

# Gender Differences in the Perception of Safety in Transport

## The case of subways

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### Abstract

This study quantifies the gender gap in the perception of safety and satisfaction in metros. We use a large-scale unique customer satisfaction survey on 25 countries worldwide over 2014-2018. Each respondent rates on a 1-5 scale to what extent they agree with the statements: (i) "Trains are a secure place for me" and (ii) "Stations are a secure place for me". They also rate their overall service satisfaction on a 1-5 scale. We run ordered probit specifications since dependent variables are ordinal. Results suggest a significant gender gap: we find that women are 10% more likely than men to feel unsafe in metros. The gender gap is smaller and only of 3% for overall service satisfaction. Results are stable across specifications and robust to city-level controls and time fixed effects. Effects are heterogeneous with respect to age and country. Results show that this gap is differentiated both at the city and continent levels. Additional regressions test for the influence of metro characteristics on perceived safety. We find that more acts of violence, larger carriages and emptier vehicles decrease the feeling of safety among women. Also, more staff in metros does not significantly increase female safety. Results suggest grounds for intervention from service providers.

**JEL codes:** G40; R38; R42.

**Keywords:** Gender; Safety; Public Transport; Subway; Customer Satisfaction; Behavioural Responses.

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# 1 Introduction

Customer satisfaction and passenger safety are top priorities for almost all subway service providers (Comet/Nova, 2013). Lower safety levels imply a reduction in passenger ridership <sup>1</sup>, which is a crucial financial concern for service providers. Yet, there is an incentive for providers to intervene since metro characteristics have an impact on customer satisfaction (Zelinka and Brennan, 2001). Safety measures also have a different impact on women compared to men (Yavuz and Welch, 2010). However, there is a significant mismatch between female customers' safety needs and strategies used by subway companies (Loukaitou-Sideris and Fink, 2009). In addition, although studies find that gender is the main driver of both trip satisfaction and fear in transport (St-Louis et al., 2014).

Women's fear of crime in public spaces is widely studied <sup>2</sup>, yet women's safety in public transport remains the focus of much limited attention. Does the perception of safety in public transport differ by gender, and to what extent? What are the potential drivers of these differences?

This study bridges the current literature gap and quantifies gender differences on safety perception. We use unique customer satisfaction survey data for 25 cities worldwide over 2014-2018. Customer satisfaction is assessed as follows. Participants are provided with statements: (i) "Trains are a secure place for me" and (ii) "Stations are a secure place for me". They rate to what extent they agree with each statement on a 1-5 scale: (1= strongly disagree; 5= strongly agree). We also use a satisfaction question where individuals estimate on a 1-5 scale how happy they are with the service. The contribution of this dataset is two-fold: it provides more robust results, and also complements existing studies that use smaller datasets on limited geographical areas. To disentangle the potential drivers of the feeling of safety, we use Key Performance Indicators (KPI). Those include: (i) staff members (regular staff and security staff), (ii) total costs (iii) number of acts of violence and (iv) metro ridership. Data covers the period 2014-2017 for 25 cities.

We use ordered probit specifications, which is motivated by the ordinal nature of the dependent variables. In a first part, we quantify the gender gap; in a second section, we test for the influence of metro characteristics.

Results suggest a significant gap between men and women both in the perception of satisfaction and safety. We find that women are 10% more likely than men to feel unsafe in metros. The gender gap is smaller for overall satisfaction, as women are 3% more likely to be dissatisfied with the general service. This smaller magnitude is consistent

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<sup>1</sup>See Lynch and Atkins (1988); Carter (2005); Delbosc and Currie (2012) for detailed studies.

<sup>2</sup>See Hall (1985), Gordon & Riger, 1989; Valentine (1990); Gilchrist et al. (1998); Koskela and Pain (2000), Pain (2001).

with safety being only one dimension of overall satisfaction (Oliver, 1997). Despite this gap, women are on average satisfied with both safety and the service. Results are stable across specifications and robust to city-level controls and time fixed effects. Effects are heterogeneous with age: the older the respondent, the smaller the gender gap in the perception of safety. Gaps are also heterogeneous geographically: the gap is larger in North America and Europe than in Asia and South America.

Additional regressions test for the influence of metro characteristics on the feeling of safety. We note that more acts of violence, larger carriages and emptier vehicles decrease the feeling of safety among women. It is noteworthy that more staff in metros does not significantly increase female safety.

To the best of our knowledge, this study is the first cross-country study of the gender difference in the perception of both safety and satisfaction. Our large dataset provides external validity to our results. We find evidence of a robust gap in the perception of safety between men and women. The magnitude of this gap differs based on metro characteristics, suggesting grounds for intervention from service providers.

## 2 Data and Empirical Strategy

**Data.** This study uses the Comet/Nova dataset, which records a total of 137,513 observations covering the period going from 2014 to 2018. In the specification, we use sociodemographic and economic variables as controls.

We observe that gender is evenly distributed over time. Overall, distributions are rather constant over the period 2014/2018. Individuals in this survey are often daily commuters who are travelling for work. Descriptive statistics are presented in the Table 1 below.

	Share of the sample (Transport Mode: Subway)					
	2014	2015	2016	2017	2018	2014/18
<b>Gender</b>						
Women (%)	0.46 (0.50)	0.43 (0.50)	0.47 (0.50)	0.49 (0.50)	0.46 (0.50)	0.46 (0.50)
<b>Age</b>						
Less than 18	0.04 (0.19)	0.04 (0.19)	0.04 (0.20)	0.04 (0.19)	0.04 (0.20)	0.04 (0.19)
18-29	0.42 (0.49)	0.39 (0.49)	0.40 (0.49)	0.41 (0.49)	0.37 (0.48)	0.40 (0.49)
30-39	0.24 (0.43)	0.26 (0.44)	0.24 (0.43)	0.23 (0.42)	0.23 (0.42)	0.24 (0.43)
40-49	0.14 (0.35)	0.15 (0.36)	0.15 (0.35)	0.15 (0.36)	0.16 (0.36)	0.15 (0.36)
50-65	0.13 (0.34)	0.14 (0.34)	0.14 (0.35)	0.15 (0.35)	0.15 (0.36)	0.14 (0.35)
More than 65	0.03 (0.17)	0.03 (0.16)	0.03 (0.17)	0.03 (0.17)	0.04 (0.20)	0.03 (0.18)
<b>Freq. of use</b>						
Very Often	0.62 (0.49)	0.64 (0.48)	0.63 (0.48)	0.64 (0.48)	0.61 (0.49)	0.63 (0.48)
Often (min:3times/week)	0.20 (0.40)	0.19 (0.39)	0.19 (0.39)	0.19 (0.39)	0.20 (0.40)	0.19 (0.39)
Sometimes (min:once/week)	0.10 (0.30)	0.09 (0.29)	0.10 (0.30)	0.09 (0.29)	0.11 (0.31)	0.10 (0.30)
Rarely (min:once/month)	0.05 (0.22)	0.05 (0.22)	0.05 (0.22)	0.05 (0.22)	0.05 (0.22)	0.05 (0.22)
Very rarely (less than once/month)	0.03 (0.16)	0.03 (0.16)	0.03 (0.17)	0.03 (0.17)	0.03 (0.17)	0.03 (0.17)

Standard errors in parentheses.

Source: Comet/Nova data.

Figure 1: Descriptive Statistics

**Empirical Strategy.** This methodology has been chosen over all the others as it fits the nature of the dependent variable (of interest). This methodology is the most relevant for this analysis because of the ordinal nature of the variables of interest (strongly disagree – disagree – neither agree nor disagree – agree – strongly agree). I ran ordered probit regressions for all statements in Comet/Nova. We assume the observed  $y$  is generated by a latent variable  $y^*$ :

$$y_i^* = x_i'\beta + u_i$$

with  $y_i = j$  if  $\alpha_{j-i} < y_i^* < \alpha_j$ .

The probability that individual  $i$  selects the alternative  $j$  is the following:

$$p_{ij} = p(y_i = j) = p(\alpha_{j-i} < y_i^* < \alpha_j)$$

$$\Leftrightarrow p(\alpha_{j-i} < x_i' \beta + u_i < \alpha_j)$$

where  $y$  is the dependent variable,  $x_i'$  is the vector of characteristics (on gender, age, travel frequency, travel purpose, time controls, city controls), and  $\beta$  is the corresponding vector of coefficients.

## 3 Results

### 3.1 First Results

**Gender effect analysis.** Table 1 present the ordered probit estimates for safety-related questions, with controls for sociodemographics, time controls, city dummies. Dependent variables are statements on safety and overall satisfaction.

For the subway estimates, results are stable across specifications and robust to city and time controls.

	Statements		
	The train is a secure place for me	Stations are a secure place for me	How satisfied are you overall with the service?
Female (Yes=1)	-0.235*** (0.00539)	-0.235*** (0.00539)	-0.0452*** (0.00548)
City dummies	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes
Observations	169,582	169,658	169,831

Standard errors in parentheses.

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1 Source: BES W13 Panel v1.2, own calculations.

Table 1: Ordered Probit Estimates: Gender Coefficients

Gender coefficients range between -.22 and -.29 for metro questions on safety. Coefficients are not easy to interpret by themselves, so we compute marginal effects in order to quantify this gender gap. We find negative and significant coefficients for women: most of the time women are less likely to be satisfied with aspects of the service compared to men. We also note that the gap is larger for questions on safety compared to other questions. We find stable results across specifications and to both city and time controls.

**Analysis of other sociodemographic variables.** On age, we note that the 18-29 and 30-39 have a comparable view of the subway system. On the motives to travel, we note that individuals who use the subway to go to work and at a daily frequency feel significantly less safe. We also find that women are also significantly less satisfied than men on questions unrelated to safety. Yet, the gap is much larger and for safety questions (-.2 to -.3) than for overall satisfaction (-.04 to -.07).

**Analysis of marginal effects.** Coefficients presented in Table 1 cannot be interpreted as such; they only present the significance of the effects and the magnitude cannot be interpreted. To do so, we compute the marginal effects. These marginal effects for the gender coefficients are presented in the Tables below.

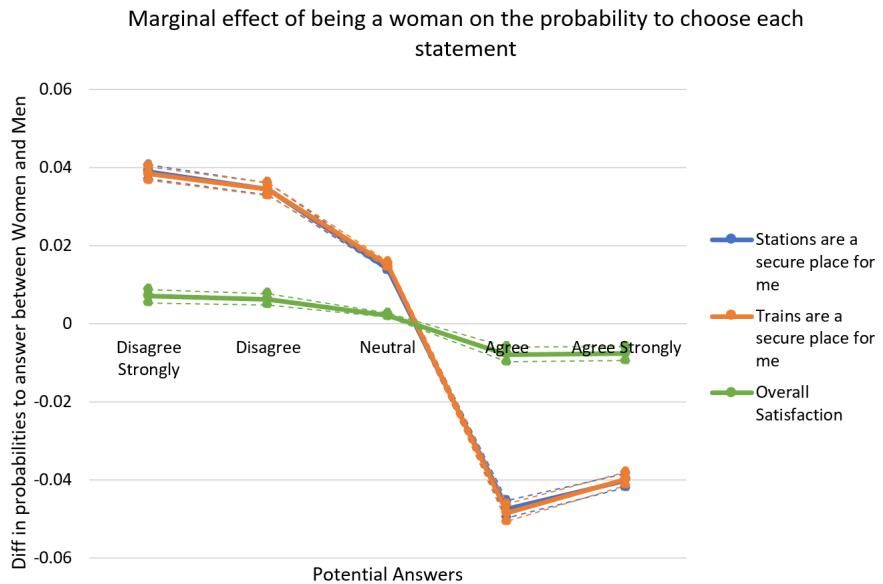


Figure 2: Marginal Effects for Safety-Related Questions

Figure 2 shows that overall, women are 10% more likely to make a negative statement on security than men. This figure shows that the two statements on security present marginal effects of a similar magnitude, which is in line with the fact that these statements are very close both in label and in nature. However, we notice that we record effects of a much larger magnitude for statements regarding safety compared to overall satisfaction.

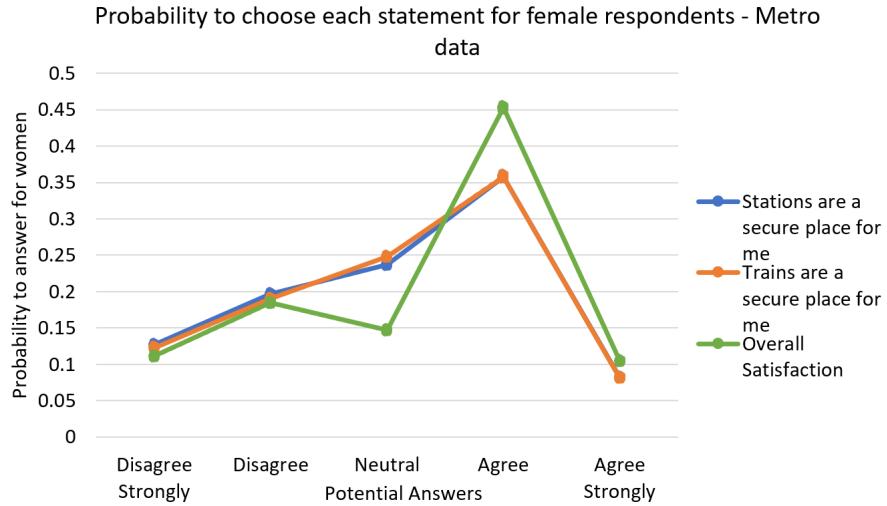


Figure 3: Marginal Effects for Other Satisfaction Questions

Yet overall women are not deeply unhappy with the service. Figure 3 presents the general probability for women to pick a given answer to a statement. It shows that although the gap between men and women is significant, the satisfaction of female customer still remains rather high.

### 3.2 Heterogeneity Checks

Figures 4 and 5 present the marginal coefficients of the gender gap by locality. This enables us to check whether there is heterogeneity at the country/continent level.

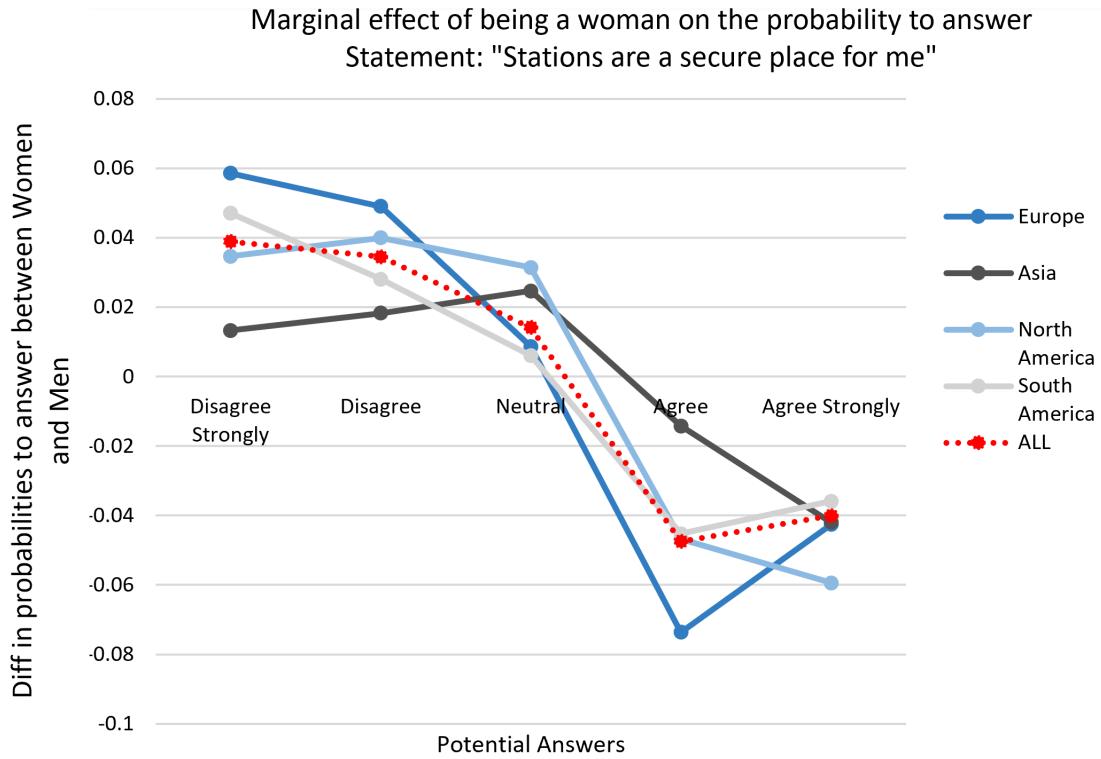


Figure 4: Marginal Effects for Safety-Related Statement: "Stations are a secure place for me"

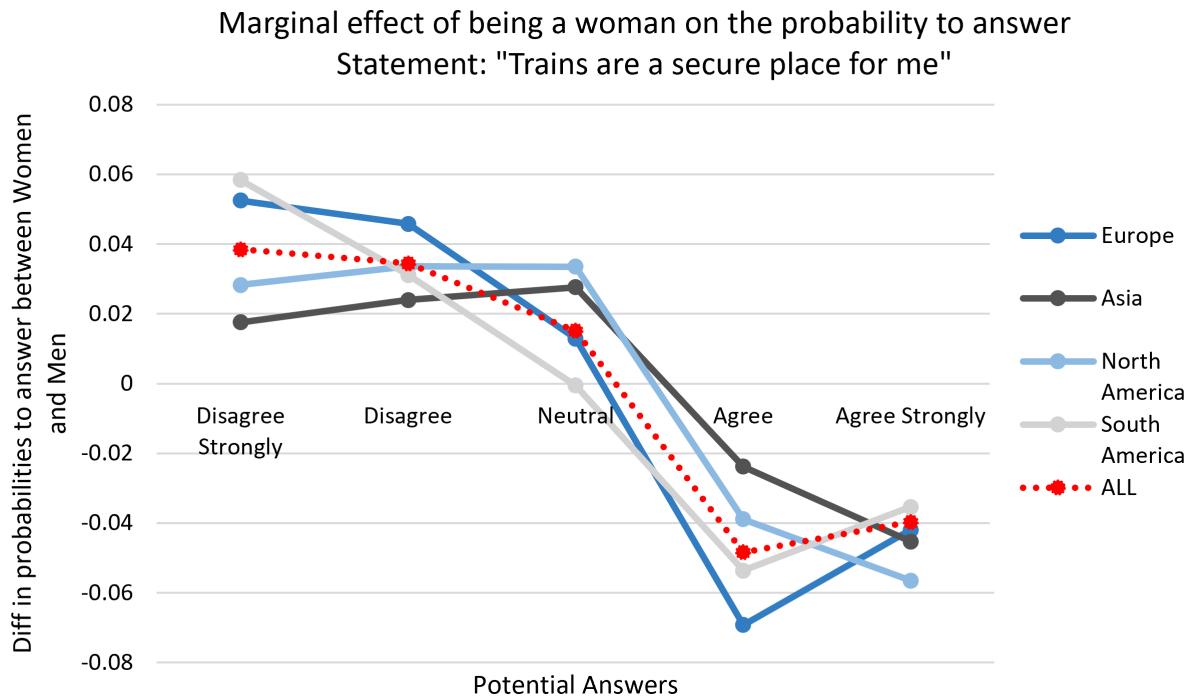


Figure 5: Marginal Effects for Safety-Related Statement: "Trains are a secure place for me"

For the sake of anonymity and because of the confidential nature of our datasets, we aggregated the information at the continent level. We note that for safety statements the

evolution is the same for all continents but with a different magnitude by continent. More precisely, results suggest that both Europe and North America have a bigger gender gap in satisfaction compared to Asia or South America.

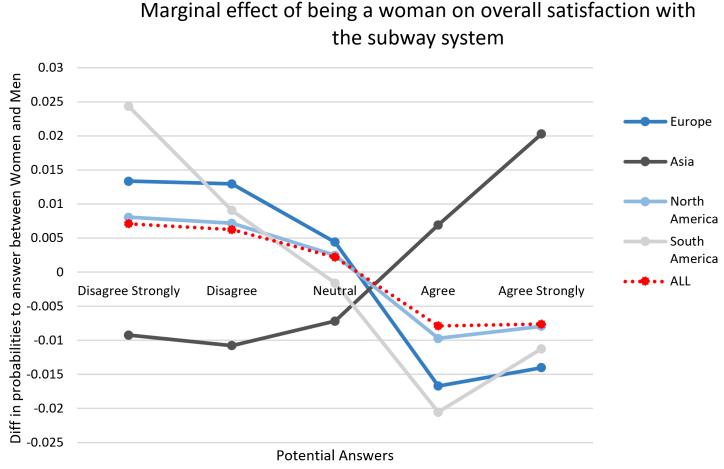


Figure 6: Marginal Effects for the overall satisfaction of customers

However, this homogeneity is not observable for the "overall satisfaction" statement. This remark is made based on the observation of the continent-level gender marginal effect in Figure 6.

**Heterogeneity based in sociodemographics.** Figure 3 presents the corresponding estimates. This subsection is dedicated to the analysis and the test of heterogeneity of the gender effect by age. We find that the overall satisfaction with public transports increases with age. In addition, satisfaction increases at an increasing rate with age for safety statements. This effect is not observed for the question on overall satisfaction. Our data shows younger women are more represented. This implies that our effect is non negligible: this results increases the magnitude of customer dissatisfaction.

**Heterogeneity based on travel purpose.** Figure 2 presents the corresponding estimates. Testing for heterogeneity on motives yields results that are comparable for both statements on safety. There is significant heterogeneity between men and women only for shopping and leisure, with the latter being significantly less satisfied.

	The train is a secure place for me	Stations are a secure place for me	How satisfied are you overall with the service?
Female (Yes=1)	-0.212*** (0.00686)	-0.206*** (0.00686)	-0.0223*** (0.00697)
Main travel purpose (ref: Work)			
Education	0.0624*** (0.0145)	0.0571*** (0.0145)	0.0973*** (0.0148)
Shopping	0.146*** (0.0112)	0.148*** (0.0112)	0.173*** (0.0114)
Leisure	0.183*** (0.0121)	0.181*** (0.0121)	0.286*** (0.0124)
Doctor	0.0587*** (0.0175)	0.0426** (0.0175)	0.220*** (0.0179)
Other	0.0812*** (0.0288)	0.0597** (0.0288)	0.185*** (0.0295)
Main travel purpose # Female			
Female & Education	-0.0273 (0.0218)	-0.0245 (0.0219)	-0.0499** (0.0223)
Female & Shopping	-0.103*** (0.0153)	-0.128*** (0.0153)	-0.0353** (0.0156)
Female & Leisure	-0.0515*** (0.0158)	-0.0625*** (0.0158)	-0.0756*** (0.0162)
Female & Doctor	0.00372 (0.0227)	-0.0108 (0.0227)	-0.0618*** (0.0232)
Female & Other	-0.0756* (0.0413)	-0.0612 (0.0413)	-0.120*** (0.0422)
Observations	169,582	169,658	169,831

Standard errors in parentheses.

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1 Source: BES W13 Panel v1.2, own calculations.

Table 2: Estimates for heterogeneity based on travel purpose

	The train is a secure place for me	Stations are a secure place for me	How satisfied are you overall with the service?
Female (Yes=1)	-0.291*** (0.00829)	-0.312*** (0.00830)	-0.0405*** (0.00844)
Age (ref: 18-29)			
Less than 18	0.272*** (0.0167)	0.224*** (0.0167)	0.411*** (0.0171)
30-39	-0.0603*** (0.00936)	-0.0625*** (0.00937)	-0.0624*** (0.00952)
40-49	-0.0626*** (0.0112)	-0.0586*** (0.0112)	0.0481*** (0.0114)
50-65	-0.0498*** (0.0118)	-0.0335*** (0.0118)	0.179*** (0.0120)
Over 65	0.0895*** (0.0202)	0.0994*** (0.0202)	0.381*** (0.0208)
Age # Female			
Female & (age: <18)	-0.192*** (0.0324)	-0.178*** (0.0324)	-0.211*** (0.0332)
Female & (age: 30-39)	0.0685*** (0.0133)	0.117*** (0.0133)	0.0410*** (0.0135)
Female & (age: 40-49)	0.116*** (0.0157)	0.151*** (0.0157)	0.0166 (0.0160)
Female & (age: 50-65)	0.151*** (0.0160)	0.171*** (0.0160)	-0.0518*** (0.0164)
Female & (age: over 65)	0.147*** (0.0302)	0.184*** (0.0302)	-0.135*** (0.0311)
Observations	169,582	169,658	169,831

Standard errors in parentheses.

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1 Source: BES W13 Panel v1.2, own calculations.

Table 3: Estimates for heterogeneity based on age

## 4 Sensitivity Analysis

This next subsection is dedicated to the analysis of the impact of metro characteristics on safety as perceived by customers. To do so, we use Key Performance Indicators (KPI) for all the metros used so far in the Comet/Nova dataset. The KPI indicators used are the following: (i) number of staff members (regular and police/security) (ii) total costs (iii) the number of acts of violence committed in the subway (iv) the level of metro ridership. KPI data is available over time period 2014-2017.

These variables have the smallest level of correlation with each other and with other independent variables, as presented in the correlation table below:

	Staff members	Total operating costs	Total nb acts violence	Car seating capacity	Staff (police and security)	Metro ridership	Metro ridership /residents
Staff members	1						
Total operating costs	-0.143	1					
Total nb acts violence	0.5685	-0.1915	1				
Car seating capacity	0.1329	-0.0957	-0.1585	1			
Staff (police and security)	0.3063	0.205	-0.1211	0.0362	1		
Metro ridership	0.6485	-0.0048	0.3642	-0.015	0.4233	1	
Metro ridership/residents	0.7601	0.1707	0.2205	0.1906	0.6394	0.6912	1

Table 4: Correlation between KPI indicators

	Trains are secure for me	Stations are secure for me	Overall satisfaction	Likelihood to recommend to another person
	(1)	(2)	(3)	(4)
Female (yes=1)	-0.233*** (0.00760)	-0.243*** (0.00761)	-0.0487*** (0.00772)	-0.0245*** (0.00745)
Staff members	-0.0366 (0.0305)	-0.0375 (0.0305)	-0.410*** (0.0310)	-0.297*** (0.0302)
Total operating costs	5.08e-07 (3.98e-07)	5.59e-07 (4.01e-07)	3.70e-06*** (4.07e-07)	2.74e-06*** (3.89e-07)
Total nb acts violence	-0.000139*** (3.47e-05)	-0.000169*** (3.47e-05)	-0.000406*** (3.54e-05)	-0.000359*** (3.44e-05)
Car seating capacity	-0.0419*** (0.0128)	-0.0518*** (0.0128)	-0.147*** (0.0130)	-0.175*** (0.0125)
Staff (police and security)	0.0505 (0.0313)	0.0182 (0.0313)	-0.0705** (0.0319)	-0.0255 (0.0311)
Metro ridership	2.04e-10** (9.57e-11)	2.59e-10*** (9.58e-11)	6.48e-10*** (9.70e-11)	8.38e-10*** (9.35e-11)
Controls				
Time	Yes	Yes	Yes	Yes
City	Yes	Yes	Yes	Yes
Number of observations	85,858	85,919	86,012	84,725

Standard errors in parentheses.

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1 Source: BES W13 Panel v1.2, own calculations.

Table 5: Effect of metro characteristics on the perception of safety by gender

Table 5 presents the corresponding ordered probit estimates. That table also include the likelihood to recommend service to someone the respondent know (on a 10-point scale).

We find that more acts of violence, larger vehicles implies less satisfaction from customers. Surprisingly, more staff members (both regular staff and police staff) have no significant impact on perceived safety. In addition, individuals are more satisfied with safety levels in busier cities. We note that the more general questions on customer satisfaction slightly differ from safety questions. We find the same impact as safety for following: nb acts of violence, car seating capacity and metro ridership. Results also suggest that larger costs increase satisfaction with the service, yet more staff indicate a smaller satisfaction. That is probably because it indicates a less modern / user-friendly system.

## 4.1 Testing for Heterogeneity

	Trains are secure for me (1)	Stations are secure for me (2)	Overall satisfaction (3)	Likelihood to recommend to another person (4)
Female (yes=1)	-	-	-	-
Staff members	0.0229 (0.0503)	-0.0106 (0.0503)	-0.411*** (0.0514)	-0.256*** (0.0496)
Total operating costs	2.83e-07 (1.03e-06)	4.08e-07 (1.03e-06)	4.35e-06*** (1.05e-06)	5.80e-06*** (1.01e-06)
Total nb acts violence	-0.000163*** (5.58e-05)	-0.000204*** (5.57e-05)	-0.000459*** (5.71e-05)	-0.000409*** (5.51e-05)
Car seating capacity	-0.0710*** (0.0193)	-0.0993*** (0.0193)	-0.169*** (0.0197)	-0.230*** (0.0190)
Staff (police and security)	0.0300 (0.0547)	-0.0562 (0.0546)	-0.142** (0.0558)	-0.138** (0.0541)
Metro ridership	4.43e-10** (1.73e-10)	4.27e-10** (1.73e-10)	8.21e-10*** (1.76e-10)	1.09e-09*** (1.69e-10)
Controls				
Time	Yes	Yes	Yes	Yes
City	Yes	Yes	Yes	Yes
Number of observations	36,463	36,500	36,551	36,015

Standard errors in parentheses.

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1 Source: BES W13 Panel v1.2, own calculations.

Table 6: Heterogeneity by gender in the perception of metro characteristics

Table 6 presents the estimates for heterogeneity in the perception of subway characteristics by gender. To get these results, we run regressions on the subgroup of women. Questions regarding safety have similar outcomes: the negative effects on the perception of car seating capacity and the number of acts of violence are larger. In addition, the perception of staff (both general and police staff) is still non significant. Finally, the metro ridership effect is still observed: more riders make women feel safer. As found previously, results from general customer satisfaction questions slightly differ from safety ones. The significant elements are again the same as those observed for the whole population.

## 5 Conclusion

This study quantifies the gender gap in the perception of safety and satisfaction in metros. We use a large-scale unique customer satisfaction survey on 25 countries worldwide over 2014-2018. Results suggest a significant gender gap: we find that women are 10% more likely than men to feel unsafe in metros. The gender gap is smaller and only of 3% for

overall service satisfaction. Results are stable across specifications and robust to city-level controls and time fixed effects. Effects are heterogeneous with respect to age and country. Results show that this gap is differentiated both at the city and continent levels.

Additional regressions which test for the influence of metro characteristics on perceived safety show that more acts of violence, larger carriages and emptier vehicles decrease the feeling of safety among women. Also, more staff in metros does not significantly increase female safety. Results suggest grounds for intervention from service providers.

The relevance of this study is contained in the fact that it uses a unique dataset on both customer satisfaction and subway performance indicators. Therefore, we find that it is useful to determine performance benchmarking for public transport operators, as we make a new link between transport provision and the evaluation of safety by gender.

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