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

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August 5, 2020

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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 crowdsource information on 22,000 rides. Women in the public space experience harassment once a week. A fifth of riders are willing to pay 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. IATs show that women face a stigma for riding in the public space that may outweigh the benefits of the safe space.

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

*This draft benefited from comments from Girija Borker, Peter Christensen, Simeon Djankov, Erica Field, Gabriel Kreindler, John Loeser, Sveta Milusheva, Pedro Olinto, Dev Patel, Martin Raiser, Dan Rogger, 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, the Umbrella Facility for Gender Equality, 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 their dedication in implementing this research design. This trial was registered in the 3IE database under ID-5a125fecae423 and Duke IRB D0910/2017-0401 and AEA RCT Registry AEARCTR-0006142. The views expressed in this manuscript do not reflect the views of the World Bank. All errors are our own. Replication package and Online Appendix are available at `https://github.com/worldbank/rio-safe-space`.

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1 Introduction

Sexual harassment limits women's ability to engage in market activities (Jayachandran, 2020). 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). The risk of violence might altogether discourage women from market participation (Velásquez, 2019) or from choosing better schools (Borker, 2018). However, the recurring economic costs women face when they choose to commute daily have not been formally documented.

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.[1] While these reserved spaces may provide an avenue for avoiding harassment (Aguilar et al., ming), 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 363 Brazilian women who commute daily to crowdsource data on $\approx$ 22,000 of their rides.[2] 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 harassment. We exploit within-commuter variation in opportunity costs and

[1] At the time of publication, women-reserved spaces in public transit have been adopted by cities in Brazil, Mexico, Pakistan, India, Bangladesh, the Islamic Republic of Iran, the Arab Republic of Egypt, the United Arab Emirates, Israel, Belarus, the Philippines, Malaysia, Indonesia, the Republic of Korea, and Japan, among others.

[2] The analysis dataset is available on the World Bank's Microdata Catalogue under the reference code BRA_2015-2016_DSS_v01_M (Kondylis et al., 2020).

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, 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. We find that 20% 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 18% 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 magnitudes are corroborated by the fact that 60% of riders cite 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. Taken at face value, 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: 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. However, as compliance to the reservation 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, imposing an additional cost on women traveling 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 labor supply (Jayachandran, 2015; Field et al., 2019; Bursztyn et al., ming; Jayachandran, 2020). Accordingly, understanding how safe spaces interact with 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 to document the costs of a recurring, frequent crime such as public sexual harassment (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 (Cullen & Levitt, 1999; Gibbons, 2004; 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., ming). 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 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

[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; Iyer et al., 2012; Bisschop et al., 2017; Cunningham & Shah, 2017), these studies do not isolate an effect on sexual harassment from other types of crimes.

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-minute 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. Half of SuperVia's passengers are women,[5] and one in six to eight carriages are reserved

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

[5]Source: SuperVia administrative data.

for women, depending on the train length.[6] 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 time and stations. This foreshadows substantial differences in compliance to the reservation rule across space and time.

3 Data

We generate two main types of data.[7] 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 IATs on a random sample of male and female commuters. 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 Crowdsourced rider experiences

Women and men riders were recruited and invited to report on their commuting experiences through a smartphone application for a monetary payment. The application allows us to vary the assigned location (reserved vs public space), pay-out, and data collection task across 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.

[6]The location of the reserved cars is stable for a given train length.

[7]The analysis dataset is available on the World Bank's Microdata Catalogue under the reference code BRA_2015-2016_DSS_v01_M (Kondylis et al., 2020).

3.1.1 Rider reports

Recruitment

A total of 363 women commuters and 51 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.[8] 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. Of those riders, 72.5% 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 were then offered to participate in ride tasks, while men riders were asked to collect platform observations. We now describe these two work streams.

Women riders' tasks

Each woman rider is offered a series of tasks which entail riding the SuperVia and answering questions before, during and after each ride. Data were 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.[9,10] 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

[8] Our survey of a random sample of commuters indicates that 85% of them own a smartphone.

[9] This payment covers the SuperVia transit fare.

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

to 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 48 rides in this phase.[11]

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 each 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 ride types and their pay-outs. To minimize potential for gaming through strategic timing of when to ride, riders are not told the total number of rides they will be offered, or of the conditions or payment variation of future rides. A rider's take up or refusal decisions do 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

[11]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.[12]

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' stated preference as well as stated willingness to pay for the reserved space. Finally, we ask about the perceived risk of harassment across spaces, as well as the stated attitudes towards commuters using either space.[13]

3.1.2 Men riders' platform observations

Men riders recruited through the app served as platform observers and collected data on crowding and enforcement of the gender reservation policy across the system through the same application. Each 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-

[12]Upon checking out, riders are asked whether they switched spaces; they report doing so on 4%-6% of rides across phases. We revisit this as a margin of adjustment in the results section.

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

hour 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 bins. We confirm that data collected by the platform observation team are strongly correlated with what riders themselves observe on their ride (Table A3).

3.2 Social Norm Survey and Implicit Association Tests

To measure the attitudes of other commuters women face traveling in the public space, we administer a social norm survey and IATs on a random sample of 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 women in public transit. Questions followed the same wording as that 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, during the evening commute (5-8pm). Table A1, Panel B, summarizes patterns of response. A total of 1,078 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%.[14] 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 series of IATs.[15] The IAT method and instruments are discussed in Section 6.4.

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

[15] For respondents who agree to participate in the IATs we randomize whether the platform survey is taken

Participants in the IATs are offered a compensation of R$30.00, or about $7.50.[16] A booth was set up close to the platform and equipped with laptops on which participants took the test. The platform survey was conducted until 300 finished IATs were completed.[17] The response rate for the IATs is reported in Table A1. Conditional on being invited to take the IATs, 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 IATs (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 IATs (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

Trains are densely packed throughout the rush-hour period, which corresponds with the times during which the reserved space is in operation (Figure A2). We observe similar patterns

before or after completion of the IAT to control for priming effects differential fatigue in the instruments. We find that the order in which the respondents take either task does not affect the results (Table A5)

[16]Eighty-six platform respondents were not invited to the IATs because they were illiterate, making completion of the task, requiring matching words and pictures, impractical, and 14 were excluded due to significant disruption caused by a samba party on the train platform.

[17]Nine IATs 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.

across crowdsourced and administrative data. Half of the SuperVia passengers are women,[18] but only one in eight or one in six 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 (Figure 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 public and reserved space 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 respondents. 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 times a week. Unemployed participants are the minority, but are over-represented in the rider 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

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

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 our crowdsourcing app 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 take-it-or-leave-it single offer price method of eliciting willingness to pay (Lee et al., 2016; Ashraf et al., 2010; Cohen & Dupas, 2010). 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 make the price difference salient (Figure 1b).[19] 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.[20] To limit framing in these first phase rides, we do not elicit experiences of harassment from riders at the end of these rides.

[19]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.

[20]We randomize whether the reserved or public space option is offered on top in the app. Table A6 shows that this order does not affect the results.

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

$$ChoseReservedSpace_{i,t} = \beta_{\tau_{i,t}} + \epsilon_{i,t} \quad (1)$$

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:

$$ChoseReservedSpace_{i,t} = \alpha + \beta d_{i,t} + \epsilon_{i,t} \quad (2)$$

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 rides 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 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.[21]

[21] 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.

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

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

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; as commuters have fairly rigid commuting habits, this absorbs a lot of fixed variations such as commuting-route-specific compliance or crowding. 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 a 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 27% 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 16.4 percentage points (Table 2). The F-stats presented in the two lower panels of Table 2 indicate that willingness to pay does not vary significantly across opportunity costs.[22] 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

[22]Berry et al. (2019) also observe inelastic demand for a proven clean water technology at low ranges of the price distribution.

level (Figure 2). This suggests that 20 cents per ride is a lower bound on riders' willingness to pay for the reserved space.[23]

Other margins of adjustment

Riders may respond to our offer of a higher payment to ride in the public space by adjusting 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 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 variation in the presence of men in the women-reserved

[23]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.

space to shed light on potential heterogeneity in riders' demand for the reserved space across compliance levels. We estimate a modified version of (4), interacting dummies indicating whether a positive opportunity cost was assigned at ride 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:

$$\begin{aligned} ChoseReservedSpace_{i,t} = {} & \beta_{M_1}\mathbf{1}[M_{i,t} > 0] \times FewMenInReservedSpace_t \\ & + \beta_{M_2}\mathbf{1}[M_{i,t} = 0] \times FewMenInReservedSpace_t \\ & + \beta_{M_3}\mathbf{1}[M_{i,t} > 0] \times ManyMenInReservedSpace_t \\ & + \beta_{M_4}\mathbf{1}[M_{i,t} = 0] \times ManyMenInReservedSpace_t + \gamma_i + \epsilon_{i,t} \end{aligned} \tag{5}$$

Equation (5) does not include a constant, and the categories are mutually exclusive and exhaustive. Results are reported in Panel B of Table 2. When they face a zero cent opportunity cost, riders are $(\hat{\beta}_{M_2} - \hat{\beta}_{M_4})$ =6.4 percentage points 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 21.8% 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 ($\hat{\beta}_{M_1} - \hat{\beta}_{M_3} = 0.022, p - value = 0.042$), 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.[24]

[24]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

We notice that, at low levels of congestion, the share of men in the reserved space is flat, at about 20%. As congestion passes the 0.4 load factor mark, which applies to 41% 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 1.3% 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.[25] 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.

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 setup in the previous phase, riders are now offered a ride task for

part of this pilot in all specifications. More details on the pilot are available upon request.

[25]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 a 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.

specific space for a fixed payment of $4.70 per ride through the same app.[26] Upon logging into the app, a participant could see only whether she had an offer on that day and, if so, in which space she was assigned to ride (Panel (c), 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.

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:

$$y_{i,t} = \alpha + \beta AssignedToReservedSpace_{i,t} + \gamma_i + \epsilon_{i,t} \tag{6}$$

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

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

public space report experiencing some form of harassment (physical, verbal, or staring) in 18% 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 2.5 percentage points less likely to report experiencing any harassment, or a 14.2% 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

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, $(\hat{\beta}_3 - \hat{\beta}_4)$, 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 instead that the presence of men in the reserved space does not affect harassment in the public space, and vice versa (Figure A10). However, we cannot test whether perpetrators sort between cars when the rule *is* well followed, because we 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 does 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:

$$\begin{aligned} y_{i,t} = {} & \beta_1 AssignedToReservedSpace_{i,t} \times FewMenInReservedSpace_t \\ & + \beta_2 AssignedToPublicSpace_{i,t} \times FewMenInReservedSpace_t \\ & + \beta_3 AssignedToReservedSpace_{i,t} \times ManyMenInReservedSpace_t \\ & + \beta_4 AssignedToPublicSpace_{i,t} \times ManyMenInReservedSpace_t + \gamma_i + \epsilon_{i,t} \end{aligned} \tag{7}$$

Results are reported in Panel B of Table 3. Equation (7) does not include a constant, and the categories are mutually exclusive and exhaustive, so the difference in coefficients, $(\hat{\beta}_1 - \hat{\beta}_2)$, 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, $(\hat{\beta}_3 - \hat{\beta}_4)$. 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 1.7 percentage points (p-value=0.004) ($\hat{\beta}_1 - \hat{\beta}_2$, cols 3-4). This is a reduction

of 65% over the mean harassment in the public space.[27] 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 take-up 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, take-up 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, take-up of the reserved space under positive opportunity cost remains positive. This suggests that, while they value 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 (take-up 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.[28] 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 col-

[27]Table A8 shows that 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 survives multiple hypothesis testing.

[28]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.

lected 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.

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 adapt (5) to interact the assignment to a positive opportunity cost of riding in the reserved space with a rider's self-reported risk perception. 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 of risk perception. Women who are most concerned about physical or verbal forms of sexual harassment are 26-43% 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 ($\hat{\beta_{M_3}} - \hat{\beta_{M_1}}$, Panel B, Table 4). Riders who perceive a higher chance of physical and verbal harassment are more likely to use the reserved space.

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 the option of a reserved space is available. This mechanism could explain sustained take-up 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, 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.[29]

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 (Figure A11). While women accurately perceive other women's attitudes towards women riding in the public space, they appear to be overly pessimistic about men's attitudes.

[29]The full instruments and details of recruitment are provided in the Online Appendix.

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. 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). More details on the IAT methodology and how it was adapted to our study context are provided in Appendix E.[30]

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 ($p < 0.000$). These results imply that commuters associate women in the reserved space with seeking safety

[30]The Online Appendix, which includes the full instruments, is available at `https://github.com/worldbank/rio-safe-space/tree/master/Online%20Appendices/`.

more than women in the public space. They also associate women in the public space with being more open to sexual advances than women in the reserved space.

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:

$$\begin{aligned} Score_{i,j} = \beta_0 + \beta_1 AdvancesIAT_j + \beta_2 FemaleRespondent_i \\ + \beta_3 AdvancesIAT_j \times FemaleRespondent_i + \epsilon_{i,j} \end{aligned} \tag{8}$$

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; $\epsilon_{i,j}$ is a random error term; standard errors are 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, Table A10). 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, Table A10).[31]

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 of 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.[32] Our revealed preference experiment introduced an opportunity cost M to ride in the reserved space. We model the relationship between rider i's willingness to pay to ride in the reserved space, their characteristics and the ride conditions in each space as:

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

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

[31] 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 estimate on $AdvancesIAT$ is not affected, showing that our results are not driven by this generic association.

[32] 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 endogenously determined by riders' preferences in this model.

leads to a general version of our main estimating equations (3) and (4):

$$\begin{aligned} ChoseReservedSpace_{i,t} &= \mathbf{1}[WTP_{i,t}^{Reserved} \geq M] \\ = \mathbf{1}[(\alpha^{Reserved} - \alpha^{Public}) + (X_{i,t}^{Reserved} - X_{i,t}^{Public})'\beta - M + \epsilon_{i,t} \geq 0] \end{aligned} \tag{9}$$

Generating experimental variation in the opportunity cost of riding in the reserved space M allows 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 allows us to identify demand shifters.[33]

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:

$$COST_{harassment} = \frac{\mathbf{E}[WTP_{i,t}^{Reserved}]}{\mathbf{E}[Harassment_{i,t}^{Reserved} - Harassment_{i,t}^{Public}]} \tag{10}$$

i.e. row (f) = (b) / (e) in Table 5. Column (1) assumes as a benchmark that take-up 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

[33]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 on riding in the reserved space.

in the reserved space; the results are similar.

By relating $WTP^{Reserved}$ directly to the protective effect of the reserved space estimated in (6), this benchmark measure captures the cost of harassment gross of other differences in amenities across spaces as expressed in (9). 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 (Tables 3 and 4). The only significant varying condition we estimate on $WTP^{Reserved}$ was presence of men, which we assume operates through harassment (Tables 2 and 3). The fact that our experiment targets regular commuters with rigid habits allows us to rule out very large $\epsilon_{i,t}$ across rides. At the same time, note that $WTP^{Reserved}$ does not go to zero even when presence of men equalizes across spaces. These results suggest that the amenity value riders place in the reserved space includes a non-varying component ($(\alpha_{Reserved} - \alpha_{Public})$ in (9)). 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:

$$COST_{harassment} = \frac{\mathbf{E}[WTP_{i,t}^{Reserved, few\ men} - WTP_{i,t}^{Reserved, many\ men}]}{\mathbf{E}[Harassment_{i,t}^{Reserved, few\ men} - Harassment_{i,t}^{Reserved, many\ men}]} \tag{11}$$

This approach allows us to difference out the $(\alpha_{Reserved} - \alpha_{Public})$ term in (9). 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 female commuters' observation set when they decide in which space to ride in. This implies our reduced form estimate of presence of men on take-up 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 Conclusion

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 experiences of harassment by providing women a secure platform, 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 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.

Even though they provide a low-bound value, our estimates of the cost harassment imposes on women who commute daily are economically meaningful. 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. A 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 traveling 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.

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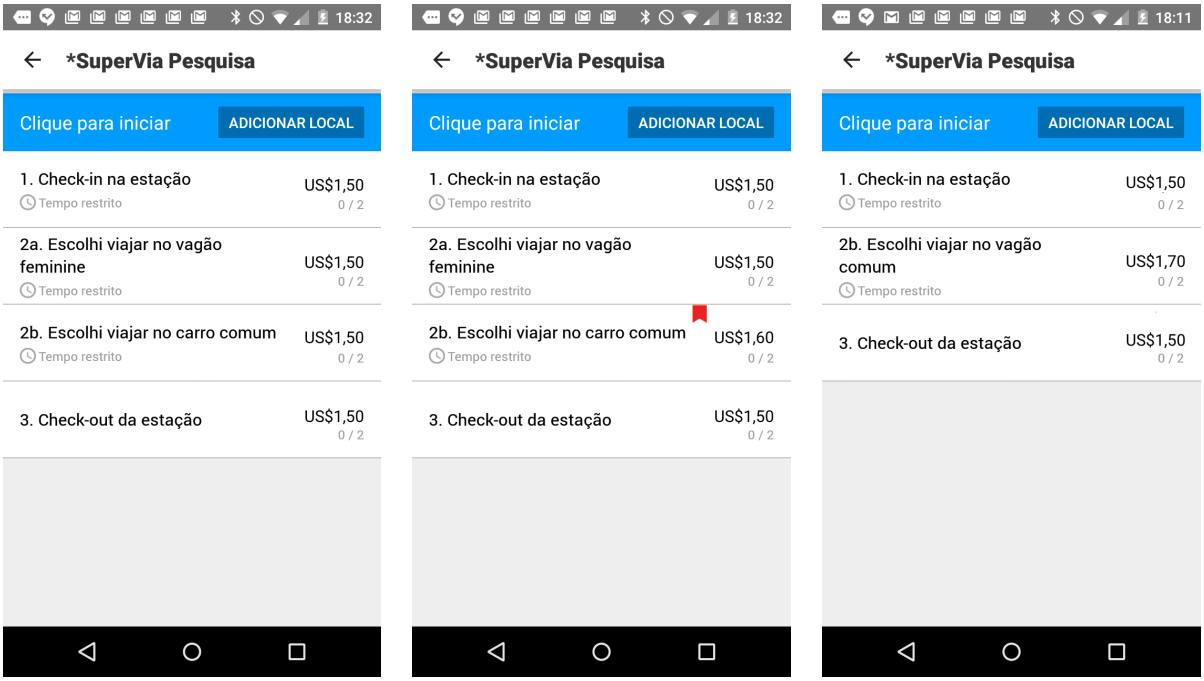
Figures

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

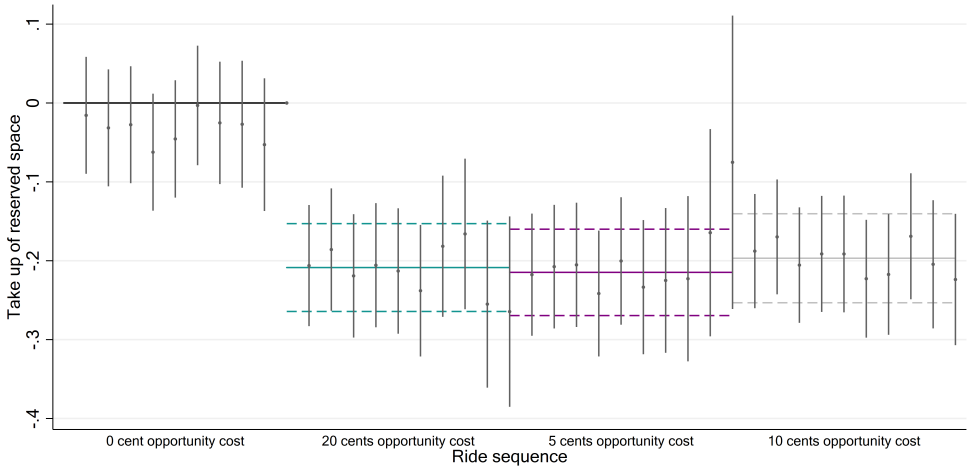


(a) Revealed preference: zero cent opportunity cost

(b) Revealed preference: positive opportunity cost

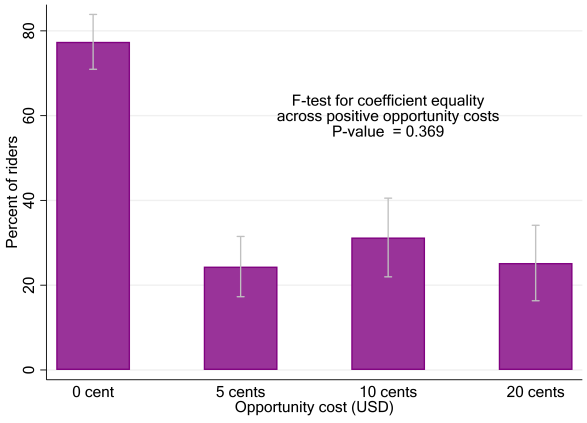
(c) Randomized assignment to space

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

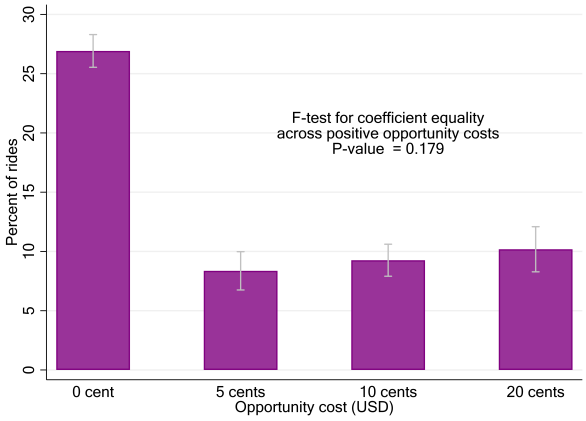


Notes: Sample includes all riders who started willingness to pay rides, and includes only the last ten rides each user took for each premium level. Displayed values are point estimates and 95% confidence intervals from a regression of take-up of reserved space on dummies for order in which the rides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

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



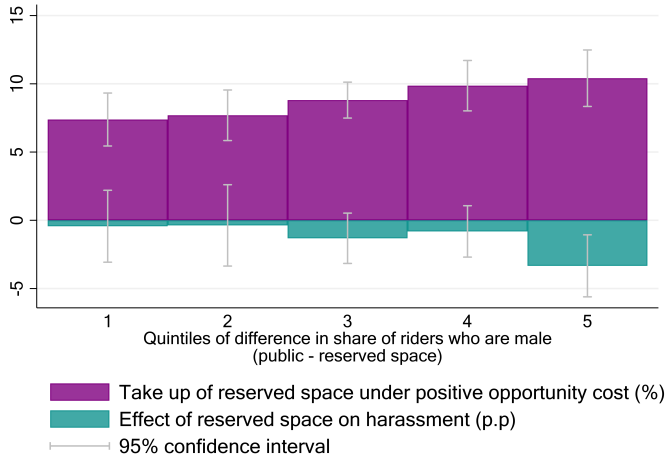
(a) Percent of riders who ever use the reserved space



(b) Percent of rides in the reserved space

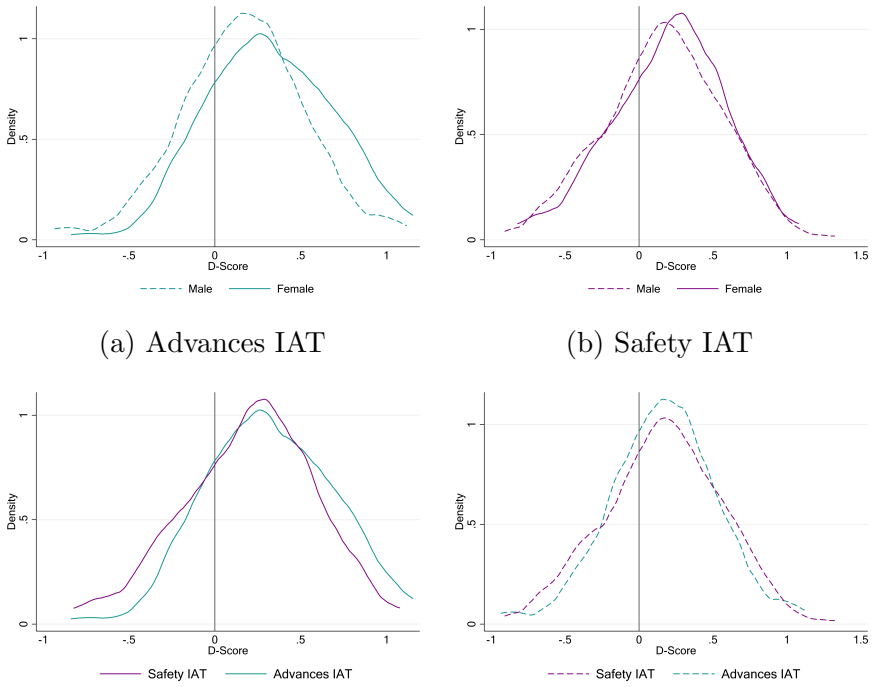
Notes: Displayed percentages are predictions from a regression of take-up of the reserved space on dummies for the different opportunity cost levels. Both figures only include rides from the revealed preference phase of the 261 riders who completed revealed preference rides. Standard errors in parentheses, 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 take-up and harassment by presence of men



Notes: Sample includes respondents who started randomized car assignment rides. Take up bars show predicted values from a regression of choosing reserved space on quintile dummies. Effect on harassment show the point estimates of a regression of physical on quintiles dummies. Rider fixed effects are included. Standard errors are clustered at rider level. Observations are weighted observations by the inverse of the number of rides taken by the individual rider.

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					
Employed	0.678	0.913	0.927	0.235	-0.0150
	(0.025)	(0.018)	(0.017)		
Age	32.51	37.22	36.41	4.712	0.808
	(0.617)	(0.665)	(0.763)		
Years of schooling	12.95	11.31	11.01	-1.643	0.304
	(0.186)	(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	1367	1233	1178	-134.1	54.85
	(38.908)	(48.298)	(42.969)		
Violent crimes at rider home station	45.39	47.77	46.91	2.377	0.853
	(0.660)	(0.785)	(0.717)		
Crimes against property at rider home station	263.8	228.9	214.8	-34.90	14.08
	(9.427)	(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	13.50	-2.639
	(2.578)	(4.035)	(4.419)		
Physical, public space	21.14	62.75	64.13	41.62	-1.382
	(3.555)	(5.026)	(5.317)		
Verbal, reserved space	22.95	39.80	39.64	16.85	0.165
	(3.644)	(4.622)	(4.906)		
Verbal, public space	40.08	84.47	82.97	44.39	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	-	0.0790	-
	(0.017)	(0.022)	-		
Current scenario, 30 cents opportunity cost	0.374	0.466	-	0.0920	-
	(0.023)	(0.040)	-		
Current scenario, 65 cents opportunity cost	0.278	0.374	-	0.0960	-
	(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.

Table 2: Revealed preferences, overall and by ride condition

	Dependent variable: Chose reserved space	
	(1)	(2)
Panel A: Overall		
Positive opportunity cost	-0.164	-0.163
	(0.011)	(0.010)
High crowding		-0.008
		(0.012)
Few men in reserved space		0.041
		(0.009)
Constant	0.249	0.228
	(0.005)	(0.007)
Mean dependent variable		
Zero opportunity cost	0.245	
	(0.014)	
Panel B: Heterogeneous effects by male presence in reserved space		
$\hat{\beta}_{M_1}$: Positive opportunity cost × Few men in reserved space	0.096	0.096
	(0.008)	(0.008)
$\hat{\beta}_{M_2}$: Zero opportunity cost × Few men in reserved space	0.280	0.280
	(0.009)	(0.009)
$\hat{\beta}_{M_3}$: Positive opportunity cost × Many men in reserved space	0.074	0.075
	(0.007)	(0.007)
$\hat{\beta}_{M_4}$: Zero opportunity cost × Many men in reserved space	0.216	0.216
	(0.008)	(0.008)
Mean dependent variable		
Zero opportunity cost × Few men in reserved space	0.293	
	(0.019)	
Zero opportunity cost × Many men in reserved space	0.194	
	(0.014)	
Observations	17047	17047
Riders	363	363
Control for high crowding	No	Yes
Rider fixed effect	Yes	Yes
Post-estimate tests for heterogeneous effects		
By opportunity cost: zero opportunity cost - positive opportunity cost		
Few men in reserved space: $\hat{\beta}_{M_2} - \hat{\beta}_{M_1}$	0.184	0.184
P-value	0.000	0.000
Many men in reserved space: $\hat{\beta}_{M_4} - \hat{\beta}_{M_3}$	0.141	0.142
P-value	0.000	0.000
By male presence in reserved space: few men - many men in reserved space		
Zero opportunity cost: $\hat{\beta}_{M_2} - \hat{\beta}_{M_4}$	0.064	0.064
P-value	0.000	0.000
Positive oppotunity cost: $\hat{\beta}_{M_1} - \hat{\beta}_{M_3}$	0.022	0.021
P-value	0.042	0.050

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.

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	-0.025	-0.025	-0.013	-0.013	-0.009	-0.009	-0.007	-0.007
	(0.013)	(0.013)	(0.005)	(0.005)	(0.008)	(0.008)	(0.012)	(0.012)
High crowding		0.005		-0.013		0.002		-0.002
		(0.029)		(0.014)		(0.011)		(0.028)
Few men in reserved space		-0.004		0.002		0.005		-0.011
		(0.018)		(0.008)		(0.008)		(0.016)
Constant	0.168	0.169	0.031	0.031	0.058	0.055	0.124	0.129
	(0.006)	(0.012)	(0.002)	(0.005)	(0.004)	(0.006)	(0.006)	(0.010)
Mean dependent variable								
Assigned to public space	0.176		0.026		0.066		0.128	
	(0.013)		(0.004)		(0.009)		(0.013)	
Panel B: Impact of randomized assignment by presence of men in reserved space								
$\hat{\beta}_{M_1}$: Assigned to reserved space × Few men in reserved space	0.139	0.139	0.018	0.017	0.052	0.052	0.109	0.108
	(0.012)	(0.012)	(0.004)	(0.005)	(0.006)	(0.006)	(0.011)	(0.011)
$\hat{\beta}_{M_2}$: Assigned to public space × Few men in reserved space	0.167	0.167	0.035	0.034	0.061	0.061	0.121	0.121
	(0.012)	(0.012)	(0.005)	(0.005)	(0.006)	(0.006)	(0.011)	(0.011)
$\hat{\beta}_{M_3}$: Assigned to reserved space × Many men in reserved space	0.146	0.146	0.019	0.020	0.047	0.047	0.125	0.125
	(0.013)	(0.013)	(0.006)	(0.006)	(0.007)	(0.007)	(0.011)	(0.012)
$\hat{\beta}_{M_4}$: Assigned to public space × Many men in reserved space	0.168	0.168	0.027	0.028	0.056	0.056	0.126	0.126
	(0.014)	(0.014)	(0.005)	(0.005)	(0.008)	(0.008)	(0.011)	(0.011)
Mean dependent variable								
Assigned to public space × Few men in reserved space	0.141		0.025		0.053		0.095	
	(0.023)		(0.006)		(0.014)		(0.02)	
Assigned to public space × Many men in reserved space	0.209		0.027		0.078		0.161	
	(0.024)		(0.007)		(0.019)		(0.021)	
Observations	3695	3695	3695	3695	3695	3695	3695	3695
Riders	259	259	259	259	259	259	259	259
Control for high crowding	No	Yes	No	Yes	No	Yes	No	Yes
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								
$\hat{\beta}_{M_1}$ - $\hat{\beta}_{M_2}$	-0.028	-0.028	-0.017	-0.017	-0.009	-0.009	-0.012	-0.012
P-value	0.087	0.087	0.004	0.004	0.366	0.367	0.454	0.453
Impact on harassment when many men in reserved space: reserved space - public space								
$\hat{\beta}_{M_3}$ - $\hat{\beta}_{M_4}$	-0.022	-0.022	-0.008	-0.008	-0.008	-0.008	-0.002	-0.002
P-value	0.259	0.260	0.264	0.259	0.501	0.502	0.924	0.923

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.

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	0.105	0.095	0.089	0.072	0.064	0.064	-0.009	-0.022	-0.027
	(0.036)	(0.035)	(0.033)	(0.033)	(0.032)	(0.032)	(0.047)	(0.048)	(0.047)
High crowding			-0.002			0.008			0.015
			(0.040)			(0.036)			(0.052)
Few men in reserved space			0.088			0.088			0.078
			(0.023)			(0.022)			(0.033)
Constant	0.246	0.249	0.204	0.248	0.252	0.205	0.299	0.304	0.262
	(0.017)	(0.017)	(0.021)	(0.019)	(0.019)	(0.021)	(0.028)	(0.026)	(0.029)
Mean dependent variable									
Low risk perceiver		0.246			0.248			0.299	
		(0.009)			(0.009)			(0.015)	
Riders	208	208	208	205	205	205	111	111	111
Line fixed effects	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Panel B: By risk type and opportunity cost									
$\hat{\beta}_{M_1}$: Positive opportunity cost × Low risk perceiver	0.081	0.078	0.073	0.092	0.089	0.088	0.137	0.127	0.106
	(0.015)	(0.015)	(0.015)	(0.018)	(0.018)	(0.019)	(0.029)	(0.031)	(0.025)
$\hat{\beta}_{M_2}$: Zero opportunity cost × Low risk perceiver	0.333	0.323	0.326	0.311	0.304	0.308	0.263	0.265	0.262
	(0.030)	(0.030)	(0.030)	(0.026)	(0.026)	(0.026)	(0.034)	(0.034)	(0.035)
$\hat{\beta}_{M_3}$: Positive opportunity cost × High risk perceiver	0.091	0.093	0.090	0.085	0.088	0.084	0.121	0.127	0.131
	(0.015)	(0.015)	(0.015)	(0.016)	(0.016)	(0.015)	(0.022)	(0.022)	(0.022)
$\hat{\beta}_{M_4}$: Zero opportunity cost × High risk perceiver	0.250	0.251	0.251	0.246	0.247	0.245	0.308	0.311	0.312
	(0.018)	(0.018)	(0.018)	(0.019)	(0.019)	(0.019)	(0.030)	(0.029)	(0.029)
Observations	13136	13136	12710	13110	13110	12684	7586	7586	7304
Riders	208	208	208	205	205	205	111	111	111
Control for high crowding	No	No	Yes	No	No	Yes	No	No	Yes
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									
High risk perceivers: $\hat{\beta}_{M_4} - \hat{\beta}_{M_3}$	0.253	0.245	0.253	0.219	0.214	0.221	0.126	0.138	0.156
P-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Low risk perceivers: $\hat{\beta}_{M_2} - \hat{\beta}_{M_1}$	0.159	0.158	0.160	0.161	0.159	0.161	0.187	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									
Zero opportunity cost: $\hat{\beta}_{M_4} - \hat{\beta}_{M_2}$	0.084	0.073	0.075	0.064	0.056	0.063	-0.044	-0.046	-0.050
P-value	0.019	0.040	0.034	0.049	0.083	0.052	0.331	0.312	0.273
Positive opportunity cost: $\hat{\beta}_{M_3} - \hat{\beta}_{M_1}$	-0.010	-0.015	-0.017	0.007	0.001	0.004	0.016	-0.000	-0.025
P-value	0.651	0.473	0.403	0.768	0.969	0.878	0.653	0.996	0.459

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.

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

	Overall	Men in reserved space		Lower bound cost
		Many men (Q1)	Few men (Q5)	Q1 - Q5
	(1)	(2)	(3)	(4)
a) Take up of reserved space on rides with positive opportunity cost ride	9.23%	7.40%	10.40%	3.00 %
b) Average willingness to pay for reserved space	$ 0.018	$ 0.015	$ 0.021	$ 0.006
c) Average occurrence of physical harassment in public space (% of rides)	2.58%	1.72%	4.49%	1.72 %
d) Change in physical harassment caused by riding reserved space (p.p.)	-1.267	-0.436	-3.336	-2.900
e) Percent change in physical harassment caused by riding reserved space	-49.2%	-25.4%	-74.4%	-49.0 %
f) Cost of harassment				
f.1) Per ride	$ 0.038		$ 0.028	$ 0.012
f.2) Per incident	$ 1.456		$ 0.623	$ 0.712
f.3) Per year	$ 11.81		$ 8.804	$ 3.853
f.4) Percent of minimum wage	0.34%		0.25%	0.11 %
f.5) Percent of gender wage gap	1.67%		1.24%	0.54 %

Notes: Male presence is defined by quintiles of difference between share of public space riders who are male and share of reserved space riders who are male. (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 For online publication: Supplementary Figures and Tables

Figure A1: SuperVia lines and riders home location

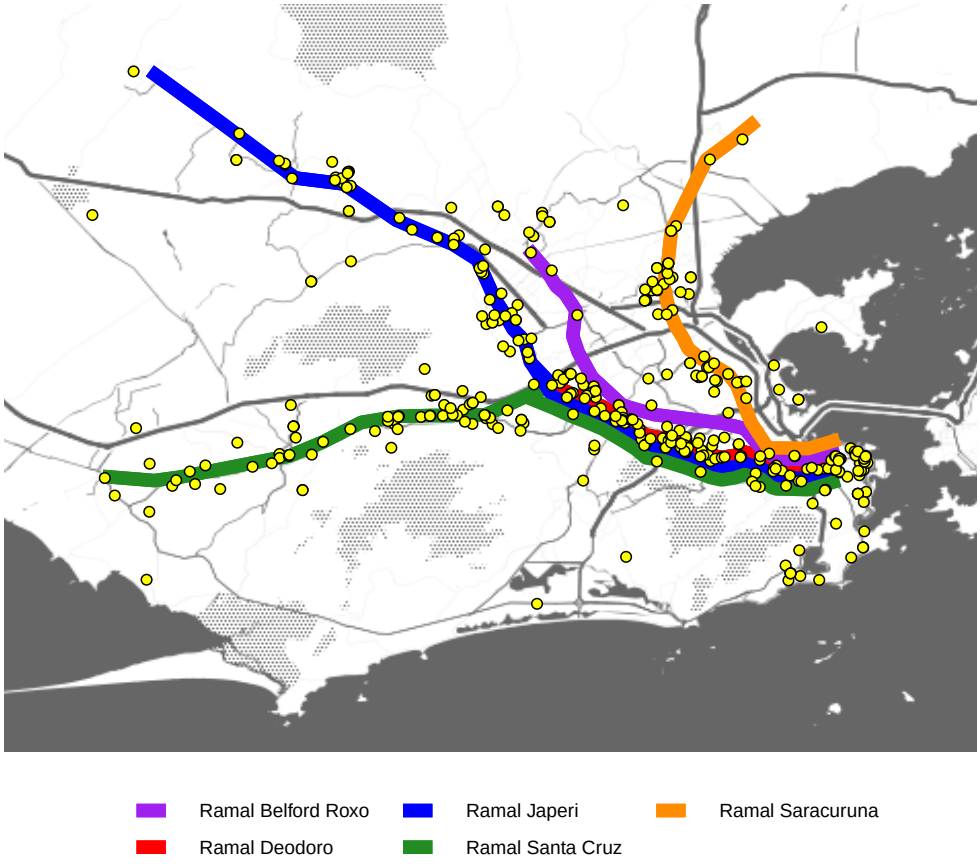
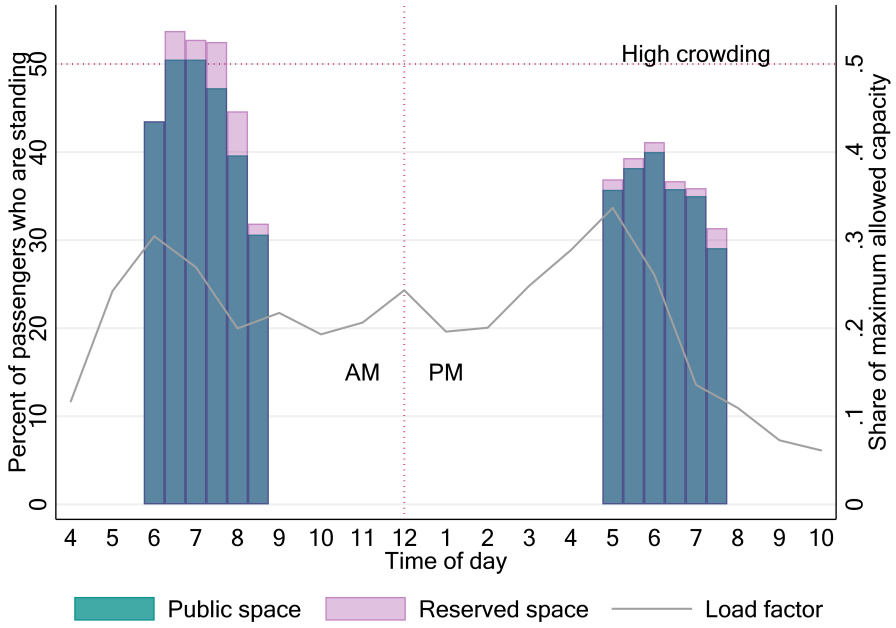
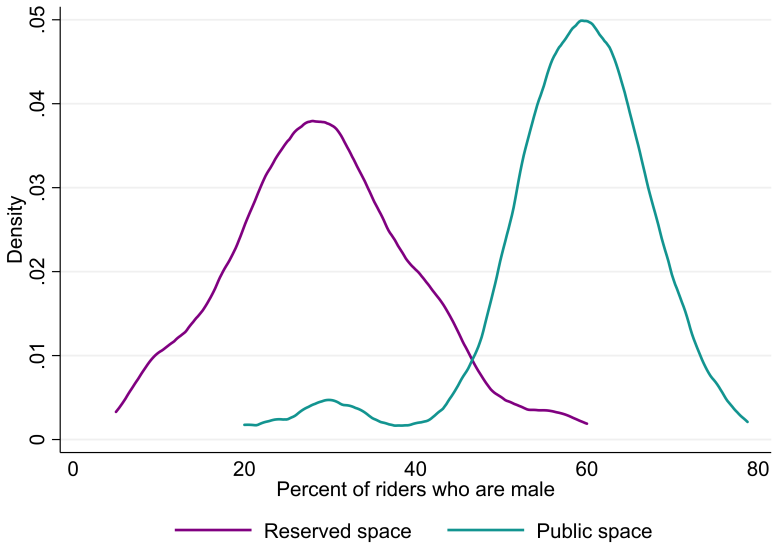


Figure A2: Congestion in the system by time window



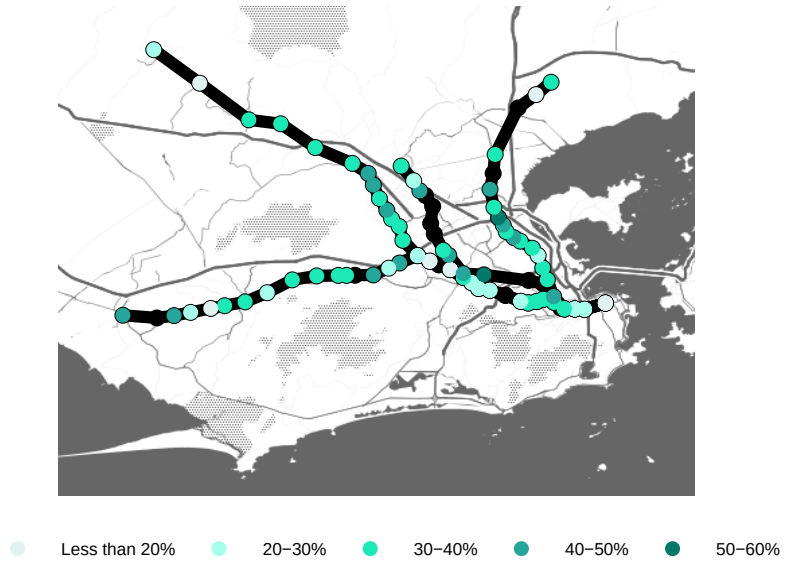
Notes: Platform reports observations from rider study correspond to rush hour windows, when riders could submit ride observations for the study. Administrative data about load factor was obtained from Supervia.

Figure A3: Presence of male riders by space



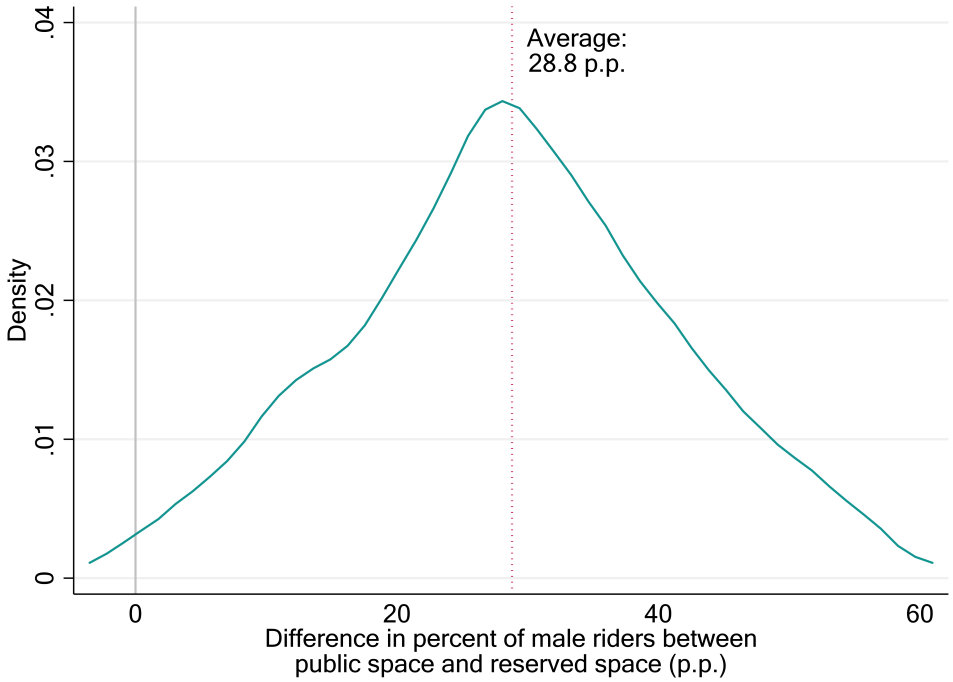
Source: Platform observations.

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



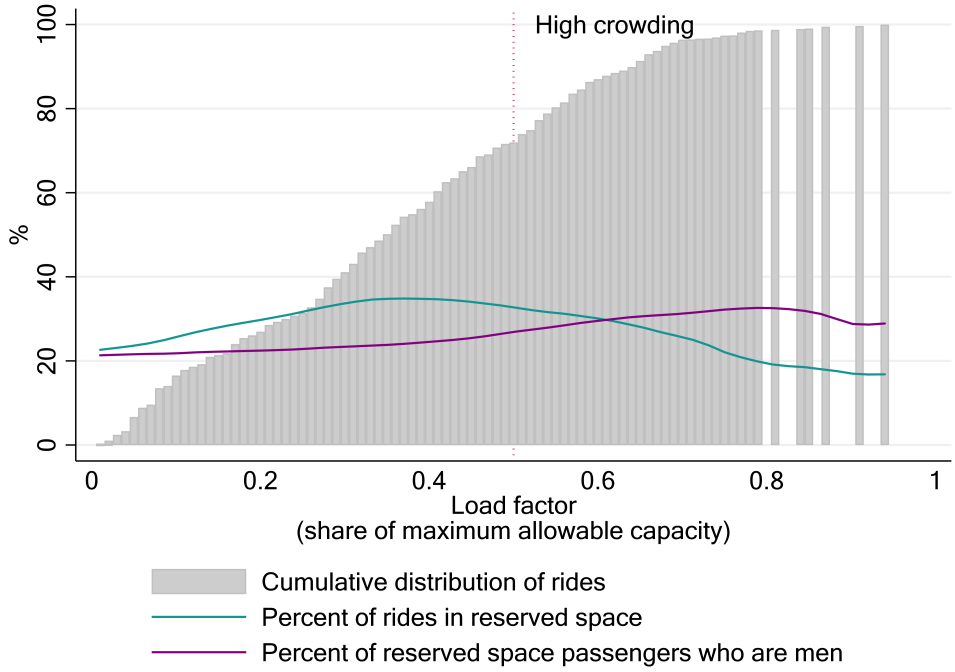
Source: Platform observations.

Figure A5: Difference in presence of male riders between spaces



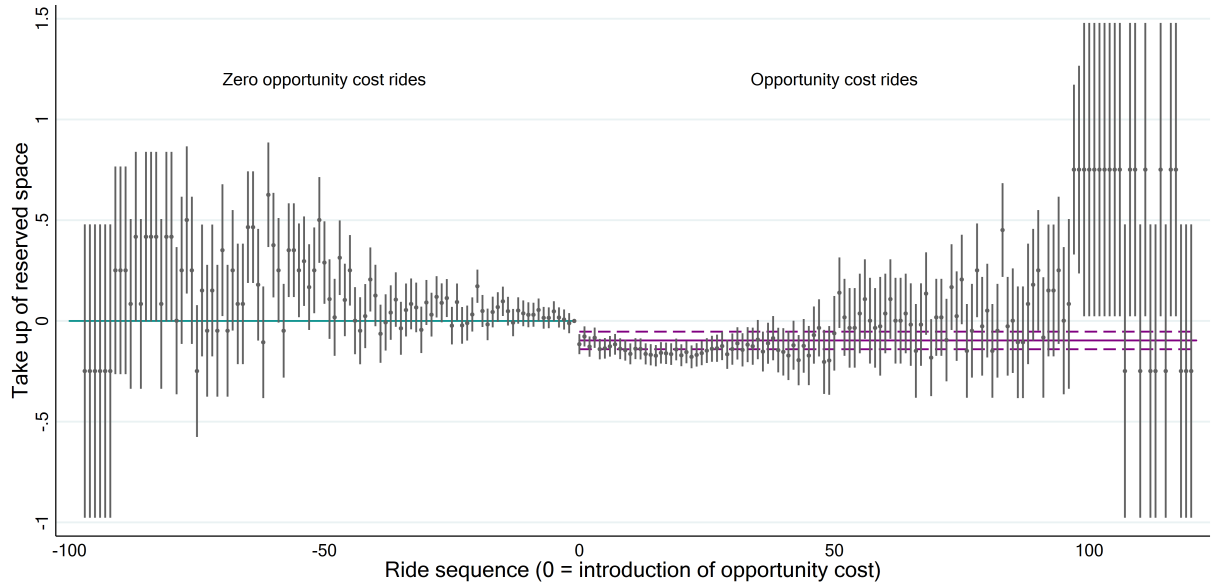
Source: Platform observations.

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

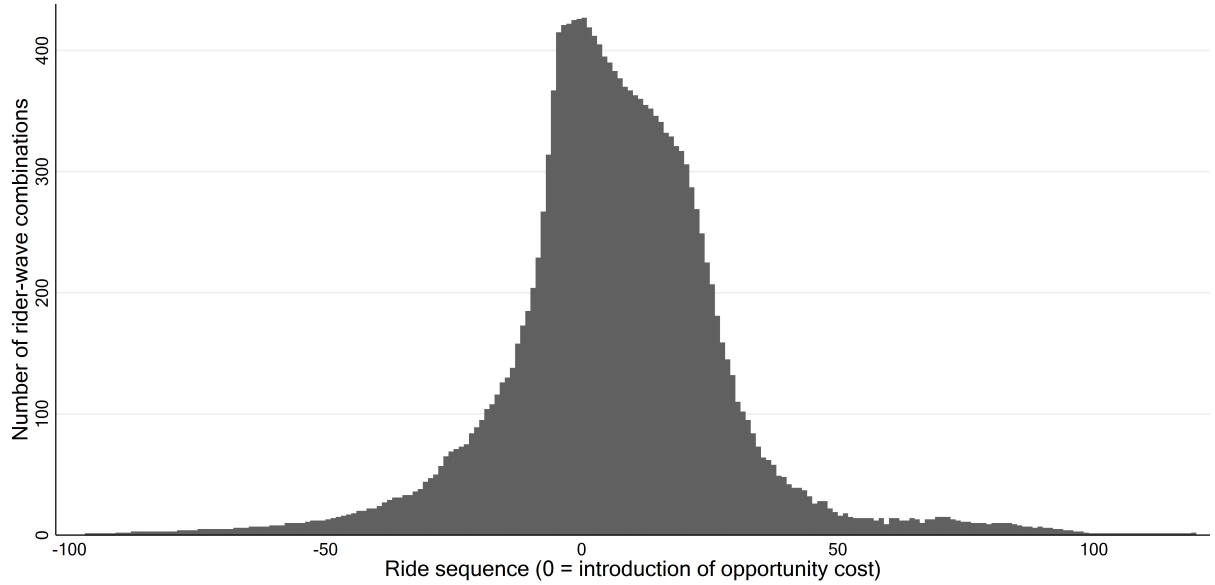


Notes: Sample is restricted to zero cent opportunity cost rides of riders who moved on to positive opportunity cost rides.

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



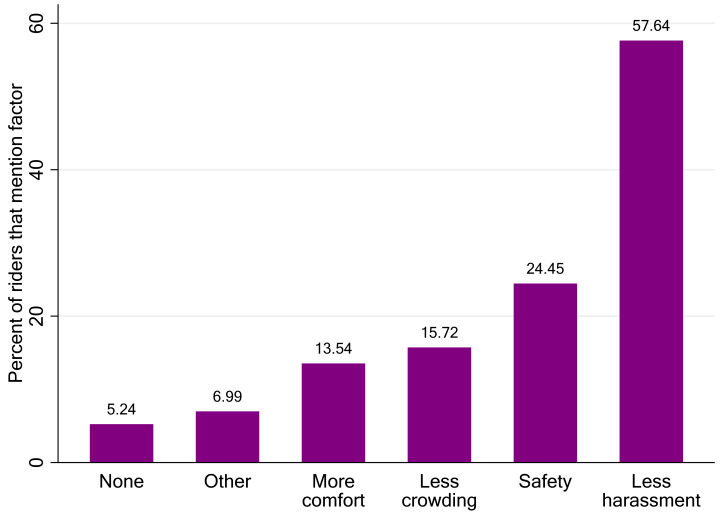
(a) Take-up of reserved space compared to last zero cent opportunity cost ride



(b) Number of observations

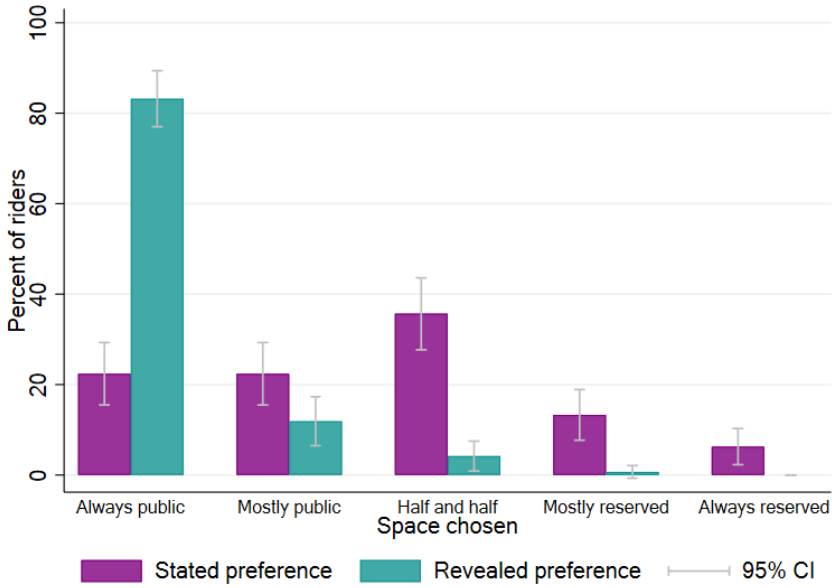
Notes: Sample includes all willingness to pay rides. Displayed values are point estimates and 95% confidence intervals from a regression of take-up of reserved space on dummies the for order in which the rides happened. Omitted ride (take up = 0) is the last ride with no opportunity cost. The ride sequence 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



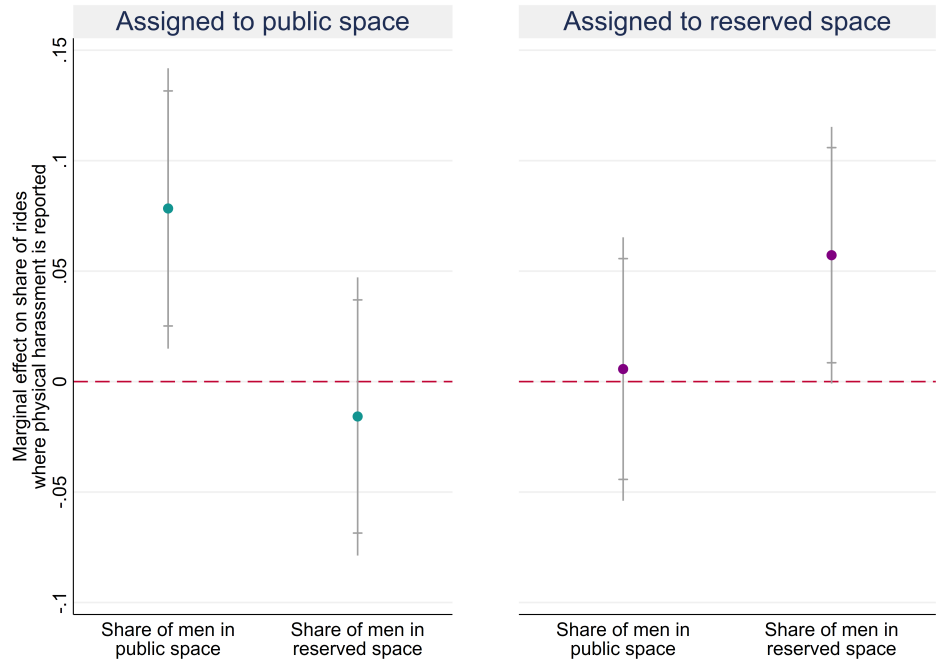
Source: Rider exit survey.

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



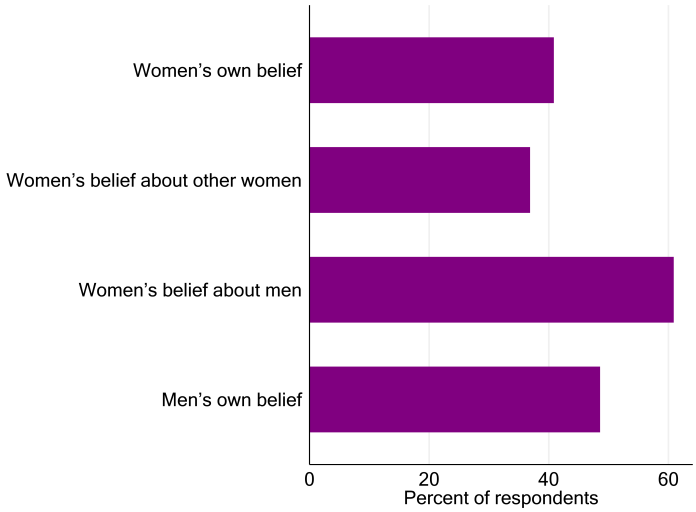
*Notes:*Source: Revealed preferences sample includes all 5 cents opportunity cost rides of riders who took at least 5 revealed preferences rides and completed the exit survey. Stated preferences data include responses from the same rider about how often they would ride each space under 5 cents opportunity cost and status quo presence of men in the reserved space.

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	17,591	48
2. Random assignment to reserved space	261	71.9	3,806	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 reserved space riders who are male	0.636 (0.055)	
High crowding		0.246 (0.029)
Constant	0.158 (0.017)	0.490 (0.018)
Observations	4846	20742
Riders	327	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.

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 usually choose reserved space				-0.013 (0.067)
Constant	0.856 (0.015)	0.435 (0.025)	0.422 (0.035)	0.551 (0.041)
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.

Table A5: IAT: Robustness check for priming with survey questions

	Dependent variable: IAT D-Score	
	Advances	Safety
	(1)	(2)
Order: advances IAT; advances questions; safety IAT; safety questions	-0.071	0.046
	(0.065)	(0.064)
Order: advances questions; advances IAT; safety questions; safety IAT	0.033	-0.109
	(0.056)	(0.063)
Order: safety questions; safety IAT; advances questions; advances IAT	-0.029	-0.059
	(0.056)	(0.058)
Constant	0.256	0.215
	(0.038)	(0.042)
(Omitted category: Order: safety IAT; safety questions; advances IAT; advances questions)		
Observations	299	301
Sample mean	0.242	0.177

Notes: Unit of observation is one respondent. Sample in column (1) includes all respondents who completed the Provokes Advances test. Sample in column (2) includes all respondents who completed the Safety test. Robust standard errors in parentheses.

Table A6: Test for order effects in on screen presentation of public / reserved space

	Dependent variable: Chose reserved space	
	(1)	(2)
Reserved space shown first	0.005	-0.008
	(0.010)	(0.020)
Positive opportunity cost		0.014
		(0.021)
Reserved space shown first × Positive opportunity cost		0.013
		(0.022)
Constant	0.068	0.054
	(0.011)	(0.018)
Observations	6001	6001
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.

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	-0.104	0.004	-0.009	-0.003	-0.032	-0.032
	(0.252)	(0.008)	(0.007)	(0.011)	(0.022)	(0.026)
Observations	17072	17525	10759	17591	9308	8283
Riders	363	363	361	363	354	355
Uncontrolled mean when zero opportunity cost	7.720	0.226	0.052	0.504	7.408	6.269
	(0.299)	(0.017)	(0.011)	(0.019)	(0.043)	(0.038)
Panel B: Randomized assignment of space						
Assigned public space	0.071	0.013	0.015	0.040	-0.040	0.011
	(0.370)	(0.012)	(0.008)	(0.017)	(0.026)	(0.038)
Observations	3707	3796	3703	2927	1999	1807
Riders	261	261	259	179	240	250
Uncontrolled mean when zero opportunity cost	7.142	0.325	0.048	0.498	7.399	6.216
	(0.399)	(0.022)	(0.009)	(0.032)	(0.051)	(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.

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	-0.020	0.045	0.036	-0.046	0.004	0.010	-0.034	0.023	-0.005
	(0.017)	(0.024)	(0.021)	(0.022)	(0.024)	(0.025)	(0.021)	(0.019)	(0.016)
High crowding	-0.006	0.022	0.067	-0.080	-0.062	0.009	-0.062	0.001	0.021
	(0.039)	(0.035)	(0.037)	(0.041)	(0.045)	(0.046)	(0.049)	(0.034)	(0.023)
Few men in reserved space	-0.016	-0.025	-0.017	-0.023	0.028	-0.041	0.000	0.006	0.030
	(0.020)	(0.027)	(0.027)	(0.022)	(0.029)	(0.027)	(0.020)	(0.026)	(0.019)
Constant	0.218	0.293	0.496	0.484	0.404	0.495	0.472	0.402	0.127
	(0.012)	(0.019)	(0.020)	(0.016)	(0.021)	(0.020)	(0.016)	(0.018)	(0.014)
Mean dependent variable									
Assigned to public space	0.210	0.291	0.497	0.468	0.415	0.478	0.481	0.413	0.141
	(0.013)	(0.014)	(0.016)	(0.016)	(0.015)	(0.016)	(0.016)	(0.016)	(0.011)
Panel B: Heterogeneous effects by male presence reserved space									
$\hat{\beta}_{M_1}$: Assigned to reserved space × Few men in reserved space	0.172	0.326	0.509	0.412	0.421	0.457	0.433	0.423	0.151
	(0.012)	(0.021)	(0.020)	(0.016)	(0.022)	(0.022)	(0.017)	(0.020)	(0.013)
$\hat{\beta}_{M_2}$: Assigned to public space × Few men in reserved space	0.212	0.259	0.498	0.452	0.435	0.462	0.468	0.415	0.162
	(0.015)	(0.022)	(0.017)	(0.018)	(0.019)	(0.020)	(0.018)	(0.018)	(0.014)
$\hat{\beta}_{M_3}$: Assigned to reserved space × Many men in reserved space	0.212	0.325	0.556	0.427	0.414	0.516	0.434	0.434	0.129
	(0.018)	(0.019)	(0.021)	(0.018)	(0.024)	(0.023)	(0.017)	(0.020)	(0.012)
$\hat{\beta}_{M_4}$: Assigned to public space × Many men in reserved space	0.205	0.309	0.486	0.482	0.387	0.486	0.467	0.393	0.125
	(0.013)	(0.019)	(0.021)	(0.019)	(0.020)	(0.020)	(0.019)	(0.017)	(0.015)
Mean dependent variable									
Assigned to public space × Few men in reserved space	0.183	0.290	0.552	0.433	0.393	0.467	0.459	0.457	0.144
	(0.019)	(0.02)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.016)
Assigned to public space × Many men in reserved space	0.242	0.292	0.435	0.509	0.440	0.491	0.507	0.363	0.137
	(0.019)	(0.019)	(0.022)	(0.022)	(0.021)	(0.022)	(0.022)	(0.021)	(0.014)
Observations	3695	3594	3594	3594	3594	3594	3594	3594	3594
Riders	259	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									
Few men in reserved space: $\hat{\beta}_{M_1}$ - $\hat{\beta}_{M_2}$	-0.040	0.067	0.011	-0.040	-0.013	-0.005	-0.035	0.008	-0.011
P-value	0.046	0.053	0.686	0.147	0.666	0.877	0.246	0.772	0.603
Many men in reserved space: $\hat{\beta}_{M_3}$ - $\hat{\beta}_{M_4}$	0.007	0.016	0.070	-0.055	0.027	0.030	-0.033	0.041	0.004
P-value	0.768	0.511	0.017	0.048	0.381	0.322	0.265	0.090	0.845
By male presence in reserved space: few men - many men in reserved space									
Assigned reserved space: $\hat{\beta}_{M_4}$ - $\hat{\beta}_{M_2}$	-0.040	0.001	-0.047	-0.015	0.007	-0.060	-0.001	-0.011	0.023
P-value	0.090	0.973	0.166	0.540	0.856	0.100	0.974	0.742	0.269
Assigned public space: $\hat{\beta}_{M_3}$ - $\hat{\beta}_{M_1}$	0.006	-0.050	0.012	-0.030	0.047	-0.024	0.001	0.022	0.037
P-value	0.781	0.153	0.700	0.322	0.131	0.453	0.970	0.466	0.132

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).

Table A9: Social norms survey

	Female respondent Mean/SE (1)	Male respondent Mean/SE (2)	Difference (1)-(2) (3)
Women in public space are more likely to accept advances	0.408	0.486	-0.077
	(0.041)	(0.042)	
Women invite advances then change their minds	0.314	0.347	-0.033
	(0.037)	(0.041)	
Women on reserved space are less likely to invite advances then change their minds	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)
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)
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						
$\hat{\beta}$_Advances × Male respondent + $\hat{\beta}$_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.

B Variable definitions

Table B1: Rider audits: demographic survey

Variable	Definition
Age	Median age in years of the rider's age category when demographic survey was responded
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
Low education (middle school or less)	= 1 if highest degree obtained by the rider at the time the demographic survey was responded is middle school or lower
Number of Supervia rides in typical a week	Number of times rider would normally ride the Supervia in a typical week during which they are not taking any app rides
Single	= 1 if rider was not married when responded to demographic survey
Years of schooling	Number of years equivalent to rider's highest level of education when demographic survey was responded
Young (18-25 years-old)	= 1 if rider was between 18 and 25 year-old when responded to demographic survey

Table B2: Rider audits: rides

Variable	Definition
	All rides
Afraid of harassment	= 1 if rider reports being afraid that a stranger might touch them intentionally during the ride in an inappropriate way
Against traffic	= 1 if rider is going in direction to the Central Station at the evening or away from it in the morning
High crowding	= 1 if rider report of share of passengers standing in the car they boarded is above the median
Moved within space	= 1 rider moved inside a car during the ride, but did not switch from public to reserved space or vice-versa
Time - AM	= 1 if ride started during the morning
Time - PM	= 1 if ride started during the evening
Wait time	Time rider spent waiting for the train in the platform (minutes)
Time task opened	Local time at which the ride started

Table B3: Rider audits: rides (cont.)

Variable	Definition
Revealed preferences rides only	
Chose reserved space	= 1 if rider takes up the reserved space during ride
Reserved space shown first	= 1 if option to ride reserved space is on the top of the app screen
Share of reserved space riders who are men	Rider report from the platform before check-in
Opportunity cost of riding the reserved space (USD)	
0 cent opportunity cost	= 1 if there is no difference in pay off for riding the public and the reserved space
5 cents opportunity cost	= 1 if difference between pay off for riding the public and the reserved space is \$0.05
10 cents opportunity cost	= 1 if difference between pay off for riding the public and the reserved space is \$0.10
20 cents opportunity cost	= 1 if difference between pay off for riding the public and the reserved space is \$0.20
Positive opportunity cost	= 1 if opportunity cost of riding the public space larger than zero
Randomized car assignment rides only	
Assigned to reserved space	= 1 if rider is assigned the reserved space for a given ride
Assigned to public space	= 1 if rider is assigned the public space for a given ride
Switched spaces	= 1 if rider moved from reserved to public space, of vice-versa, during a ride
Riders experiences of harassment during ride	
Any harassment	= 1 if any of the three following variables is 1
Physical harassment	= 1 if rider reports being touched intentionally by a stranger during the ride in a way that made them feel uncomfortable
Staring	= 1 if rider reports being stared by a stranger during the ride in a way that made them feel uncomfortable
Verbal harassment	= 1 if rider reports that a stranger made comments during the ride that made them uncomfortable
Above median on self-reported scale	
Overall well-being Happy Sad Tense Relaxed Frustrated Satisfied Versus before	For each feeling, riders are asked: "On a scale from 1 to 10, where 1 is the worst and 10 is the best, how much do you fell [feeling]?" Constructed variable is = 1 if the self-reported level is above the median

Table B4: Rider audits: exit survey

Variable	Definition
	Advantages of reserved space
None More comfort Less harassment Less crowding Safety Other	Open-ended question categorized according to most commonly mentioned factors. Each constructed variable is = 1 if rider's response mentioned factor.
	Number of occurrences of harassment in a year, by type of harassment and car ridden
Physical, public space	"Imagine a woman similar to you who rides the Supervia every day to work on the same commuting route as yours. How often do you think a man would touch her against her will/grope her at some point during a year of commuting, while traveling in the public space?"
Physical, reserved space	"Imagine a woman similar to you who rides the Supervia every day to work on the same commuting route as yours. How often do you think a man would touch her against her will/grope her at some point during a year of commuting, while traveling in the reserved space?"
Verbal, public space	"Imagine a woman similar to you who rides the Supervia every day to work on the same commuting route as yours. How often do you think a man would make unwanted sexual comments during a year of commuting, while traveling in the public space?"
Verbal, reserved space	"Imagine a woman similar to you who rides the Supervia every day to work on the same commuting route as yours. How often do you think a man would make unwanted sexual comments during a year of commuting, while traveling in the reserved space?"
	Share of reserved space rides under hypothetical scenarios
Status quo Current scenario, 30 cents opportunity cost Current scenario, 65 cents opportunity cost No men on reserved space, 30 cents opportunity cost No men on reserved space, 65 cents opportunity cost	Riders are presented with different scenarios for male presence in reserved space and ticket prices by space. They are asked which space they would prefer to ride during they usual commute hours if they had to buy a space-specific ticket. Options "Always ride in public space", "Mostly ride in public space", "Sometimes ride in public space, sometimes ride in reserved space", "Mostly ride in reserved space", and "Always ride in reserved space" are converted to 0, .25, .5, 75 and 1, respectively.
	Rider risk perception
Physical harassment Robbery Verbal harassment	Riders was asked to imagine a woman similar to them who rides the Supervia every day to work on the same commuting route as they do, on the public space. They were then asked about the chance that inside the train different situations would happen to them. The constructed variable *high-risk perceiver* is = 1 for each situation if the response is above the median. Conversely, the *low-risk perceiver* variable is = 1 is the response is below the median.

Table B5: Rider audits: platform observations

Variable	Definition
Percent of passengers who are standing	
High crowding	
Difference in presence of male riders between spaces	Share of reserved space rider who are male - Share of reserved space rider who are male
Share of reserved space rider who are male	
Share of public space riders who are male	

Table B6: Administrative data

Variable	Definition
Load factor	Data from Supervia indicates the share of maximum allowed capacity between every two stations by month, hour of the day, line and direction of travel.
Crimes against property rate at home station	Monthly data on crime and population from Instituto de Segurança Pública do Rio de Janeiro, spatially matched to riders' home station
Crime rate at home station	
Violent crime rate at home station	

Table B7: Platform survey

Variable	Definition
Finished the platform survey	= 1 if respondent did not leave before the end of the interview
Number of platform where survey was conducted	
Responded to IAT	= 1 if respondent accepted to take the IAT
Was invited to take the IAT	= 1 if respondent was randomly selected to take the IAT
	Respondent profile
Age	Median age in years of the respondent's age category
Female family members usually choose reserved space	= 1 if answer to "Which of the Supervia spaces do the women in your family usually ride during their usual rush hour commute?" was either "Always reserved space" or "Mostly reserved". Asked only to male respondents.
Female respondent	= 1 is respondent is female
Low education (middle school or less)	= 1 if respondent's highest degree is middle school or lower
Male respondent	= 1 is respondent is male
Number of Supervia rides in a typical week	Answered only by female respondents
Years of schooling	Number of years equivalent to respondent's highest degree
Young (18-25 years-old)	= 1 if respondent is between 18 and 25 years-old
Respondent is employed	= 1 if respondent has part-time or full-time job
Usually chooses reserved space	= 1 if answer to "Which of the Supervia spaces do you ride during your usual rush hour commute?" was either "Always reserved space" or "Mostly reserved". Asked only to female respondents.

Table B8: Platform survey (cont.)

Variable	Definition
Share of reserved space rides under hypothetical scenarios	
Status quo Current scenario, 30 cents opportunity cost Current scenario, 65 cents opportunity cost No men on reserved space, 30 cents opportunity cost No men on reserved space, 65 cents opportunity cost	Riders are presented with different scenarios for male presence in reserved space and ticket prices by space. They are asked which space they would prefer to ride during they usual commute hours if they had to buy a space-specific ticket. Options "Always ride in public space", "Mostly ride in public space", "Sometimes ride in public space, sometimes ride in reserved space", "Mostly ride in reserved space", and "Always ride in reserved space" are converted to 0, .25, .5, 75 and 1, respectively.
Yearly occurrences of verbal harassment when riding public space	"Imagine an average woman who rides the Supervia every day to work on the same commuting route as yours on the public space. How often do you think she would be subject to unwanted sexual comments by men during a year of commuting?"
Number of occurrences of harassment in a year, by type of harassment and car ridden	
Physical, public space	"Imagine an average woman who rides the Supervia every day to work on the same commuting route as yours on the public space. How often do you think she would be subject to unwanted sexual comments by men during a year of commuting?"
Physical, public space	= 1 if respondent thinks a woman with the same commuting pattern as they have who travels daily using the public space will be touched against her will at least once a month over a year of commuting
Verbal, public space	"Imagine an average woman who rides the Supervia every day to work on the same commuting route as public on the reserved space. How often do you think she would be subject to unwanted sexual comments by men during a year of commuting?"
Verbal, reserved space	"Imagine an average woman who rides the Supervia every day to work on the same commuting route as yours on the reserved space. How often do you think she would be subject to unwanted sexual comments by men during a year of commuting?"
Ever chose not to go somewhere due to lack of safety or harassment on Supervia	= 1 if responded "yes"
Social norms	
Women are partly at fault if harassed on public space	= 1 if respondent does not completely disagree with the statement "If a woman goes on the mixed car and gets harassed, it is partly her fault – she could have chosen the women's car and avoided it"
Women invite advances then change their minds	= 1 if respondent says that at least sometimes women on the Supervia invite advances but later change their minds and say they were harassed
Women on reserved space are less likely to invite advances then change their minds	= 1 if respondent says that women who ride the reserved space are "Much less likely" more or less likely to invite advances but later change their minds and say they were harassed
Bystanders rarely intervene when witnessing harassment on public space	= 1 if answer to "How often do people intervene if they see a woman on the public space being harassed?" is one of "Sometimes", "Rarely", "Very rarely" or "Never"
Bystanders rarely intervene when witnessing harassment on reserved space	= 1 if answer to "How often do people intervene if they see a woman on the reserved space being harassed?" is one of "Sometimes", "Rarely", "Very rarely" or "Never"

Table B9: Platform Survey (cont.)

Variable	Definition
	First and second order beliefs
Own belief	Respondents are first asked how likely they believe women who ride the public space are to accept advances, compared to women who ride the reserved space. They are then asked what men and women believe.
Belief about women	
Belief about women	Constructed variables are = 1 if the response is either "More likely" or "Much more likely".

Table B10: Implicit Association Test

Variable	Definition
D-Score on Gender-Career IAT	Normalized difference in average response times between the "stereotypical" and "nonstereotypical" paired tests for each instrument.
D-Score on Advances IAT	
D-Score on Safety IAT	
Female respondent	= 1 is respondent is female
Finished all IAT instruments	= 1 is respondent has valid scores for the gender-career, the advances and the safety IATs
Male respondent	= 1 is respondent is male

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, participants were allowed to drop out of our experiment at any point. Participation in each ride opportunity was voluntary and compensation separately. 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 D1). 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 D1 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.

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 D2). 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.

Figure D1: Take-up of reserved space by opportunity cost level - lower bounds for attrition

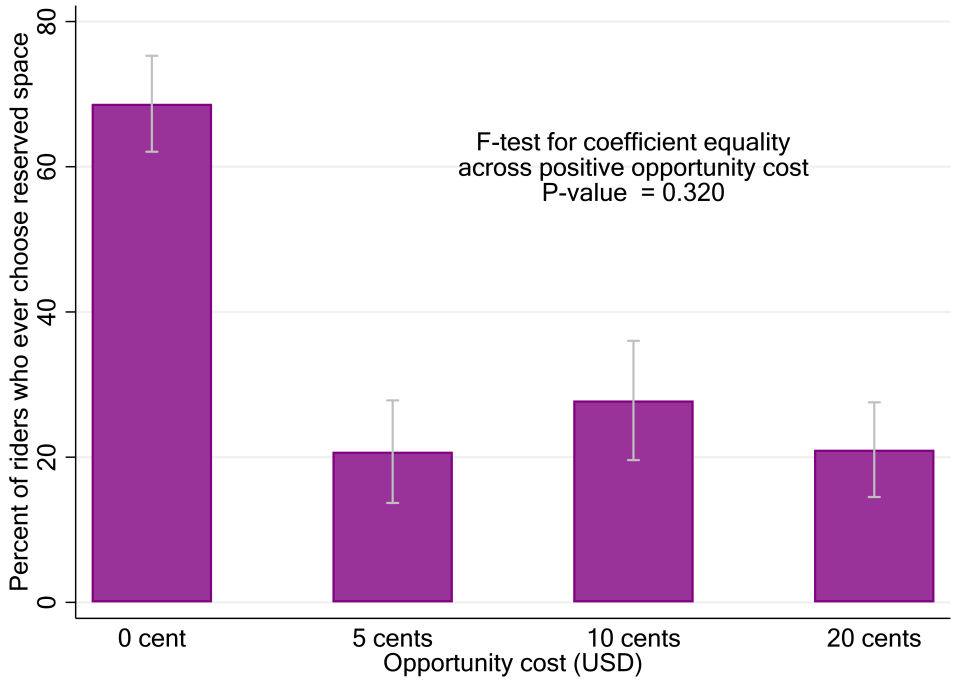


Table D1: Correlates of attrition across phases

	Dependent variable:				
	Started revealed preferences rides		Started randomized car assignment rides		
	(1)	(2)	(3)	(4)	(5)
Low education (middle school or less)	-0.014	0.074	-0.004	0.067	0.030
	(0.056)	(0.044)	(0.060)	(0.061)	(0.043)
Young (18-25 years-old)	-0.067	-0.016	-0.174	-0.162	-0.052
	(0.057)	(0.045)	(0.061)	(0.064)	(0.045)
Single	0.056	0.003	-0.005	-0.056	-0.024
	(0.052)	(0.042)	(0.056)	(0.059)	(0.040)
Employed	-0.067	-0.032	-0.140	-0.128	-0.056
	(0.054)	(0.042)	(0.058)	(0.060)	(0.042)
High self-reported socio-economic status	0.046	0.042	0.030	0.029	0.024
	(0.078)	(0.061)	(0.084)	(0.086)	(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					0.058
					(0.038)
Constant	0.750	0.833	0.717	0.757	0.985
	(0.069)	(0.066)	(0.074)	(0.093)	(0.073)
Observations	371	296	371	296	226
Regression sample mean	0.709	0.885	0.563	0.703	0.916

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.

Table D2: Effect of random assignment on participation

	Dependent variable: Accepted task	
	(1)	(2)
	Rider-ride	Rider-day
Assigned to reserved space	-0.029	-0.022
	(0.015)	(0.014)
Constant	0.397	0.320
	(0.008)	(0.007)
Observations	5056	4517
Riders	244	244

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.

E IAT

An IAT is a computerized test originating in psychology to uncover implicit attitudes based on a rapid categorization task (Banaji et al., 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, 2019), 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., 2019; 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 E1 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.

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).

Table E1: 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

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