatively little to a participant who had no other purpose in riding. So participants were already familiar with the SuperVia system, its environment and the segregated space policy.

Second, before proceeding to rides offering positive opportunity cost for riding the reserved space, we reviewed the data and verified that majority of participants of zero cent opportunity cost rides had experience riding the public space. In fact, all the participants who continued past the zero cent opportunity cost rides chose the public space on at least some of those rides in the study. In addition, fewer than 2% of participants responding to a question about usual ride space reported that they always choose the reserved space.

Third, participation in each ride opportunity was voluntary, and participants were paid for each ride they completed shortly after completion, regardless of the total number they completed. Thus participants could choose to discontinue participation at any time if they felt uncomfortable. In the revealed preference phase of the experiment, the order of the premia offered to ride in the public space was fixed for each rider, and the same task was offered until completed. In each of these rides, participants were always offered the possibility to ride in the women-reserved space for the same base pay-out as was offered in the initial stage of the experiment. In the randomized assignment phase, the task assignment was independent of previous assigned spaces and a rider's decision to take-up that task.

Fourth, in the phase of the experiment during which riders were randomly assigned to ride in a particular space, participants were asked about whether they experienced any

harassment. In case a respondent reported any harassment, the app directed her to the platform guards to whom she could report harassment incidences on SuperVia, who are trained to respond to these reports, as well as to other resources available in the Rio area.

Finally, for the development of all protocols and sensitive survey questions in the project we took feedback from gender experts at the World Bank and local researchers working on gender related issues to ensure that these were worded appropriately.

D Robustness to attrition

For ethical as well as logistical reasons, participation in each ride opportunity was voluntary and compensated separately. This allowed participants to drop out of our experiment at any point. Table A1 presents descriptive statistics on participation patterns of dropouts throughout the sequence of rides. Of the 546 initial participants who tried out at least one zero cent opportunity cost ride, 66.5% continued to rides with positive opportunity cost for riding the reserved space and 48.3% continued to the randomized assignment of reserved or public space. Much of this early attrition is driven by casual participants who experimented briefly with the app at the beginning and then did not continue: conditional on completing five or more rides with zero cent opportunity cost, 84% continue to the opportunity cost rides and 61% to the randomized assignment of space.

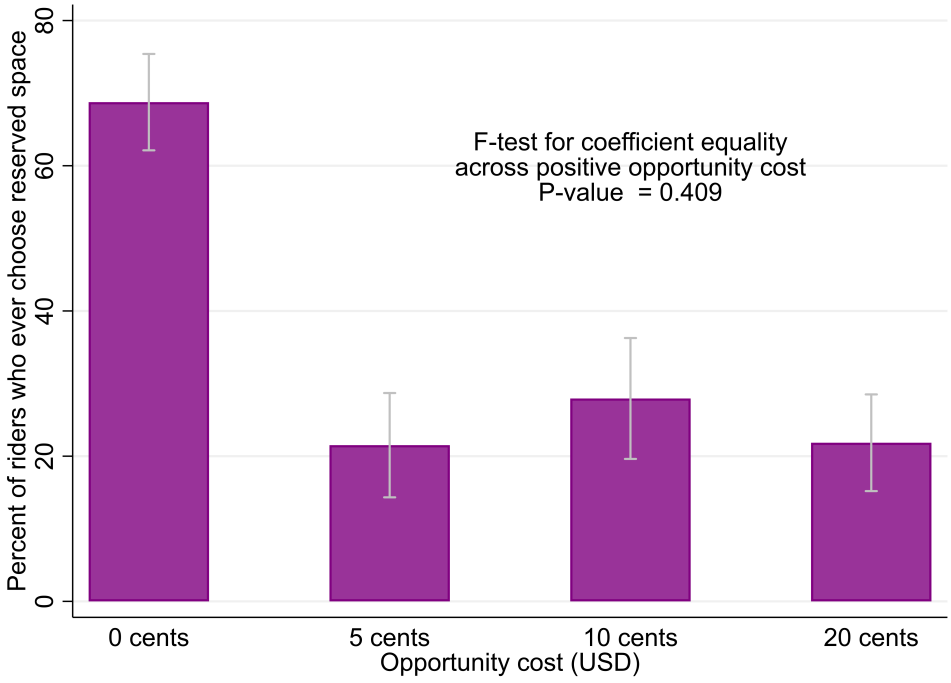
We first account for attrition bias originating from early attriters who only completed a few rides in the zero-opportunity cost phase of the experiment. First, we verify that observable characteristics do not jointly explain participation in the different phases of the experiment (Table A11). Second, we estimate a conservative bound our results on willingness to pay by assuming that all participants who tested the app and dropped out would always choose the public space. This is a conservative assumption since attriters are in fact somewhat more likely to choose the reserved space at when there is no opportunity cost. Figure A12 shows the results: over 20% of participants still demonstrate positive willingness to pay for the reserved space, even assuming that none of the attriters do so. We also note that the results presented in the event study graph in Figure A7 provide reassurance, as the treatment effects are remarkably stable even as density of observations decline within each phase of the experiment.

Table A11: Correlates of attrition across phases

	Dependent variable:				
	Started revealed preferences rides		Started randomized car assignment rides		
	(1)	(2)	(3)	(4)	(5)
Low education (Middle school or less)	-0.019	0.073*	-0.008	0.066	0.030
	(0.056)	(0.043)	(0.060)	(0.061)	(0.043)
Young (18 to 25 years-old)	-0.065	-0.016	-0.172***	-0.162**	-0.053
	(0.057)	(0.045)	(0.061)	(0.064)	(0.045)
Single	0.059	0.001	-0.002	-0.059	-0.023
	(0.052)	(0.042)	(0.056)	(0.059)	(0.040)
Employed	-0.071	-0.032	-0.143**	-0.128**	-0.056
	(0.054)	(0.042)	(0.058)	(0.060)	(0.042)
High self-reported socio-economic status	0.048	0.041	0.031	0.028	0.024
	(0.078)	(0.061)	(0.084)	(0.085)	(0.061)
Take-up at zero opportunity cost		0.000		0.001	-0.001
		(0.000)		(0.001)	(0.000)
Any take-up with positive opportunity cost					0.057
					(0.038)
Constant	0.751***	0.831***	0.718***	0.752***	0.983***
	(0.069)	(0.066)	(0.074)	(0.093)	(0.073)
Observations	372	297	372	297	226
Regression sample mean		0.843		0.614	0.884

Notes: Unit of observations is the rider. Sample in columns (1) and (3) include all participants. Sample in columns (2) and (4) are restricted to riders who completed at least 5 zero cent opportunity cost rides. Sample in column (5) includes only riders who completed at least 5 positive opportunity cost rides. Standard errors in parentheses. * $p < .1$, ** $p < .05$, *** $p < .01$

Figure A12: Take-up of reserved space by opportunity cost level - lower bounds for attrition



Second, we account for potential attrition bias originating from riders systematically responding to assignment to a given space. First, we simply regress rider's take up of a task on treatment assignment (Table A12). Results confirm that participants did not selectively drop out in response to treatment assignment on any given day. Second, we show that our results are robust to restricting the analysis sample to the subsample of individuals who completed the entire sequence of activities up to the exit survey (see Online Appendix on Robustness Checks). Under monotonicity assumption on attrition in response to treatment, this is sufficient to conclude that attrition is unlikely to bias our estimates.

Table A12: Effect of random assignment on participation

	Dependent variable: Accepted task	
	(1)	(2)
	Rider-ride	Rider-day
Assigned to reserved space	-0.032*	-0.024
	(0.017)	(0.016)
Constant	0.423***	0.343***
	(0.009)	(0.008)
Observations	4769	4228
Riders	243	243

Notes: Unit of observation in column (1) is one rider. Unit of observation in column (2) is one rider-day, and the outcome variable indicates whether the user accepted at least one ride in the day. Standard errors in parentheses, clustered at participant level. All specifications include rider fixed effects. *** p < .01; ** p < .05; * p < .1.

E IAT

An IAT is a computerized test originating in psychology to uncover implicit attitudes based on a rapid categorization task (Banaji, 2001). An IAT uses the speed with which a respondent sorts items into categories to measure the respondent's strength of association between two ideas. The key assumption underlying any IAT is that the stronger the association a respondent makes between two concepts, the faster they are to make these associations.

The IAT measures an implicit, "gut" reaction, and does not measure behavior, which may be a product of both implicit attitudes and explicit decision-making. While it does not always correlate to considered decisions (Karpinski & Hilton, 2001), it has been found to correlate meaningfully with actions in a range of areas (Poehlman et al., 2009; Greenwald & Nosek, 2015; Mcconnell & Leibold, 2001), including economically meaningful decisions such as hiring (Rooth, 2010; Reuben et al., 2014), grading (Alesina et al., 2018; Carlana, 2018), voting (Arcuri et al., 2008; Raccuia, 2016), and clinical decisions (Green et al., 2007). As IAT measures typically offer better predictor of behavior than stated attitudes on sensitive topics, it has become ubiquitous in economics (Bertrand et al., 2005; Beaman et al., 2009; Corno et al., 2018; Lowes et al., 2015; Glover et al., 2017).

The respondent sees a series of stimuli, which can be words or images, in the middle of a monitor. At the top of the screen are the two categories in which stimuli need to be sorted with a keystroke to the right or left. Every stimulus has a clear correct category to which it belongs. Each IAT includes several training rounds, a stereotypical ("easy") paired test, and a non-stereotypical ("hard") paired test. In the training rounds, the respondent practices making only one type of categorization. For example in an IAT designed to measure gender stereotypes with regard to career and home tasks, respondents categorize words (e.g., parents or office) into career versus family and pictures of people into male and female. Then, in the "stereotypical" paired test, a respondent sees the same stimuli, but the categories in which to order them are presented together. The pairs are made to follow the stereotype; women with home and men with career. Stimuli still always fall only in one of the four categories.

In the final "nonstereotypical" round, the categories are presented in pairs that are not stereotypically associated (women and career; men and home). This approach assumes that respondents who have a stronger association between the two stereotypical categories (women are associated with home, while men are associated with career) will find it easier to group stimuli in the stereotypical round, compared to the non-stereotypical round. The IAT D-score is the normalized difference in average response times between the "stereotypical" and "nonstereotypical" paired tests (Greenwald et al., 2003).

For this study we developed two sets of IATs to test for associations between the two car types and "safety" and "provokes advances". Table 1 gives an overview of the IATs. We used an identical set of photographs of the women-reserved and public space in both IATs. We selected sets of words for the two tasks that had a similar number of elements, similar length and were all in common daily use in the Rio context; we piloted these with native speakers to eliminate any words that were difficult or ambiguous from either set. We also translated a widely used standard IAT of gender and career IAT as a benchmark.

Table 1: New IAT instruments developed by authors

Round	Categories		Stimuli
	Respond left	Respond right	
Panel A: Safety IAT			
1. Training	Reserved space	Public space	Pictures
2. Training	Seeks safety	Not worried about safety	Words
3. Stereotypical paired	Reserved space Seeks safety	Public space Not worried about safety	Mix
4. Training	Public space	Reserved space	Pictures
5. Non-stereotypical paired	Public space Seeks safety	Reserved space Not worried about safety	Mix
Panel B: Provokes advances IAT			
1. Training	Reserved space	Public space	Pictures
2. Training	Not provoking	Provoking	Words
3. Stereotypical paired	Reserved space Not provoking	Public space Provoking	Mix
4. Training	Public space	Reserve space	Pictures
5. Non-stereotypical paired	Public space Not provoking	Reserved space Provoking	Mix

Each participant who consented to the IAT completed the safety, provocation and career instruments. The order in which a respondent takes the three different IATs is randomized. We implemented the IAT instruments with the software developed by Meade (2009), which calculates the main outcome of interest, the D-score, following the standard methodology in Greenwald et al. (2003).

IAT References

Alesina, A., Carlana, M., Ferrara, E. L., & Pinotti, P. (2018). Revealing Stereotypes : Evidence from Immigrants in Schools. (November).

Arcuri, L., Castelli, L., Galdi, S., Zogmaister, C., & Amadori, A. (2008). Predicting the

Vote: Implicit Attitudes as Predictors of the Future Behavior of Decided and Undecided Voters. *Political Psychology*, 29(3), 369–387.

Banaji, M. R. (2001). Implicit Attitudes Can Be Measured. In H. L. Roediger, I. Nairne, & A. Suprenant (Eds.), *The Nature of Remembering: Essays in Honor of Robert G. Crowder*.

Beaman, L., Chattopadhyay, R., Duflo, E., Pande, R., & Topalova, P. (2009). Powerful Women: Does Exposure Reduce Prejudice. *Quarterly Journal of Economics*, 4(124).

Bertrand, M., Chugh, D., & Mullainathan, S. (2005). Implicit Discrimination. *American Economic Review: Papers & Proceedings*, 95(2), 94–98.

Carlana, M. (2018). Implicit Stereotypes: Evidence from Teachers' Gender Bias. *IZA Discussion Paper No. 11659*, (11659).

Corno, L., Ferrara, E. L., & Burns, J. (2018). Interaction, stereotypes and performance. Evidence from South Africa. *Institute for Fiscal Studies Working Paper W19/03*.

Glover, D., Pallais, A., & Pariente, W. (2017). Discrimination as a Self-Fulfilling Prophecy: Evidence from French Grocery Stores. *The Quarterly Journal of Economics*, 132(3), 1219–1260.

Green, A., Carney, D., Pallin, D., Ngo, L., Raymond, K., Iezzoni, L., & MR, B. (2007). Implicit bias among physicians and its prediction of thrombolysis decisions for black and white patients. *Journal of General Internal Medicine*, 22(9), 1231–8.

Greenwald, A. G. & Nosek, B. A. (2015). Statistically Small Effects of the Implicit Association Test Can Have Societally Large Effects. *Journal of Personality and Social Psychology*, 108(4), 553–561.

Greenwald, A. G., Nosek, B. A., & Banaji, M. R. (2003). Understanding and Using the Implicit Association Test: I. An Improved Scoring Algorithm. *Journal of Personality and Social Psychology*, 85(2), 197–216.

Karpinski, A. & Hilton, J. L. (2001). Attitudes and the Implicit Association Test. *Journal of Personality and Social Psychology*, 81(5), 774–788.

Lowes, S., Nunn, N., Robinson, J. A., & Weigel, J. (2015). Understanding ethnic identity in Africa: Evidence from the Implicit Association Test (IAT). *American Economic Review*, 105(5), 340–345.

Mcconnell, A. R. & Leibold, J. M. (2001). Relations among the Implicit Association Test, Discriminatory Behavior, and Explicit Measures of Racial Attitudes. *Journal of Experimental Social Psychology*, 37, 435–442.

Meade, A. W. (2009). FreeIAT: An open-source program to administer the implicit association test. *Applied Psychological Measurement*, 33(643), 2003.

Poehlman, T. A., Uhlmann, E. L., Greenwald, A. G., & Banaji, M. R. (2009). Understanding and using the Implicit Association Test: III. Meta-analysis of predictive validity. *Journal of personality and social psychology*, 97(1), 17–41.

Raccuia, L. (2016). Single-Target Implicit Association Tests (ST- IAT) Predict Voting Behavior of Decided and Undecided Voters in Swiss Referendums. *PLOS One*, 11(10).

Reuben, E., Sapienza, P., & Zingales, L. (2014). How stereotypes impair women's careers in science. *Proceedings of the National Academy of Sciences*, 111(12), 4403–4408.

Rooth, D.-o. (2010). Automatic associations and discrimination in hiring: Real world evidence. *Labour Economics*, 17(3), 523–534.