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# Financial Incentives to Reduce Vehicle Miles Traveled

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# Financial Incentives to Reduce Vehicle Miles Traveled

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**16. Abstract**

The willingness-to-accept monetary incentives to promote the use of transit and micromobility options was estimated for Puerto Rico. The analysis of a community survey showed that the decision to use an e-scooter as an alternative to an automobile for a commute trip depends on weather conditions, safety risks, and service cost, whereas for transit the decision highly depends on transit travel time, parking conditions, and service fare. The minimum incentives accepted went from $17.10 for the Tren Urbano heavy rail service to $18.90 for e-scooters as alternative modes to automobiles. The results show that the incentive value decreases as the age and the income of the person increase. A field experiment studied the potential impact of monetary incentives to reduce VMTs of college students by offering $15 and $30 per e-scooter trip in the Municipality of Mayagüez. Fourteen subjects completed 57% of the scheduled trips. The results show that financial incentives can help motivate, within some limits, a migration from private vehicles to alternative modes of transportation. However, the effectiveness of the incentives varies, influenced by factors such as age, income, and perceptions about the transit service quality and the safety of the e-scooters. While younger and lower-income populations are more responsive to higher financial incentives, older adults are willing to accept lower incentives, which suggests a lower valuation of time of these social groups.

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# Abbreviations and Acronyms

| | |
|---|---|
| CV | Contingent Valuation |
| DC | Discrete Choice |
| EOS | Expert Opinion Survey |
| GLM | Generalized Linear Model |
| MOM | Municipality of Mayagüez |
| NICR | National Institute for Congestion Reduction |
| NB | Negative Binomial |
| SJMA | San Juan Metropolitan Area |
| SP | Stated Preference |
| TT | Travel Time |
| TU | Tren Urbano |
| U.S. | United States |
| VMT | Vehicle Miles Traveled |
| VOCT | Values of Commuting Time |
| VOT | Value of Time |
| VWPSM | Van Westendorp Price Sensitivity Meter |
| V2G | Vehicle-to-Grid |
| WTA | Willingness-to-Accept |
| WTP | Willingness-to-Pay |

# Executive Summary

This research explores the viability and effectiveness of positive financial incentives with the objective of promoting the use of transit and micromobility alternatives to private automobiles. The study methodology consisted of nine tasks, including a literature review, a survey to estimate the willingness-to-accept of monetary incentives for the use of alternative transportation modes, a field experiment to evaluate the effectiveness of financial incentives for the use of e-scooters on a student community, interviews to the experiment participants to analyze their involvement and decisions during the experimental procedure, and the feedback from a panel of experts about the potential use of financial incentives.

The literature review examined previous studies related to incentives, both financial and non-financial, positive and negative, designed and implemented to reduce vehicle miles traveled (VMT) on automobiles, primarily within the United States. The focus of the review was the outcomes and effectiveness of these initiatives to understand the different types of incentives and their impact on VMT. Additionally, the review explored the relationship between positive financial incentives and public policy decisions associated with implementing these incentive programs.

A community survey was conducted to gather data on the willingness-to-accept (WTA) monetary incentives of commuters to change their behavior and mode choice to reduce their vehicle miles traveled (VMT). The convenience sample obtained 336 complete responses from the local population for a 5.2% error at a 95% confidence level. A high percentage (76.5%) of the participants use their private automobile as the primary mode of transportation. Only 16% of the sample stated to be transit users and 20.6% stated to use e-scooters. Several critical factors impact the choice of transit and micromobility over private vehicles. The three most important factors in the decision to use transit are the parking conditions, transit travel time, and travel security. In the case of e-scooters, the three most important factors are the weather conditions, riding safety, and service fare.

The analysis of the responses to the WTA questions determined that the Tren Urbano had the lowest mean incentive value ($17.10 per trip) as an alternative to the automobile, whereas e-scooters obtained the highest mean incentive of $18.90 per trip. The difference in WTA values between the three alternative modes: municipal buses, Tren Urbano, and e-scooters, was found to be statistically significant. An important tendency was that the incentive value requested for each of the three alternative modes decreases as the age and the income of the person increase. The discrete choice model developed with the stated preference scenarios found that as the monetary incentive offered for using the Tren Urbano heavy rail increases it increased the probability of choosing it over the automobile option. On the other hand, the models found that as the travel time for a trip in any of the three alternative modes increases (reducing or removing savings in travel time) the probability of the person choosing any of them over their automobile significantly decreases.

The field experiment tested the use of financial incentives on the e-scooter service offered in the municipality of Mayagüez. The experimental procedure evaluated the potential long-term impact to reduce VMTs on college students by offering incentives of $15 and $30 per trip. Fourteen subjects participated in the experiment, completing 57% of the 28 scheduled trips. The participants were called during the morning or the afternoon period on weekdays to inform them of their time to make a trip using the e-scooter service and the amount of the incentive offered. Five students (36%) did both incentivized trips, six students (43%) completed one of the trips, and three students (21%) did not make any of the incentivized trips. Interviews were conducted six months after the end of the experiment to obtain feedback about the decisions and experiences of using the

e-scooters. The results suggest that e-scooters have potential to replace automobile use for the student population, especially if proper riding safety measures and long-term cost considerations are taken. The incentive program seems to have been successful in motivating the willingness of using or acquiring an e-scooter on some of the participating students.

A panel of eight experts with diverse professional backgrounds in transportation and civil engineering, urban planning, sociology, public policy, law, and economics was invited to share their feedback and opinions about the main study results. The expert panel considered the potential use of financial incentives to promote the selection of alternative modes to reduce VMT. The opinion of the experts about the results from the field experiment conducted in Mayagüez tend to agree that while financial incentives could change the transportation mode selection for a short period, their actual implementation will require sustained improvements in transit services and improvements in road infrastructure.

The results indicate that financial incentives can help motivate, within some limits, a shift from private vehicles to alternative modes of transportation, such as transit and micromobility. However, the effectiveness of these incentives varies significantly across different demographic groups, influenced by factors such as age, income, and perceptions about the transit service quality and the safety of the e-scooters when sharing the road with other vehicles. The study points out that while younger and lower-income populations are more responsive to higher financial incentives, older adults are willing to accept lower incentives, which suggests a lower valuation of time of these social groups.

Regarding policy implementation, the study highlights the benefits of promoting transit and micro-mobility, but these must be perceived by the community as safe, efficient and reliable services. The study recommends the potential implementation of a program of financial incentives as a public policy strategy that must be accompanied by street infrastructure improvements, like exclusive lanes or right-of-way to accommodate e-scooters, wider shared lanes that allow separation from vehicular traffic, and increase restrictions on the use of private cars in urban areas by limiting free on-street parking. Furthermore, additional research that could focus on increasing and stratifying the sample (by age, gender, students, faculty and employees) of the experimental study of financial incentives as well as including new variables and alternative modes.

# Chapter 1. Introduction

This chapter presents the justification and objectives of the research study. The chapter is divided into three sections with the description and explanation of the research statement and justification, the objectives of the study, and the organization of the report.

## Research Statement

Apart from the reduction in vehicle miles traveled (VMT) related to the COVID-19 pandemic restrictions established in 2020, traffic congestion has increased consistently in the United States (U.S.) since 1982 (Schrank et al., 2019). Traffic congestion in the U.S. cost more than $81 Billion in 2022, with a typical driver having 51 hours in traffic delays, 15 hours more than in 2021 (M. Gitlin, 2023). According to INRIX (2022) and Rekor (2024), an average driver paid $134 more for fuel in 2022 than 2021 due to the inflation and increased fuel prices. According to ATRI (2022), as cited in (Brasher, 2023), the cost of congestion to the trucking industry was at its highest level in 2021 reaching $94.6 Billion, resulting on a 27% increase in a 5-year period.

Traffic congestion is a multifactorial problem in which population growth is one of the main drivers. Population growth induces vehicular growth. Congestion is also related to land-use and transit systems presenting negative externalities such as environmental or economic issues (Marshall & Dumbaugh, 2020) or problems related to public health due to the pollution. It is also a phenomenon linked to travel behavior and car use patterns, as it occurs when demand reaches or exceeds the capacity limits of the road infrastructure (Moyano et al., 2021), causing traffic to move at speeds lower than free-flow conditions, and thus, increasing the time required to travel congested corridors (Moya-Gómez, 2018).

Once a highway network reaches a state of operation with high traffic densities and becomes saturated, decision-makers face the challenge of looking for alternatives to alleviate traffic congestion and to prevent new traffic jams (Huang et al., 2016). Historically, traffic congestion has been battled by increasing roadway capacity. A regular person could assume that increasing the roadway capacity will allow the number of vehicles on the road to travel faster and thus reduce congestion. The main shortcoming of this assumption is that traffic demand will not remain unaltered due to the increase in the transportation offer. Research has demonstrated that when roadway capacity is increased, an induced growth in demand for travel is often promoted which in turn increases again the traffic density, and therefore cancel the initial increase in the average speed of travel or result in greater congestion (Anupriya and Graham, 2023).

Another strategy to reduce VMT in urban areas is stimulating the use of transit and micromobility, among other modes (Ferrell, 2019). There are, however, several barriers to the increase in transit and micromobility use. Transit needs to have frequent route services in a well-connected system for this strategy to be accepted by the population as an effective mobility alternative to the private automobile. Transit ridership in the U.S. significantly declined in 2020 due to the COVID-19 pandemic and had encounter difficulties to recover users (Burris et al., 2023). Transit ridership has decreased due to factors such as increases in automobile ownership, availability of ride hailing alternatives, telecommuting and distance learning practices, and online shopping options, in combination to typical issues with quality-of-service levels, service costs, and external socio-economic factors (Erhardt et al., 2022; O'Toole, 2018). Micromobility, particularly e-bikes and e-scooters, has emerged as an option for short trips in urban areas that have primarily captured the interest of high-income groups and young males (Zhao et al., 2022). Yet, the regulatory framework , affordability, and safety concerns hinder the potential of micromobility to broadly expand to other socio-economic groups or trip options (Ecola

& Fraade-Blanar, 2021). The use of positive financial incentives can be an alternative mean to reduce traffic congestion in urban areas by targeting the reduction of VMT with the promotion of alternative mobility options in particular population groups.

## Justification

A way of mitigating traffic congestion is the reduction of vehicle miles traveled (VMT). The reduction of VMT is linked to public and social goals like better air quality, sustainable and healthy environments, and the reduction of fuel consumption, among others impacts. Aiming to achieve these goals, decision-makers look to stimulate changes in population behavior through the design and implementation of incentives and deterrents. Implementation examples of financial incentives and operational strategies to reduce traffic congestion and VMT in the U.S. have led to diverse results. This project will study the acceptability, implantability, and the impact of positive financial incentives aimed at the reduction of VMT using alternative means of transportation to the private motor vehicle.

## Research Objectives

The main goal of this study is to analyze the acceptability, implantability, and the impact on automobile users of positive financial incentives that can be used for the design of policies aiming towards the reduction of VMT. The results could be used to determine the acceptability of the population of such incentives and to make policy recommendations based on expert knowledge.

The specific objectives identified to achieve the main goal include to:

- Review the different types of financial and non-financial incentives and disincentives implemented in U.S. jurisdictions that have been recommended and implemented to reduce VMT. Particular attention was given to literature related to positive financial incentives and their effectiveness and the possible relationship between the availability of financial incentives and the potential VMT reduction.
- Develop and carry out a survey instrument oriented to travelers to determine their willingness-to-accept (WTA) financial incentives to change their travel mode selection decision toward VMT reduction alternatives. Stated preference (SP) questions were used for the WTA determination. The survey included socio-economic and demographic questions used to describe and analyze the acceptability of incentives based on socio-economic and demographic profiles.
- Perform a field experiment with subjects to evaluate their opinions about the potential effectiveness of positive financial incentives to reduce VMTs by promoting a micromobility alternative in the Municipality of Mayagüez in Puerto Rico.
- Develop and conduct an Expert Opinion Survey (EOS) including academics and practitioners in the fields of economics, transportation and civil engineers, and urban planners. The EOS will assist in obtaining the experts' opinions and assessment about the primary traveler's survey and field experiment results, as well as providing their interpretations about the effectiveness and feasibility of implementing incentives to reduce VMT in small cities and college towns.

This research focuses on the strategy of promoting alternative modes to the private automobile by estimating the Willingness to Accept (WTA) of monetary incentives and the Value of Time (VOT). The main contribution is the study of WTA estimates by conducting a travelers' survey and a field experiment with local subjects in Puerto Rico. This report presents the WTA measures that were estimated for the Tren Urbano, municipal buses,

and e-scooters using Contingent Valuation (CV) and Stated Preference (SP) discrete choice analysis. This information adds knowledge that can be used by academicians, practitioners, and government officers for the design of policies for financial incentives on similar mid-size urban areas and college towns.

## Organization of the Report

This report is organized into five chapters. Chapter 2 presents the results from a review of relevant literature related to financial positive incentives, willingness-to-accept values, value of time, and contingent valuation. Chapter 3 details the methodology employed to achieve the objectives of this study. Chapter 4 examines the data obtained from the travelers' survey, the field experiment, and the expert opinion survey and discusses the findings derived from the statistical analysis conducted. Finally, Chapter 5 presents the conclusions drawn from the research and provides recommendations for transportation policy considerations and future research studies.

# Chapter 2. Literature Review

This chapter presents the results from the literature review conducted for this study. The focus of the review was on the selection and application of financial positive incentives to modify behavior. This review evaluated the outcomes and effectiveness of these initiatives. It focused on understanding the different types of incentives and their impact on VMT. Additionally, the review explored previous studies and experiments on the relationship between receiving positive financial incentives and the public policies associated with implementing these incentive programs.

Economic principles are not universal laws, but there is a high probability for them to happen. One of the Mankiw's Ten Principles of Economics  is that "*people respond to incentives*" (Mankiw, 2022). Aiming to achieve public and social goals, decision makers in our economic system (a market oriented mixed open economy) and political system (a three-branch check and balance representative democracy) frequently stimulate changes in population behavior through the design and implementation of incentives (Hartman, 1994; Paz et al., 2014; Tan et al., 2021). Incentives are useful to guide and motivate customers toward desired actions and behaviors. In terms of transportation, the travelers' mobility decisions can be guided by designing targeted incentives that offer compensation for an individual's change in behavior. Incentives designed and implemented to change population behavior can be financial and non-financial. In terms of the impact to travelers, incentives can be positive or negative. Incentives have been implemented in U.S. jurisdictions to reduce congestion and VMT (Bauer et al., 2018). Examples of congestion-related positive incentives are monetary payments, transit passenger subsidies, home relocation subsidies, tax exemptions, tax credits and tax rates. Examples of negative incentives are fuel tax, parking fees, congestion pricing, and road tolls. The effects of the implementation of such incentives in transit have been studied (Zeiske et al., 2021).

If public policy for battling congestion moves towards the reduction of VMT by the implementation of positive financial incentives, a way to understand and determine the acceptability and potential of those policies is by the estimation of the WTA. Hasan, Bahrain, and Bakar (2015) defined WTA as the minimum value of money that people demand to accept as compensation because of losses so that they are indifferent between being paid and bear the losses. These authors defined the Willingness-to-Pay (WTP) as the sum people are willing to pay to show indifference on paying and enjoying the gains.

The desirability to receive incentives to change behavior has been analyzed in health sciences (Martin et al., 2012) and agriculture (Shittu et al., 2021). Kadota et al. (2021) studied WTA incentives for tuberculosis diagnostic evaluation in Uganda. Subjects were asked whether they would be willing to accept a random starting value to facilitate return to the health center for completion of diagnostic evaluation. Seventy percent of the subjects responded to modest cash transfers to return to the health center. Their study concluded that hypothetical Contingent Valuation (CV), such as WTA, can be useful in the design of programs associated with public health. Shittu et al. (2021) estimated the WTA incentives for farmers in Nigeria to switch into Climate-Smart Agriculture practices to ameliorate climate change. The authors concluded that a higher incentive to farmers will increase the probability of change behavior and move into the desired direction.

CV is a method that applies open questions to assess the WTA. CV consists of directly asking the participant of the study for an amount of money or range of amounts which the individual is willing to accept as a compensation to change behavior. In the present study, participants were directly asked about the minimal amount of money they were willing to accept as compensation to use the transit or micromobility options instead of driving their private motor vehicle. A disadvantage of the CV is the hypothetical nature of the test

subject's response. The answers provided by the participants are of non-committal nature and only reflect their WTA, therefore, these do not necessarily reflect the real intention of changing behavior, bringing disputes about the method external validity (Wertenbroch & Skiera, 2002).

For the WTA and WTP analysis, the application of Stated Preference (SP) models for the estimation of the marginal rates of substitution (MRS) is a standard procedure. A common MRS measure is the value of time. In transportation economics, VOT refers to the opportunity cost of time spent on travelling (Jayasooriya et al., 2019); that is the amount of money a traveler would be willing to pay for savings in time, or the amount of money a traveler would be willing to accept as compensation for losses in time. Figueroa-Medina et al. (2022) applied a combination of the Van Westendorp Price Sensitivity Meter (VWPSM) with a SP model to estimate the WTP and VOT for the selection of a dynamic toll lane for freeway travel in Puerto Rico. The main assumption of the VWPSM is that consumers cannot express a single 'perfect price' for a good or service, but a range of prices based on the perceptions of quality and price (Figueroa-Medina et al., 2022). From the perspective of the present study, WTA was applied, and not WTP, because it was assumed that choosing to make a trip using transit or micromobility, instead of the private motor vehicle, is considered as a loss, and to change that behavior a positive incentive is needed. The VWPSM does not apply to WTA because of the method conceptualization using ranges, whereas for the WTA the compensation can be limitless in theory. The price to pay and the compensation to accept are not the same. This issue raises the question: are WTA and WTP identical?

Hasan-Basri et al. (2015) explained from a Hicksian perspective that the economic value estimated from WTA and WTP should produce identical results. If they are different, is because of the wealth and income effects. The authors emphasized that empirical studies on the disparity between WTA and WTP found different results. Radmehr et al. (2018) concluded that WTA and WTP can be equivalent in the experimental setting but different statistically. Their research showed that the WTA/WTP ratio was approximately 3.5:1, evidence of a significative gap between WTA and WTP. Ramjerdi & Lindqvist Dillén (2007) studied the gap between WTP and WTA and argued that it could be explained using a Hicksian framework. In a Hicksian framework, equivalent loss is associated with WTP, and equivalent gain is associated with WTA. The authors explained from Norwegian and Swedish VOT studies that the observed WTA VOT is about 1.5 to 2.0 times larger than the WTP VOT. The authors concluded that the nature of the gap is of great consequence for policy measures. Whittington et al. (2017) explained that the interpretation of the WTA–WTP discrepancy has changed due to the incorporation of the findings of psychologists and behavioral economists into microeconomic theory. This is the body of work from Prospect Theory. The authors cited Kahneman & Tversky who found that people value gains and losses differently and that is the reason for the disparity. The theory stated that people dislike losses more than they like gains.

Based on utility maximization theory applied to transportation, Wang et al. (2020) researched the travelers' mobility decisions and the effects of customer incentives in the U.S. using an online questionnaire with SP questions. A multinomial logistic regression model was used for analysis. The authors stated that "*among the 661 respondents, 76.9% accepted an incentive to leave the congested route to become a potential customer, which demonstrated the effectiveness of the contextual incentive in redistributing traffic demands.*" Their study discussed that different individuals have different preferences for incentives and concluded that incentives should be tailored for different travelers.

Bliemer et al. (2009) studied the rewards for evading commute travel during peak hours in private motor vehicles in the Netherlands. Their study led to four real-life rewarding projects in which participants earned monetary rewards ranging from 3 to 7 euros. Most travelers changed their transportation behavior when

compensated modestly. The authors concluded that "*People are sensitive to monetary incentives, either by charges or by rewards (although the response to losses or gains can be different).*"

Zeiske et al. (2021) studied the effects of supplying free transportation fare cards, for non-free transport, as an incentive for commuting decisions to promote sustainable travel in the Netherlands. The authors focused on understanding the effects of incentives for short-term and long-term periods. A sample of 380 subjects were given the free transportation fare cards for three weeks. Using linear mixed modelling, the authors concluded that although financial incentives may motivate people to use public transportation in the short term it does not assure that commuters will continue to use public transportation once the incentives are no longer provided.

Studies have also tested the effectiveness of providing financial incentives to commuters for switching from private automobiles to another transportation mode. Fujii & Kitamura (2003) explored this case in Japan with an experiment targeting 43 drivers. In this experiment, a one-month free bus ticket was given to 23 drivers in the experimental group. The other twenty drivers were in the control group. The study found a significant shift in behavior when the incentives were substantial enough. The attitudes toward buses were more positive and the frequency of bus use increased, while the habits of using automobile decreased from before the intervention, even one month after the intervention period.

Lee et al. (2020) shows the application of CV in transportation to estimate WTA. Specifically, the authors worked with WTA values for vehicle-to-grid (V2G) service in South Korea. The CV approach used a questionnaire with three categories: general background, questions on monthly WTA for a V2G service, and questions regarding the respondent's socio-demographic features. Their results indicate that 75.6% of the subjects were willing to accept a V2G service. Also, their study concluded that the WTA value depends on the amount of reduction in parking charges, connection duration, and the number of service sessions per month. Swärdh & Algers (2016) used a SP approach to estimate WTA applied to transportation, specifically the WTA commuting time within the household. The authors used SP data to derive estimated values of commuting time (VOCT) and compared how the spouses in a household value each other's commuting time. The authors measured the VOCT in the WTA context and argued that there is strong evidence in the literature of non-market goods valuation, such as VOT studies, that WTA values exceed WTP values.

A comparative study made by Gneezy & Rustichini (2000) about economics' assumptions that monetary incentives improve performance and psychology's assumptions that the opposite may happen, found that in some contexts, the introduction of financial incentives could break existing motivations for behavior change, such as personal environmental concern or social norms. Their study found that the effect of monetary compensation on performance was not monotonic. In the treatments in which money was offered, a larger amount yielded a higher performance. However, offering money did not always produce an improvement as subjects who were offered monetary incentives performed more poorly than those who were offered no compensation.

# Chapter 3. Methodology

This chapter explains the methodology followed to achieve the project's objectives, which involved developing and conducting two survey instruments and a field experiment. Figure 1 shows the main tasks of the study methodology. The methodology consisted of nine major tasks, ranging from the literature review to the writing of the final report.



**Figure 1. Methodology Tasks**

The first task was the literature review focused on research studies related to incentives (financial and non-financial, positive or negative) designed and implemented to reduce VMT, with emphasis on those implemented, but not exclusively, in the U.S. The review also focused on the results and effectiveness of those experimental initiatives or public policies.

## Online Traveler's WTA Survey

The second and third tasks were the development and administration of the traveler's WTA Survey instrument. The online survey was designed with the purpose to collect data on the traveler's WTA incentives that can change their behavior and choose VMT reduction alternatives. Stated Preference questions were included along with complementary open questions for the identification of travel mode preferences. Socio-economic and demographic questions were also included to describe and analyze the acceptability of incentives based on the sample characteristics. Residents of Puerto Rico were selected as the target population. The survey, prepared on a Google Form, was administered online from November 2022 to February 2023.

The survey instrument was approved by the UPRM Institutional Research Board. Advertising efforts using social media outlets and institutional e-mail messages were used to acquire subjects. The questionnaire included six sections: Use of Transit and Micromobility, Perceptions and Opinions About Transit, Perceptions and Opinions About e-scooters, WTA Assessment (two methods), and Socio-demographic Factors.

For the first WTA Assessment method, the survey included questions that required participants to state the minimum monetary amount they were willing to accept to select an alternative travel mode instead of their private automobile. Three alternative modes were considered: the Tren Urbano heavy rail, a municipal bus service, and a shared e-scooter service. For each alternative mode, respondents were required to directly type in the monetary amount (in US dollars and cents) that they would be willing to accept to shift from their private auto.

For the second WTA Assessment method. respondents were presented with three SP scenarios based on the combination of travel conditions shown in Figure 2. These scenarios required participants to select either the use of their automobile or one of the alternative modes to complete a commuter trip. Each SP scenario included nine questions in which the respondent was presented with combinations of three monetary incentive values and three travel time (TT) differences between two competing modes. The incentive values were $1.00, $3.50, and $7.00, and the TT differences were 0 minutes, 5 minutes more, and 5 minutes less. The middle incentive value represented the actual average cost of a e-scooter trip as provided by a local shared service operator. The top incentive value was established as double the average cost for the trip. The lowest incentive value was assumed as a reasonable minimum amount. For each combination of the incentive amount and TT difference, each subject answered with a YES or NO response his/her willingness to accept the incentive to use the alternative mode instead of their automobile.
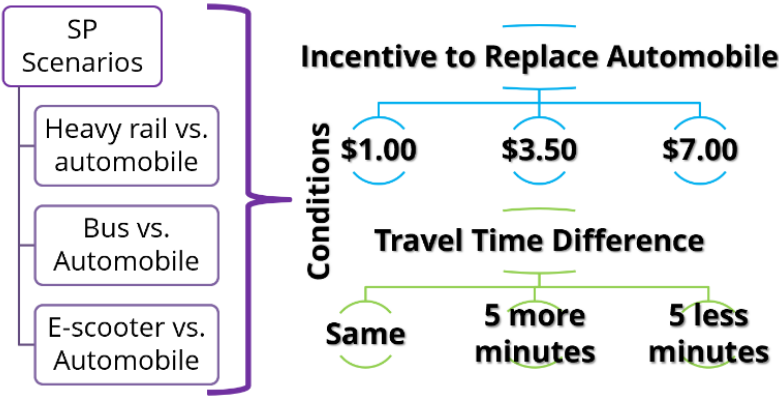


Figure 2. Stated Preference Scenarios

The survey section related to the socio-demographic factors gathered basic characteristics from the respondents, such as gender, age, income, education, occupation, and municipality of residence and work. A short description of the transportation conditions in Puerto Rico and the characteristics of the transportation options in the survey were provided to give a basic knowledge of the local transportation context to all the participants.

The following information in this paragraph is provided for the reader of this report to have background information to understand the setting and context of the survey respondents. Puerto Rico has an extensive highway network with 4,813 miles. Automobile ownership in Puerto Rico is 146 vehicles per road-mile, and about 87-95% of the trips are satisfied using private motor vehicles (PRHTA, 2018). The elevated level of auto ownership has led to high traffic congestion levels in Puerto Rico (Schrank et al., 2019). The Tren Urbano (TU) is a 10.7-mi long heavy rail line that operates on an exclusive right-of-way connecting three municipalities in the San Juan Metropolitan Area (SJMA). Peak service frequency goes from 7 to 12 minutes with a regular trip fare of $1.50. The service is free-of-charge to adults older than 75 years. Some of the municipalities in the territory

have established bus services free-of-charge within their municipality limits, connecting rural communities with urban areas. The Municipality of Mayagüez (MOM) is a college city in which bus and shared e-scooter services are available for residents as an option to the private motor vehicle. The micromobility option considered for the survey is the shared e-scooter service available in the SJMA and the MOM. These e-scooter services are not free of charge, with a price of $1.00 to unlock the vehicle and about $0.28 per minute. The micromobility service requires electronic fare payment using a smartphone application.

The survey instrument included a final question directed toward identifying respondents living in the MOM, including students, that were interested in becoming a participant in the field experiment to test the positive financial incentives.

# Field Experiment of Financial Incentives

The fourth task was the development and execution of the field experiment for testing the effectiveness of positive financial incentives. The experiment was designed to test the potential acceptability and effectiveness of the implementation of positive financial incentives to reduce VMT in private automobiles by promoting the use of e-scooters as a micromobility alternative.

Potential participants from the Municipality of Mayagüez were recruited using the online WTA survey. All the people that stated to be interested in participating in the experiment were UPRM students.

The field experiment was designed as a factorial experiment. Figure 3 shows the scheme used to design the experiment. This design has as a response variable whether the e-scooter was selected or not as an alternative to the automobile to complete the requested trip. The explanatory variables in the experiment were:

- **Financial Incentive.** This covariate referred to the amount of incentive the individual is offered to make the trip on an e-scooter instead of the automobile. The variable had two levels ($15 and $30).
- *Period of the day.* This covariate referred to the time of day when the trip had to take place. The variable had two levels: AM period and PM period. The AM period required the trip to be completed during the morning (from 7 AM to 12 PM). The PM period required the participant to complete the trip during the afternoon (from 1 to 6 PM).
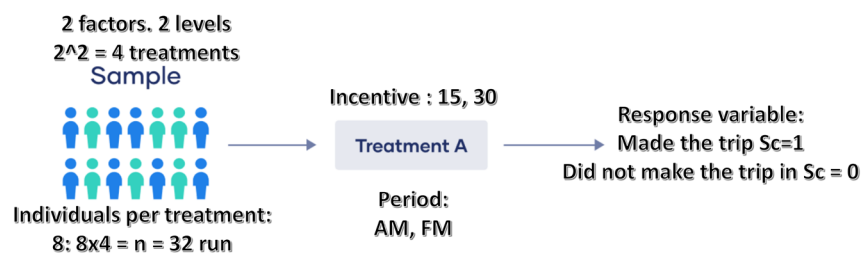


Figure 3. Experimental Design of Field Experiment

The experiment was a factorial of the 2-k type, so four treatments ($2^2$) are required given the number of factors and levels (two variables with two levels for each variable). The experiment was repeated eight times with different subjects, requiring each treatment to have eight observations for a total of 32 observations. A sample of 16 subjects was needed for the experiment. Each subject was exposed to two treatments, therefore each subject had a trial ensuring that everyone is at each factor level (AM, PM; 15, 30). Table 1 shows the variables

used in the experiment and the levels of each variable. The experiment was conducted in April 2023 with 14 subjects. Two subjects decided to not participate after the recruitment process was completed and the experiment was already underway.

### Table 1. Experimental Variables

| Variable | Type of Variable | | Levels | Response |
|---|---|---|---|---|
| **Completed trip using alternative mode** | Factor | Response variable | 2 | 0 = No |
| | | | | 1 = Yes |
| **Incentive** | Factor | Explicative variable | 2 | $ 15 |
| | | | | $ 30 |
| **Period of the day** | Factor | Covariable | 2 | AM |
| | | | | PM |

## Qualitative Method of Follow-up Interviews

Post-experiment interviews were conducted with the participants to explore their reasons or justifications for the decisions taken during the experiment and to better understand the perception and opinion of participants about the long-term use of the e-scooters. A qualitative interview method was implemented to gather a deeper understanding of the participants' mindset and impact in their decision to use an alternative travel mode. The interviews were carried out six months after the experiment. Eleven subjects from the experiment sample were available and completed the interview process. Interviews were conducted through individual online meetings. All interviews were carried out in Spanish, the primary language of Puerto Ricans.

A survey instrument was designed with open questions directed toward the experience and opinions of the participants related to the experiment and the impacts on their travel behavior. The instrument was also directed to assess the factors that influenced the participants' decision to use the e-scooters during and after the experiment (i.e., with and without financial incentives). Three questionnaires were created (referenced in this report as Questionnaire 1, Questionnaire 2, Questionnaire 3) and given out to the subjects based on the trips completed in the experiment. Given that participants had varying degrees of engagement with the incentives, Questionnaire 1 was given to five participants that completed the two scheduled e-scooter trips, hence receiving both incentives. Questionnaire 2 was answered by four participants that made only one of the two scheduled e-scooter trips. Questionnaire 3 was answered by two subjects that did not complete either trip.

Each questionnaire was divided into three sections. The first section was similar for the three questionaries, regardless of how many trips the participant completed. Six questions inquired about the ease of use of the e-scooter application, the usage of e-scooters prior to the experiment, and opinions on the ride safety and the cost of the shared service. The second section was related to the number of trips completed and the purpose for completing the trips or the reasons for not making them. The third section of the questionnaire pertained to the possible changes in behavior and to assess if the experiment had any lasting effect on the participants' travel mode selection decision and the perception of e-scooters as a mobility option. The third section was also similar regardless of the number of trips made and consisted of three questions: the first about the frequency of use of the e-scooter after the experiment, the second about the willingness to use the e-scooter instead of the car after the experiment, and the third on the causes of the decision to use or not use the e-scooter.

# Experts Opinion Survey

The fifth and sixth tasks were related to the design and administration of an Expert Opinion Survey (EOS). The objective of the EOS was to gather the opinions from academicians and practitioners about the feasibility and effectiveness of positive financial incentives to reduce VMT. Eight experts participated with the following expertise: transportation and civil engineering, urban planning, sociology, public policy, law, and economics. The invited professionals are members of professional organizations, such as the Institute of Transportation Engineers, the American Society of Civil Engineers, the College of Engineers and Surveyors of Puerto Rico, the Association of Economists of Puerto Rico and the Puerto Rico Planning Society.

An online questionnaire was developed to obtain the experts' opinions. The questionnaire provided the experts with summarized results from the Travelers' WTA Survey, the field experiment of financial incentives, and the follow-up interviews with the participants. The questionnaire included five sections with twenty-three open questions. Each question included a summary of the most relevant finding for each of the research tasks completed until that moment to give the experts the relevant information for each of the questions. The questionnaire was divided into five sections, that included four questions related to the Travelers' WTA Survey, five questions related to the WTA, four questions related to the Stated Preferences scenarios, two questions related to the Field Experiment, and four questions related to the Follow-up Interviews.

# Analysis of Results

The responses obtained from the online WTA survey were analyzed using a Regression Analysis and a Discrete Choice Analysis. The Regression Analysis was applied to test the effect of socio-economic and demographic factors, amongst others, to preferred stated values of WTA incentives to reduce VMT. Discrete Choice Analysis was applied to the responses from the Stated Preference scenarios. The analysis process included four tasks: exploration data analysis, lineal correlation, regression and discrete choice analysis.

### Exploration Data Analysis (EDA)

EDA is a procedure used to analyze and investigate data sets and their main characteristics, using methods to summarize and visualize data. EDA helps to determine the best way to manage data to obtain the answers needed, to discover patterns, detect anomalies, test hypotheses, or verify assumptions (IBM, 2024).

### Lineal Correlation

The strength of the linear correlation between two variables can be measured with the Pearson's correlation coefficient. The Pearson's correlation coefficient remains unaffected by different units of measurement and is an index easy to execute and to interpret (Alfonso Palmer et al., 2001). The validity of the correlation coefficient relies on the assumptions of linearity and homoscedasticity. A limitation of the coefficient is that it cannot be used to imply causality. If there are two variables X and Y, and the Pearson correlation coefficient between these two variables is defined as $r_{xy}$ then:

$$-1 \leq r_{xy} \leq 1, \tag{1}$$

with values of $r_{xy}$ closer to +1 or -1 indicating stronger linear associations in the dataset.

## Regression Analysis

Linear regression is a procedure that attempts to explain the relationship between a dependent variable and an explanatory variables by fitting a linear equation to the observed data to determine the line that best represents the general trend of a data set (Stewart, 2024). The procedure depends on the normal behavior of the data and the nature of it. If the data does not follow a normal distribution, or the response variable is not a continuous variable, other models should be used, such as generalized lineal models, or GLM. The term GLM refers to a larger class of models where the response variable is assumed to follow an exponential family distribution as link function, like the Poisson distribution that handle discrete variables with no dispersion and the Negative Binomial distribution that handles discrete variable with overdispersion(Dobson & Barnett, 2018; Härdle, 2016). The GLM model is defined as:

$$g(\mu) = \beta_0 + \beta x_i + \varepsilon \tag{2}$$

where:
$g(\mu)$: *link function*
$\mu$: *expected value of y*
$\beta_i$: *calibration coefficients*
$x_i$: *explanatory variables*
$\varepsilon$: *error*

## Discrete Choice Analysis

Discrete Choice models are used to predict a choice from a set of two or more discrete mutually exclusive alternatives

The discrete choice model was used to compute the marginal rate of substitution (MRS) between travel time and the monetary incentive amount. The MRS indicates how much monetary incentive would be required to change given a unit change in the trave time attribute such that the change in the total utility is zero (Hensher et al., 2015). Assuming a linear-in-parameters specification of the deterministic utility function, and that the incentive and travel time parameters are $\beta_I$ and $\beta_T$, respectively, the MRS is computed using:

$$MRS = \frac{\beta_I}{\beta_T} \tag{3}$$

The final two research tasks included the identification of conclusions and recommendations about the potential use of positive financial incentives and possible public policies, and the preparation of this research report. The following sections provide details of the primary data collection activities conducted as part of this research study.

# Chapter 4. Analysis of Results

This chapter presents the discussion of the results obtained from the Travelers' WTA Survey, the field experiment of the financial positive incentives, the follow-up interviews with the participants, and the Expert Opinion Survey (EOS). The discussion of the variables calculated and the results of the regression models estimated is presented in separate sections. The primary variables of interest is the WTA, the number of trips completed from each trial in the experiment, and the main factors and reasons identified by the subjects. In addition, the results from the EOS include the opinions and assessment of the experts about the feasibility of implementing financial positive incentives to reduce VMT.

## Sample Characteristics of the Travelers' WTA Survey

The survey obtained 406 responses. The target population was 2.69 million inhabitants aged 18 years and older in Puerto Rico. After removing incomplete responses, the sample consisted of 336 participants for a 5.2% error at a 95% confidence level. Figure 4 provides the socio-demographic characteristics of the sample. Female participation resulted in a slightly lower percentage than for the Puerto Rico population (52%). The survey was advertised through social media and the UPRM e-mail service, therefore a high percentage of responses were from students (59.5%) and young people (39% of 18-21 years old). The education level and income variables follow the same trend, as the lower income groups and the high-school level had the highest responses.
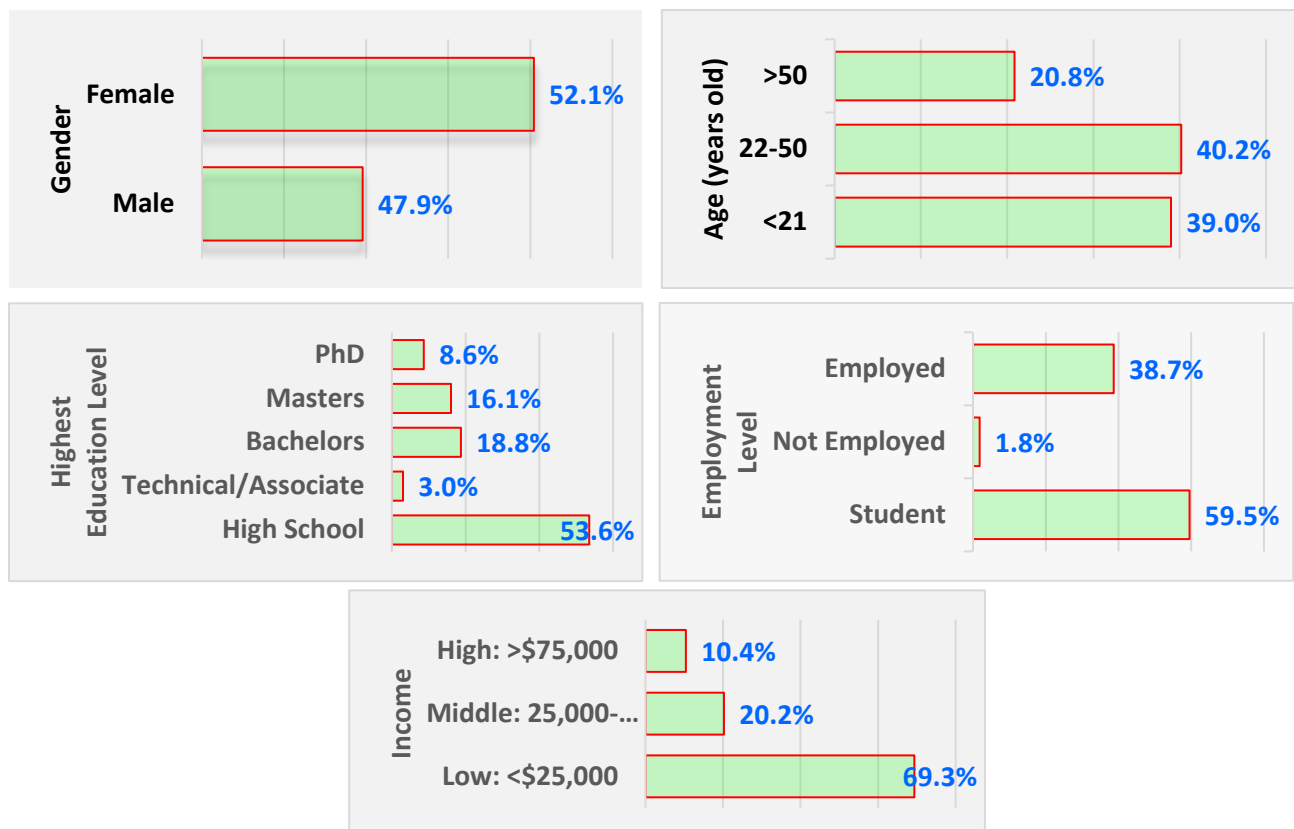


Figure 4. Socio-Demographics Characteristics of the WTA Sample

# Preferred Transportation Mode

Participants were asked to identify their primary transportation mode for commuter or school trips, or for primary trips, if the participant was neither employed or studying. Figure 5 shows the responses for the question. A high percentage (76.5%) of the participants chose the private automobile as their primary mode of transportation. Carpool was the fourth highest response with 3.3%. The U.S. Census data (2022) reports that 82.7% of residents drive alone and 6.2% use carpool for commuter trips. Transit was identified as a primary mode of transportation by only 1.8% of the survey participants. This response is similar to U.S. Census data for the territory, that indicates that only 0.7% of commuter trips are made by transit. The walk option resulted with the seconds highest response with 14%, whereas only 2.5% of the commuter trips are made in that mode (US Census, 2022). The higher walking percentage can be explained as the sample contains a large group of UPRM students.
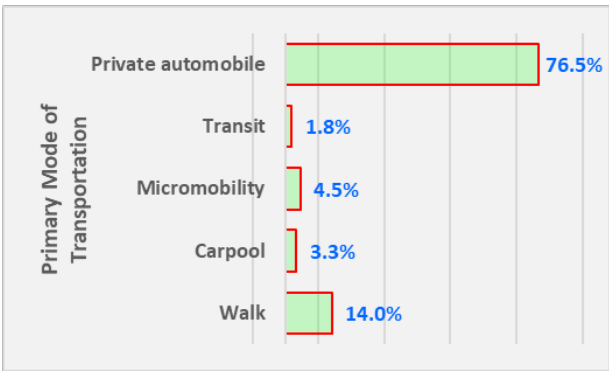


**Figure 5. Transportation Mode Survey Preferences**

Figure 6 shows the responses to the two questions related to the frequency of use of transit (municipal buses of Tren Urbano heavy rail) and e-scooters. Consistent with the results found about the primary mode of transportation, 83.5% and 79.5% of the respondents declared they are not users of transit or e-scooters, respectively. There is a higher usage of e-scooter services (20.6%) in the survey, which could be attributed to the high share of young respondents and students in the sample. A high-frequency user was defined in the survey as a person that selects the mode two or more times in a week. A low-frequency user was then defined as a persons that selects the mode less than two times per week.
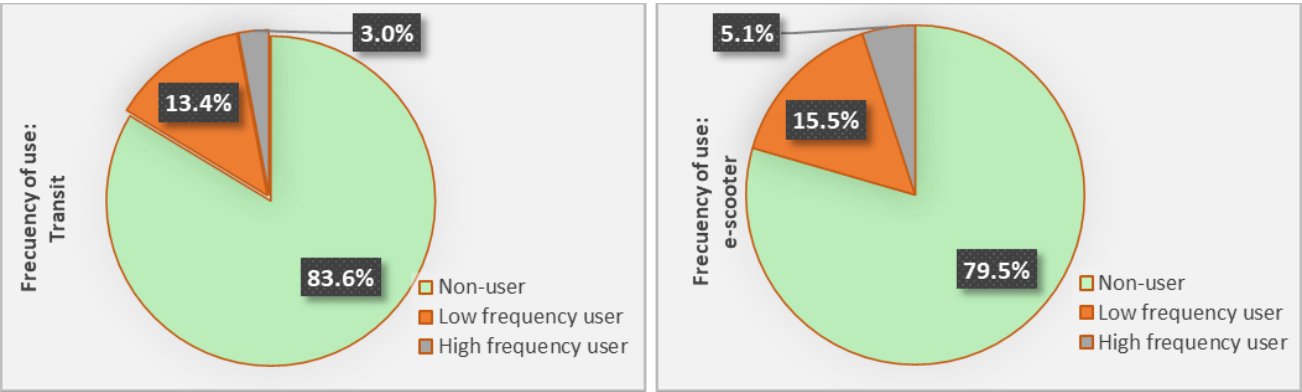


**Figure 6. Stated Frequency of Use of Transit and e-scooter Modes**

Paez and Whalen (2010) found that attitudinal responses impact the desire to travel more or less, including variables that relate to the social environment, availability of local activities, quality of facilities, productive use of the commute, and the intrinsic value found in the commute travel. Their review indicated that the utility of travel depends on three factors: the utility for the activity at the destination, the utility for activities that can be conducted while traveling and the enjoyment of the act of travel itself. Therefore, the attitudes and opinions of the respondents about the quality and service of the alternative transportation modes could be indicative of the expected frequency of use.

Figure 7 shows the responses related to the opinion of the sample about the three alternative transportation modes: municipal buses, Tren Urbano heavy rail and e-scooters. For each mode, the survey presented a Likert-style scale from 1 (very poor) to 5 (very good) for the participants to indicate their opinion. There were 396 responses per question (one per mode). The respondents have a better opinion of the service provided by the shared e-scooter rental service compared to the two transit modes. E-scooters received the highest number of positive opinions (ratings of 4 and 5) with 184 responses (46.5%), whereas Tren Urbano had 120 positive responses (30%) and municipal buses had only 71 (18%). The mean rating per mode was 3.44 for the e-scooter, 3.06 for Tren Urbano, and 2.90 for municipal buses. On the other hand, municipal buses and Tren Urbano received 97 and 90 negative ratings (24.5% and 22.7%), respectively. E-scooters had the lowest number of negative ratings with 47 (12%).
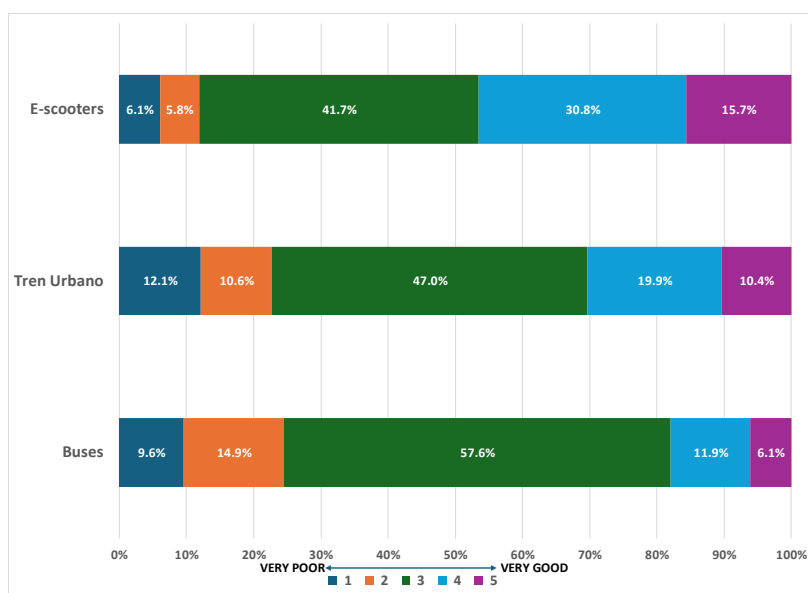


**Figure 7. Stated Opinions of Alternative Transportation Modes**

The mean ratings given to each of the three alternative transportation modes were analyzed taking into consideration the subject characteristics of the sample. Table 2 shows the mean ratings with their standard deviation values for the subject characteristics. The lowest ratings given to the municipal bus option were from subjects in the highest income group (2.43), the middle age group (2.56), not affiliated with the UPRM community (2.62), and with graduate degrees (2.66). In contrast, subjects that did not disclose their income gave the highest rating to the bus option (3.28). For the Tren Urbano option, subjects in the lowest income group (2.84) and in the middle group (2.86) gave the lowest ratings, whereas subjects that did not disclose their income (3.44), those in the oldest age group (3.39), and those in the $15k-$34.9k income bracket (3.32) gave the highest rating. The income variable is of interest in the rating for Tren Urbano. All but the income bracket

under $15,000 had ratings over the mean value for Tren Urbano. Ninety percent of that income bracket was composed of students in the sample. It is also important to note that non-family households in Puerto Rico had a median income of $15,006 as per the U.S. Census (2022). Municipal buses are typically offered free-of-charge to users, whereas Tren Urbano has a cost of $1.50 per one-way trip, which might be related to the lower rating given by the lowest income bracket. For the e-scooter option, the subjects that assigned the lowest mean ratings were those with graduate degrees (3.02), in the highest income bracket (3.11), in the middle age group (3.13), and in the $15k-$34.9k income bracket (3.19). Not surprising, the subject groups that gave the highest ratings to e-scooters were those with high school education (3.63), in the younger age group (3.60), and males (3.58).

**Table 2. Differences in Mean Ratings of Alternative Transportation Modes**

| Variable | Quantity of Responses | Municipal Buses | Tren Urbano | E-scooter |
|---|---|---|---|---|
| Overall | 396 | 2.90 (0.94) | 3.06 (1.10) | 3.44 (1.02) |
| Gender | | | | |
| *Male* | 206 | 2.86 (0.97) | 3.01 (1.08) | 3.58 (1.00) |
| *Female* | 181 | 2.93 (0.91) | 3.11 (1.12) | 3.28 (1.02) |
| *Age* | | | | |
| 18-24 years old | 251 | 3.00 (0.88) | 3.02 (1.03) | 3.60 (0.96) |
| 25-49 years old | 70 | 2.56 (1.16) | 2.86 (1.24) | 3.13 (1.10) |
| ≥ 50 years old | 75 | 2.88 (0.85) | 3.39 (1.12) | 3.21 (1.03) |
| *Highest Education Completed* | | | | |
| High-school | 229 | 3.00 (0.86) | 3.00 (1.02) | 3.63 (0.94) |
| Associate/Bachelor's | 76 | 2.89 (1.05) | 3.14 (1.22) | 3.38 (1.04) |
| Masters/PhD | 91 | 2.66 (1.01) | 3.12 (1.19) | 3.02 (1.08) |
| *Personal Income* | | | | |
| < $15,000 | 214 | 2.92 (0.92) | 2.84 (1.07) | 3.57 (0.97) |
| $15,000 - $34,999 | 43 | 2.88 (0.85) | 3.32 (1.11) | 3.19 (0.96) |
| $35,000 - $74,999 | 50 | 2.74 (1.03) | 3.28 (1.20) | 3.26 (1.06) |
| ≥ $75,000 | 35 | 2.43 (0.98) | 3.11 (1.21) | 3.11 (1.32) |
| Income not disclosed | 54 | 3.28 (0.83) | 3.44 (0.84) | 3.52 (0.90) |
| *Member of UPRM Community* | | | | |
| Study or Work at UPRM | 305 | 2.98 (0.90) | 3.01 (1.03) | 3.49 (0.98) |
| Not UPRM Affiliated | 91 | 2.62 (1.03) | 3.22 (1.28) | 3.27 (1.13) |

*Note: Standard deviation values shown in parenthesis.*

The differences between the mean ratings were also studied to detect patterns in the data. The differences between the three mean ratings were found all to be statistically significant at a 5% significance level. The mean ratings assigned to the e-scooter option by males and females were found to be statistically different with a p-value of 0.003. In terms of age groups, there were significant differences between the 18-24 years old and 25-49 years old for both the buses and e-scooters options (p-values <0.001), and between the 18-24 years old and more than 50 years old for both the Tren Urbano and e-scooters (p-values <0.007) options. The two older groups had different ratings only for the Tren Urbano option (p-value of 0.008). The education variable produced differences in mean ratings for the bus option between the groups with high-school and graduate degrees (p-value of 0.003) and for the e-scooter option between the subjects with graduate degrees and the

two other education levels (p-values < 0.003). In terms of income, all groups resulted in significant differences in mean ratings for the bus option (p-values < 0.009). The difference in mean ratings for the e-scooter option between the two extreme income brackets was also significant with a p-value of 0.01. For the characteristic if the subject was part of the UPRM community, the mean ratings assigned to the bus option was the only statistically different with a p-value of 0.001.

## Decision Factors for Alternative Transportation Modes

The survey included a question to inquiry participants about the importance they assign to specific factors in their decision to use transit or e-scooters. Figure 8a shows the stated importance of six factors related to the use of transit (Tren Urbano or municipal buses). The top three factors that received a high importance rating for the use of transit option are the parking conditions, transit travel time, and travel security. The importance of transit travel time, an internal factor, suggests a low perception of efficiency of transit to compete with a similar automobile trip. Parking availability and fuel cost are recognized external factors that affect automobile demand and tend to favor transit usage. In contrast, the top three factors perceived to have no importance in the decision to use transit are weather conditions, gas price, and service fare. The ranking of the gas price, an external factor, was also recognized as very important or important by 60% of participants (fourth highest). The rating given to the service fare, an internal factor, show a a split decision in the sample about its importance as Tren Urbano and municipal buses were combined in the question.

The first shared e-scooter service started operations in Puerto Rico in 2019 in the city of Mayagüez, Puerto Rico. After three years the service has been extended to other metropolitan areas in the territory, reaching more than 1.5 million trips in the micromobility service. Tuli et al. (2021) explored the factors of the use of e-scooters during the start of service operations in Chicago and estimated the impacts of temporal variables and time-invariant variables on trips completed. Their study found that weather variables, time of week, and gasoline price, as well as socio-demographic, built environment, and neighborhood characteristics had significant influences on e-scooter trips.

Figure 8b shows the stated importance of seven factors related to the decision to use e-scooters. The top three factors rated as having high importance on e-scooter use are the weather conditions, riding safety, and service fare. The tropical weather in Puerto Rico provides ample opportunities for the use of micromobility with warm to hot temperature throughout the year with a seasonality of high rainfall that can also be a temporal deterrence for the use of e-scooters. Safety risks from the street use of an e-scooter are present to participants as the road network does not provide dedicated facilities for micromobility vehicles and the general pavement conditions are not favorable to their safe use. The service fare is an important factor as the shared system uses a pricing fee based on an initial fixed cost and a variable cost based on the vehicle usage time. In contrast, the top three factors rated as having no importance in the decision to use e-scooter are the gas price, parking conditions, and traffic congestion. These factors are intrinsically related to the operation of a motor vehicle; therefore, it could be indicative that some participants do not foresee e-scooters as an alternative to the use of an automobile. This could be related to the typical length of their commute trip or that they reside outside of the e-scooter service area.

Taylor and Fink (2003) summarize there are external and internal influences in the decision to use transit. External factors, such as service area population and employment, are exogenous and cannot be controlled directly by the transit system, whereas internal factors are intrinsic to the service offered as fares and service levels. Their review establish that variables that directly or indirectly influence automobile access and utility, economic and, spatial factors tend to explain the use of transit. In the case of internal factors, Taylor and Fink

(2003) point to improvements in service supply such as frequency, coverage, and reliability to be more important in estimating ridership than transit pricing.
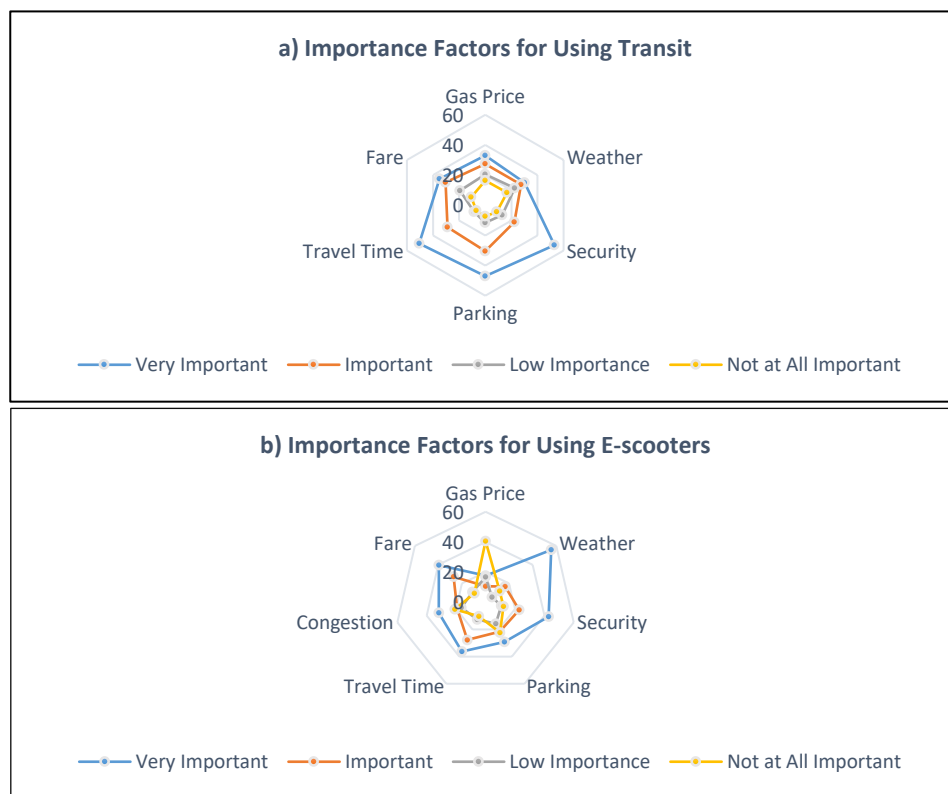


**Figure 8. Stated Importance of Factors in the Selection of e-scooters and Transit**

# WTA Monetary Incentives

Each participant were asked to state what is the minimum monetary incentive they would accept for the use of each of the three alternative modes instead of their automobile for a commute trip. The alternative modes included in the survey were municipal buses, the Tren Urbano heavy rail, and e-scooters. A limit of $100 was established in the survey as a top value for the minimum incentive accepted by the participants. The responses were grouped analyzed by the age and the income of the participants.

Figure 9 shows boxplots with the minimum WTA values stated by the three age groups for their selection of buses, Tren Urbano, and e-scooters as an alternative commuter transportation mode. All the distributions for the WTA values are skewed to the left, as can be observed in the figure. The responses for the WTA values clearly show that the incentive value requested for each of the three alternative modes decreases as age increases. Respondents under 21 years old requested a higher WTA for switching to buses compared to older subjects. Notably, the minimum WTA value decreases for individuals older than 50 years old, indicating they require less incentive to switch their commute trips to a bus. However, the presence of outliers indicate some individuals have higher WTA values. Similarly, for the selection of Tren Urbano, younger subjects under 21 years have a higher WTA to switch their mode compared to older subjects. The WTA value decreases with the age of the subject, with the lowest minimum WTA value for subjects older than 50 years old. Outliers are also observed in these responses, suggesting that some individuals require significantly higher incentives to make the switch. Note also that the oldest age group exhibit the smallest distribution of responses in their WTA value

for Tren Urbano. In the case of e-scooters, respondents under 21 years old have the highest WTA value compared to older subjects. Individuals over 50 years old requested the lowest incentive value to switch trips to e-scooters, as indicated by their lower minimum WTA values. As expected, there are data points that are outliers suggesting varied opinions on e-scooters across different age groups.
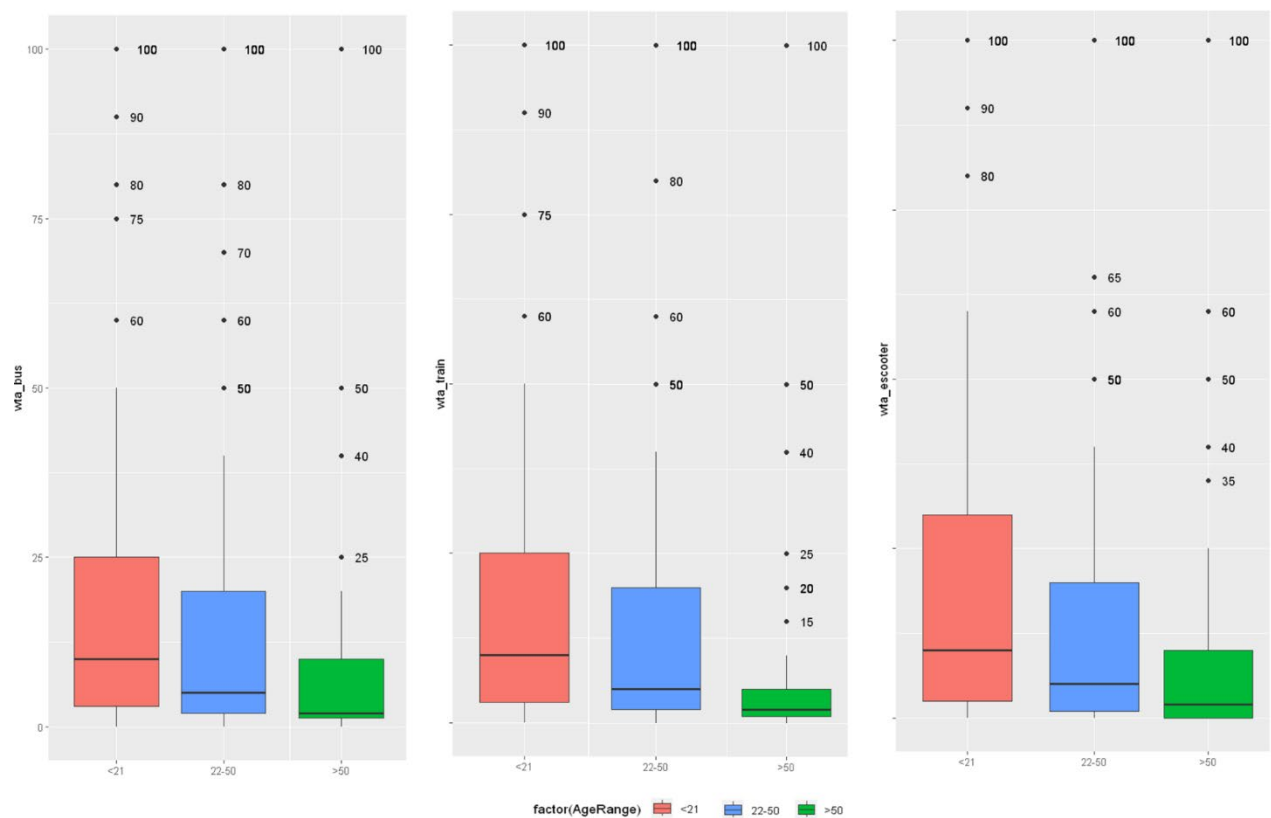


**Figure 9. WTA per Transportation Mode by Age Group**

Figure 10 shows boxplots of the minimum WTA values by the three income groups for their selection of buses, Tren Urbano, and e-scooters. Similarly, the distributions are skewed to the left. The responses for the WTA values show that the incentive value requested for each of the three alternative modes is higher for the lowest income group. For the minimum WTA requested to switch to a bus, the data shows that WTA generally decreases as income increases. Respondents with lower incomes have a higher minimum WTA compared to those with middle and high incomes. Low-income respondents show a relatively higher variation in their WTA, with outliers suggesting a wide range of reluctance to switch to the alternative bus. Similarly, for Tren Urbano, the WTA to switch tends to decrease with higher income. Lower-income respondents require the highest incentives, with a much wider distribution and notable extremely high values. Middle-income and higher income respondents have similar WTA values for the three alternative modes, and with less variation in their responses than the low-income group. Regarding e-scooters, lower-income respondents have the highest WTA, with a significant spread in their distribution. The WTA for higher and middle-income respondents is relatively similar, indicating they require similar incentives.

Table 3 shows the mean WTA values by alternative mode for the sample, by age groups, and by income levels. The income variable was defined in three levels as LOW for values lower than $25,000, MID for values between

$25,000 to $74,999, and HIGH for $75,000 or higher incomes. Overall, the Tren Urbano received the lowest mean incentive value as an alternative to the automobile, whereas e-scooters received the highest mean incentive. An interesting note from the results is that the median WTA values for the three distributions were identical at $5.00. The mean values of the WTA were used to correlate with the results of the regression modeling calibrated for each transportation mode, that are discussed in the following section.
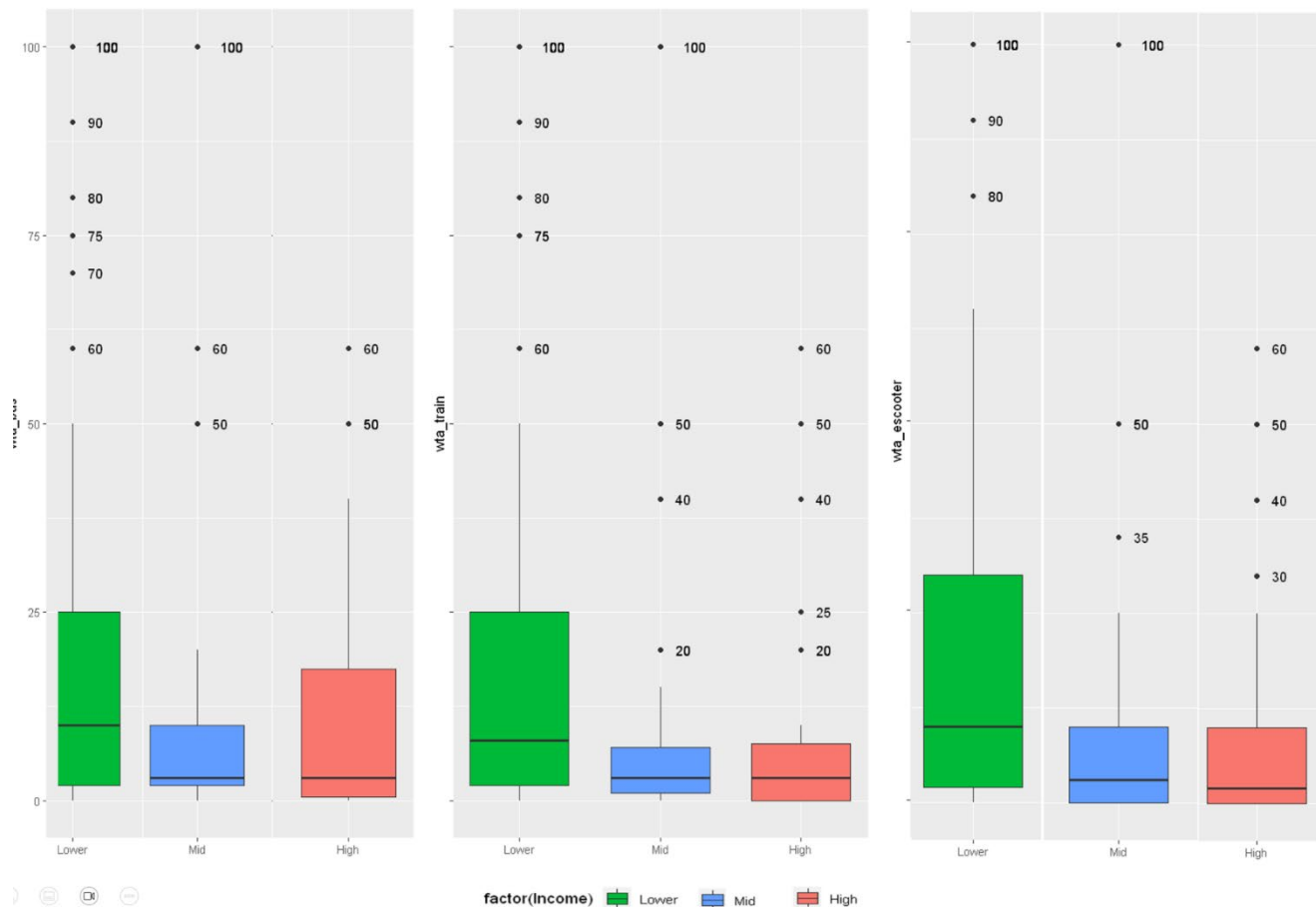


**Figure 10. WTA per Transportation Mode by Income Group**

**Table 3. Mean Minimum WTA Incentive Values by Transportation Mode (US$)**

| Variable | Level | Bus | Tren Urbano | E-scooter |
|---|---|---|---|---|
| Age | <22 years old | 19.33 | 19.67 | 19.82 |
| | 22-50 years old | 22.58 | 19.57 | 21.27 |
| | >50 years old | 8.68 | 8.01 | 12.94 |
| Income | Low | 20.88 | 20.51 | 21.88 |
| | Mid | 13.47 | 10.26 | 13.67 |
| | High | 11.57 | 8.66 | 9.84 |
| Sample | | 18.30 | 17.10 | 18.90 |

When examining differences in WTA responses between age groups, older participants require a lower monetary incentive (i.e., a higher WTA) to use either one of the three modes instead of their automobile (even for e-scooters considering the riding safety concerns established earlier). Consistent with the overall responses, older participants accepted the lowest incentive to use the Tren Urbano, which might acknowledge a better service provided by this mode. In contrast, the middle age group consistently requested the highest incentives to select either one of the three alternatives. Interestingly, the middle-age group required a higher incentive for the use of municipal buses, higher than for the use of e-scooters, which might suggest that bus travel time efficiency concerns are more significant to this group than the e-scooter safety risks. The responses from the subject group with less than 22 years old show they required a practically similar minimum incentive value for the three modes.

The WTA responses by income group might look to be surprising at first and need to be analyzed carefully. There is a clear tendency that suggests that those in higher income levels are more willing to accept lower incentive values to leave their automobile and use alternative modes, in comparison to people in the middle and low-income groups. In the case of the e-scooter, these results could be explained by the literature of micromobility rider characteristics observed in U.S. cities. But how can this trend be interpreted for the two transit modes as it is recognized that persons in low-income groups tend to use more transit? The reason might be associated with the correlation between young people and low-income people in the sample that is highly composed by students. It is important to consider there are additional factors not included in the questionnaire that influence the disposition of the participants to change their transportation mode, like the trip distance, and the service availability and accessibility.

### *Correlations of Age and Income Variables with WTA*

Figure 11 shows scatter plots with the correlations calculated between the WTA values for the buses, Tren Urbano, and e-scooters (wta_bus, wta_train, and wta_escooter), and the Age (AgeRange_Num) and income variables (Income_Num). The correlation between WTA and the age variable shows a negative correlation with different patterns for the three alternative modes. For buses, there is a correlation of -0.115, indicating that as age increases, the WTA for the selection of buses tends to decrease slightly. Tren Urbano has a stronger correlation of -0.145 compared to buses, showing a more noticeable decrease in the incentive as age increases. E-scooters, however, had no significant correlation (-0.075), suggesting that age does not strongly impact the WTA for the selection of e-scooters as an alternative mode.

When examining the WTA incentive versus the income variable, there is a weak correlation of -0.131 for buses, indicating that higher income is associated with a slightly lower incentive to switch to buses for commuter trips. For Tren Urbano, the negative correlation is stronger (-0.180), meaning that a higher income is linked to a greater decrease in the incentive needed to accept the use of trains. E-scooters show a moderate negative correlation of -0.157, suggesting that higher income is moderately linked to a reduced WTA incentive for the use of e-scooters.

In general terms, as age increases, the WTA required compensation for switching from private automobiles to transit decreases, but there is no strong relationship between age and willingness to switch to e-scooters. In terms of income, individuals with higher incomes required lower WTA compensation to switch to public transit or e-scooters, with the strongest negative correlation observed for Tren Urbano. This result indicates that higher-income individuals are much more likely to consider switching to train travel. Overall, both age and income positively influence willingness to switch from cars to other modes of transportation, but the effect is

not consistent across all modes, and it's most pronounced for Tren Urbano, which provides the higher level of service for commuter trips of the three alternative modes included in the survey.
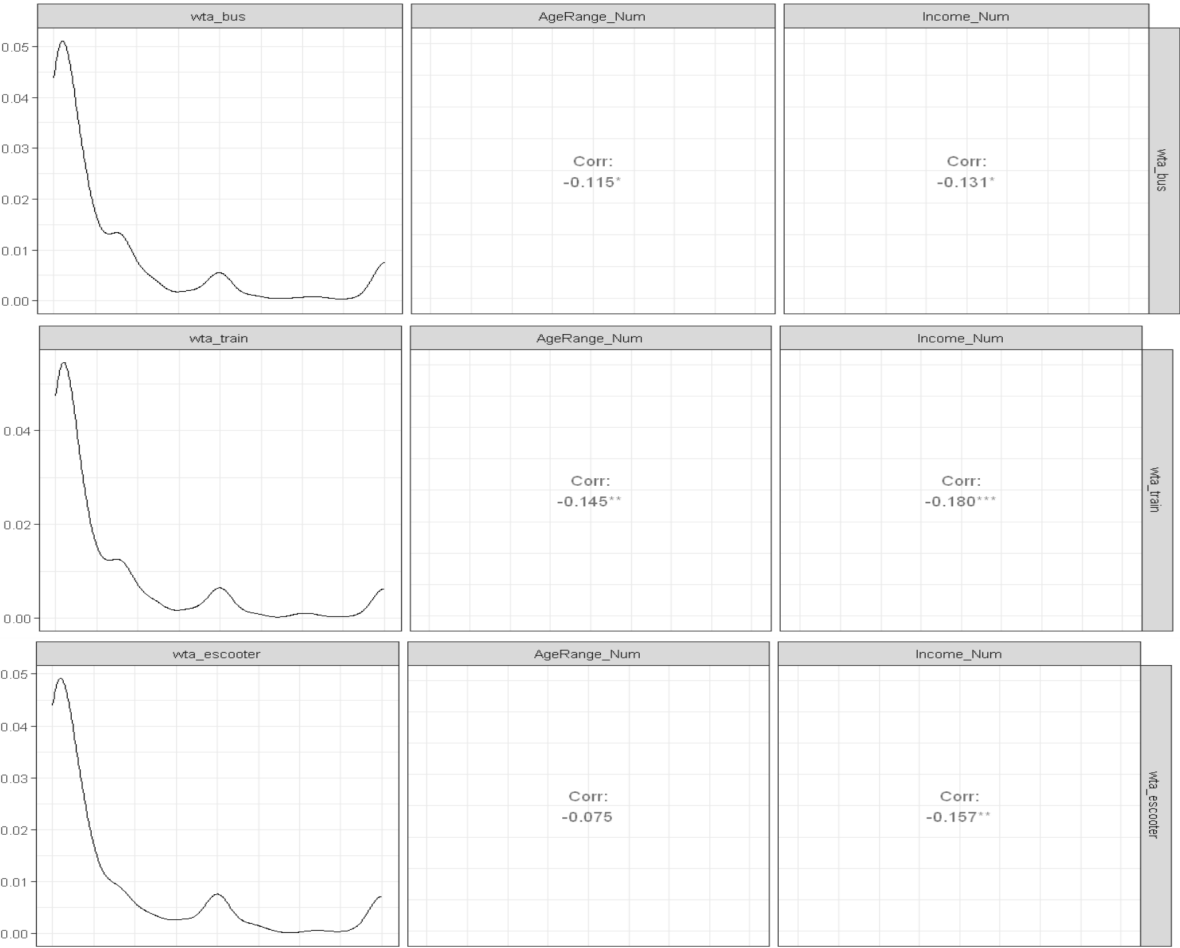


**Figure 11. Correlational Analysis of WTA by Age and Income Variables**

### *Calibration of WTA Incentive Models*

The WTA responses were rounded into whole dollar amounts to calibrate a discrete regression model that explains the effects from the combination of variables. Responses were rounded to the next integer value recognizing the WTA represents the minimum incentive a participant is willing to accept, therefore rounding down (using the conventional method) would violate their willingness and will not ensure the expected behavior. The converted incentives were modeled using the Negative Binomial (NB) discrete probability distribution as the discrete data showed overdispersion. Three regression models were calibrated for each scenario: WTA for Tren Urbano, WTA for Buses, and WTA for e-scooters, using age and income as explanatory variables.

Table 4 shows the NB model calibration results for the three WTA responses. The constant estimate represents the logarithm of the value that the response variable will take concerning the referenced category. The estimates of the parameter coefficients represent the logarithm of the times that variable occurs concerning the referenced category. A negative sign for a parameter coefficient indicates that the estimates will be less

than the average value in the referenced category, whereas a positive sign indicates that the estimates will be higher than the average in the referenced category.

Table 4. Results for the NB WTA Models

| Parameter | β | e^β | t-value | Sig | β | e^β | t-value | Sig |
|---|---|---|---|---|---|---|---|---|
| | WTA Tren Urbano - Age | | | | WTA Tren Urbano - Income | | | |
| Constant | 2.980 | | -23.566 | *** | 2.162 | | 8.701 | *** |
| >50 years old | -0.894 | 0.409 | -4.124 | *** | | | | |
| 22-50 years old | -0.006 | 0.994 | -0.031 | - | | | | |
| Low-income | | | | | 0.860 | 2.364 | -3.235 | ** |
| Mid-income | | | | | 0.170 | 1.185 | 0.556 | - |
| AIC | 2477.00 | | | | 2477.20 | | | |
| | WTA Bus - Age | | | | WTA Bus - Income | | | |
| Constant | 2.964 | | 24.154 | *** | 2.451 | | 10.1 | *** |
| >50 years old | -0.794 | 0.452 | -3.779 | *** | | | | |
| 22-50 years old | 0.155 | 1.167 | 0.899 | - | | | | |
| Low-income | | | | | 0.590 | 1.804 | 2.269 | * |
| Mid-income | | | | | 0.155 | 1.168 | 0.519 | - |
| AIC | 2538.40 | | | | 2548.70 | | | |
| | WTA E-scooter - Age | | | | WTA E-scooter - Income | | | |
| Constant | 2.988 | | 22.049 | *** | 2.288 | | 8.698 | *** |
| >50 years old | -0.425 | 0.654 | -1.842 | * | | | | |
| 22-50 years old | 0.070 | 1.072 | 0.367 | - | | | | |
| Low-income | | | | | 0.799 | 2.223 | 2.836 | ** |
| Mid-income | | | | | 0.331 | 1.392 | 1.023 | - |
| AIC | 2518.70 | | | | 2513.40 | | | |

Notes: β = Coefficient; e^β = How often the variable occurs to the referenced category.
Sig = Significance: <0.001 = '***'; <0.001 = '**'; <0.05 = '*'; >0.05 = '- '

*WTA Models for Tren Urbano*

Two NB models were calibrated: one including the effects of age and another including the effects of income on the WTA. The WTA Tren Urbano-income model shows a negative effect from age. The coefficient estimate for the > 50 years old level is -0.894, meaning that their average WTA is less than for the average value for the reference category (< 21 years old group). The older age group would accept 0.41 times the quantity of the incentive on average, in comparison to the younger group, or an $8.86 incentive. The results show that for the 22-50 years old group, their WTA value, although with a negative effect, is not significantly different from the reference group value. The WTA estimate for this age range is $19.59, which is like the reference age category.

For the income effects model, the average WTA is $8.69. The effect of the two income groups was found to have positive signs. The parameter estimate for the Low-Income group is 0.860, meaning the average WTA for this income group is greater than those of the reference category (High-Income). This group would accept 2.36 times the quantity of the incentive on average, in comparison to the High-Income group, or a $20.53 incentive. The parameter estimate for the Mid-Income group is 0.170, meaning this group would accept on average 1.185 times the incentive in comparison to the reference group. There is no significant statistical difference between

the Mid-Income and High-Income groups concerning WTA. The WTA estimate for this age range is 10.29, a value which is like the WTA for the reference income group.

## WTA Models for Buses

The WTA Bus-Age model shows opposite effects from the two age levels. The coefficient estimate for the > 50 years old level variable is -0.794, meaning that their average WTA incentive is less than for the average value for the reference category (< 21 years old group). The older age group would accept 0.44 times the quantity of the incentive on average, in comparison to the younger group, or an $8.76 incentive, which shows a similar trend as for the Tren Urbano model. In the case of the 22-50 years old group, their WTA incentive value resulted with a positive effect instead but is not significantly different from the reference group value. The WTA estimate for this age range is $22.61, which is like the reference age category.

The results for the WTA Bus-Income model were comparable to those of the WTA Tren Urbano model with positive effects for the two income groups. The parameter estimate for the Low-Income group variable represents this group would accept 1.8 times the quantity of the incentive on average, in comparison to the High-Income group, or a $20.92 incentive. The parameter estimate for the Mid-Income group means this group would accept on average 1.168 times the WTA incentive in comparison to the reference group. There is no significant statistical difference between the Mid-Income and High-Income groups concerning their WTA incentive. The WTA estimate for this age range is 13.54, like the WTA for the reference income group.

## WTA Models for E-scooters

The WTA E-scooter-Age model also shows opposite effects for the two age groups, but with a low statistical significance. The parameter estimates for the >50 years old level is -0.425, meaning their average WTA incentive is less than for the average value for the < 21 years old group. The older age group would accept 0.65 times the quantity of the incentive on average, in comparison to the younger group, or an $12.99 incentive. The WTA incentive value for the 22-50 years old group resulted in a positive effect for a WTA incentive estimate of $21.29 that cannot be considered different than for the younger age group.

The WTA E-scooter-Income model results were found to be also comparable to the WTA Tren Urbano and WTA Bus models with positive effects for the two income groups. The parameter estimate for the Low-Income group means this group would accept 2.22 times the quantity of the incentive on average, in comparison to the High-Income group, or a $21.91 incentive. The parameter estimate for the MID Income was not significant as in the previous two cases, meaning this group would accept on average 1.39 times the incentive in comparison to the reference group. The WTA estimate for this age range is $13.72, like the WTA incentive for the reference income group.

## Stated Preference Models

The Discrete Choice (DC) model is a valuable tool for measuring an individual's preference between different scenarios that can reveal the differences between individuals based on their age or income level, or the difference in characteristics for the alternative modes, such as the travel time, trip cost, or the monetary incentive that influenced the choice. Table 5 shows the calibration results of the utility function of three binary logit models and the Marginal Rate of Substitution (MRS) between travel time and the incentive  calculated for the three alternative transportation scenarios: Automobile vs. Tren Urbano, Automobile vs. Buses and

Automobile vs. E-scooters. The performance of each model is shown in Table 5 with their adjusted rho-square statistics.

**Table 5. Utility Function Parameter Estimates**

| Parameter | Automobile vs. Tren Urbano | | | Automobile vs. Buses | | | Automobile vs. E-scooters | | |
|---|---|---|---|---|---|---|---|---|---|
| | β | t-value | sig | β | t-value | sig | β | t-value | sig |
| Constant | 0.964 | 5.364 | ** | 0.790 | 4.353 | ** | -0.916 | -4.876 | ** |
| Incentive | 0.056 | 2.019 | * | 0.039 | 1.402 | - | 0.008 | 0.307 | - |
| Travel Time | -0.085 | -4.523 | ** | -0.096 | -5.712 | ** | -0.093 | -5.761 | ** |
| <21 years old | -0.417 | -1.723 | * | -0.897 | -3.682 | ** | 1.459 | 5.685 | ** |
| 22-50 years old | -0.626 | -3.862 | ** | -0.842 | -5.256 | ** | 0.170 | 1.093 | - |
| Mid-Income | 0.333 | 1.668 | * | 0.611 | 3.142 | ** | 0.394 | 2.148 | * |
| Low-Income | -0.343 | -1.617 | - | 0.098 | 0.471 | - | -0.600 | -2.738 | ** |
| Bicycle or E-scooter User | 1.450 | 3.766 | ** | 1.356 | 3.703 | ** | 1.673 | 5.054 | ** |
| Carpool User | 1.222 | 2.213 | * | 0.469 | 1.018 | - | 2.187 | 4.792 | ** |
| Transit User | 0.861 | 1.822 | * | 0.295 | 0.690 | - | -1.314 | -2.317 | * |
| Walk User | 0.744 | 2.793 | ** | 0.760 | 2.895 | ** | -0.020 | -0.074 | - |
| $\rho^2$ | 0.183 | | | 0.167 | | | 0.142 | | |
| $\rho^2_{adj}$ | 0.169 | | | 0.153 | | | 0.128 | | |
| \|MRS\| ($/minute) | 1.51 | | | 2.46 | | | 18.77 | | |

*Notes: β = coefficient*

*Sig = Significance:  <0.001 = '**'; <0.05 = '*'; >0.05 = '- '*

*Automobile vs. Tren Urbano Choice*

The estimate of the Incentive parameter shows that as the incentive offered for using Tren Urbano increases it will increase the probability of choosing the Tren Urbano over the automobile option. The negative coefficient of the travel time parameter demonstrates that as the travel time for a trip in the Tren Urbano increases it decreases the probability of the person choosing it over their automobile. Other variables were also included in the model to ascertain their potential effect on the selection of the transportation mode. The age and income of the respondents and their primary mode of transportation were evaluated. Both age binary variables resulted in negative coefficients, which shows their lesser probability of choosing the Tren Urbano over their automobile when compared to the reference group of subjects older than 50 years. The two income binary variables resulted in opposite effects in the model for the Tren Urbano choice model. The Mid-Income group resulted with a positive effect when compared to the reference group (High-Income level). The Low-Income group had a nonsignificant negative effect. In the case of the binary variables representing subject through their primary transportation mode, all resulted in positive effects compared to the reference group (automobile users). These subjects assign a higher utility to the Tren Urbano, and therefore increase their probability of selecting this mode over their automobile. The micromobility users and the carpool users had a higher probability of selecting Tren Urbano.

The estimate for the incentive parameter in this model resulted also with a positive but not significant effect, meaning the incentive does not provide enough motivation to make the choice of buses over the automobile. The main significant effect continues to be the difference in travel time between the choices, indicating that a larger travel time in the bus option significantly decreases the probability of choosing it over the automobile. The effects for the two age groups are negative like in the Tren Urbano choice model, but with a higher significance. The Mid-Income resulted in a positive significant effect, as in the case of Tren Urbano, which explains that these persons have a higher probability of choosing the bus over their automobile when compared to subjects from the High-Income group. Similar to the Tren Urbano model, there are positive significant effects for micromobility and walking users when compared to automobile users, meaning these two groups have a higher probability of migrating to the bus with an incentive. Carpool and transit users resulted in positive but non-significant effects.

*Automobile vs. E-scooter Choice*

Results for the automobile vs. e-scooter model resulted in a negative constant parameter. This could represent that when all the other explanatory variables are zero, the respondents prefer the automobile. Like the automobile vs. buses choice model, the estimate for the incentive variable has no statistical significance. Therefore, there is no evidence that the incentive levels considered provide enough motivation to make the selection of an e-scooter over the automobile. The difference in travel time continues to be the main effect controlling to the mode choice of the participants. The age binary variables have positive effects in this model, contrary to the previous two choice models, which confirms a higher probability of younger persons in choosing e-scooters over automobiles when compared to the reference oldest age group. In terms of income effects, persons in the Mid-Income group are more likely to select e-scooters over the automobile when compared to the High-Income subjects. Persons in the Low-Income group are less probable to select the use of an e-scooter over the automobile. Micromobility users and carpool users have significant positive effects assigning value to the e-scooter over the automobile. Interestingly, transit users have a significant negative effect, which assigns a low utility to e-scooter over the option of using the private automobile.

The results of the three choice models show different MRS values, with the smaller estimate of $1.51 per minute for the Tren Urbano option. The other two mode choices of buses and e-scooters resulted in options with MRS values 1.6 and 7.6 times higher, respectively. This indicates the higher reluctance of subjects in the sample to select those two modes over their automobile. It is important to note, however, that the estimated MRS value for the selection of Tren Urbano was the only one computed in which the incentive parameter was statistically significant.

## Field Experiment of Financial Incentives

The experiment procedures started with meetings with 18 potential participants conducted on April 26 and 27, 2023. At those meetings, the subjects received information about the experiment, the instructions and procedures and were introduced to the NREL OpenPath, a cellphone application that enables people to track their travel modes (NREL, 2024). The OpenPath application was used in the experiment to track the trips made by the participants. After reviewing the eligibility of the participants, only 14 subjects were recruited, ten males and four females. The experiment activities were conducted during May 2 and 3, 2024. The research assistants called each participant during the morning or afternoon on those dates to inform them of their time to make a trip using the e-scooter service and the amount of the incentive. A random order was determined to identify

when calls were going to be made for each subject. Every participant in the experiment had the opportunity to receive $45 as an incentive for completing two trips on the e-scooter service in Mayagüez. One trip could have been required in the morning and the other trip in the afternoon, and receiving a monetary incentive of either $30 or $15. Table 6 shows the experimental treatments of trips and incentives for each of the 14 participants. Two participants withdraw from the experiment after the procedures were initiated and the decision was made to continue without filling those spaces.

**Table 6. Distribution of Experimental Treatments per Subject**

| Treatment | Incentive ($) | Period | Subject Id | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | 15 | AM | 1 | 3 | 5 | 7 | 9 | 11 | 13 | | |
| **2** | 30 | AM | 2 | 4 | 6 | 8 | 10 | 12 | 14 | | |
| **3** | 30 | PM | 3 | 1 | 7 | 5 | 11 | 9 | | | 13 |
| **4** | 15 | PM | 4 | 2 | 8 | 6 | 12 | 10 | | | 14 |

Table 7 shows the number of trips scheduled and completed in the experiment. A total of 28 trips were scheduled. Table 8 shows the results from the perspective of those who made the trip. The main results from the experimental study of financial incentives for the e-scooter service are:

- Of the 14 participants, five made both scheduled trips with incentives. In other words, they completed the two e-scooter trips when the incentives were $15 and $30.
- Of the 14 participants, two completed an e-scooter trip when the incentive was $30, but did not made the trip when the incentive was $15.
- Of the 14 participants, four completed a trip when the incentive was $15, but did not make the trip when the incentive was $30.
- Of the 6 subjects that made only one of the scheduled trips, four completed the trip when the monetary incentive was $15, suggesting that the incentive was not the decisive factor in making the trip, but rather other factors, such as weather, the need to make a trip at the corresponding time, or other factors. The e-scooter lease service is shut down in events of heavy rain for safety purposes.
- Of the five participants who completed both scheduled trips, two were women (50% of the female participants).

**Table 7. Percentage of Trips Scheduled and Completed**

| Condition | Trips done | Programmed trips | % |
|---|---|---|---|
| 15 | 9 | 14 | 64% |
| 30 | 7 | 14 | 50% |
| AM | 7 | 14 | 50% |
| PM | 9 | 14 | 64% |

**Table 8. Distribution of Completed Trips in the Experiment**

| Incentive ($) | Period | | Total |
| --- | --- | --- | --- |
| | AM | PM | |
| 15 | 31.25% | 25.00% | 56.25% |
| 30 | 12.50% | 31.25% | 43.75% |
| Total | 43.75% | 56.25% | 100.00% |

## *Follow-up Participant Interviews*

Participants were interviewed months after the completion of the experiment to follow-up the net impacts on their travel decisions. The results of the relevant questions in the follow-up interviews are summarized below. The purpose of the follow-up interviews was to understand the mindset of the participants during the experiment and their acceptance to the use of e-scooters as an alternative mode of transportation. In addition, the interviews focused to identify if there were lasting changes in the pattern of use of e-scooters after the participants no longer had monetary incentives available. Eleven participants agreed to complete the follow-up survey. The following section presents a detailed summary of the responses obtained from the participants.

### *General Questions*

### Question 1: Have you used e-scooters previous to the experiment?

Despite its simplicity, Question 1 allowed the research team to judge any biases, experience, and judgements the participants had prior to the experiment. The interview process found that 8 out of 11 participants had prior experience with the usage of scooters. This prior usage could have influenced the participants' expectations regarding safety, cost, ease of use, and ease of application use. However, throughout the interview process this variable seemed to have little influence regarding most of the participants. Except for two participants, which were avid users of the e-scooter system prior to the experiment, the remaining six participants with prior e-scooter experience seemed to have used the micromobility system only once or twice as a leisure experience.

### Question 2: How easy is it to use the e-scooter application?

Question 2 was designed as a measure of the easiness of use of the e-scooter access and payment application. As the only method to access the rental service, the application could either be seen as a benefit or a deterrent of the e-scooter use. All 11 participants described the application and its use as "*easy*" with varying degrees of favorability. Out of the 11 participants, six described the application as "easy" to use. Meanwhile, three described it as "*fairly easy*" and 2 found it "*very easy*". On the other hand, two participants noted faults ("*bugs*") within the application that affected their user experience. Notably, one user was charged multiple times for the same trip, which later impacted negatively on his long-term view of the e-scooter service. The other participant which suffered from a payment issue, broke his phone during the e-scooter trip and was unable to complete the payment, and was overcharged for the use of the vehicle (the trip was not completed in the application and the vehicle remained active until the funds in the account were depleted).

## Question 3: How easy is it to find a e-scooter?

The answers of the third question were varied throughout all the participants. In general, the ease of finding a e-scooter was dependent on the location. Most participants described the process with varying degrees of easiness, one participant described it as "*very easy*", two as "*fairly easy*", and five as "*easy*". Meanwhile, two participants described the process as "*relative*", and one participant found it "*difficult*". Those participants which described the process as easy, cited the application's e-scooter map as the principal reason for the simplicity. Those who described finding an e-scooter as relative noted that the time of day, high e-scooter demand, and location were the principal factors for their description. Lastly, the participant which described the process as difficult noted that his current residential area has seen a decline in e-scooter supply, specifically during the time of the experiment.

## Question 4: Would you consider e-scooters to be safe?

As a method of transportation with inherent safety risk factors, the participants' views on the matter were paramount. The participants' answers revolved around three degrees of safety, "*safe*", "*relative*", and "*unsafe*", all of which cited similar and overlapping reasons for said description. Four participants regarded e-scooters as "*safe*", six participants viewed e-scooters as "*relative*", and one participant deemed e-scooters as "*unsafe*". The main factors that participants used to define the level of e-scooter safety were:

- Road conditions and maintenance was seen as a safety risk by eight participants,
- Other vehicles or traffic as a safety risk by five participants cited,
- Lack of dedicated infrastructure for e-scooter travel was viewed as a safety concern by three participants
- Inclement weather and rain were cited two times as a potential risk
- Initial excessive acceleration of the e-scooter was stated to be a risk by one participant, and
- Vehicle concern for individuals with disabilities reported by one participant.

## Question 5: Is the cost of e-scooter usage attractive?

The cost of the use of e-scooters was found to be a determining factor for the participants' willingness to use said method of transportation. General preconceptions of the price of e-scooter usage varied depending on the participant's experience with the system prior to the experiment. After the experiment, views on the price of e-scooter usage remained relatively unchanged. Participants also reached similar conclusions regarding pricing regardless of their description of the cost of usage. Most of the participants described the cost of e-scooter usage as "*low*", with six of the participants reaching that conclusion. Two participants found the price of e-scooters to be "*reasonable*", to say it was neither "*low*" or "*high*". Two other participants found the price of e-scooter usage to be "*expensive*", however their logic for such description overlaps with that of participants which found the cost to be "*low*". Out of the two participants which failed to complete any of the scheduled trips, one had previous experience with e-scooters and had a general notion of the pricing, while the other did not answer the question. Nearly all participants (10) cited that regardless of the pricing of e-scooter usage, the cumulative aspect of the repeated use of the rental service was a deterrent for them to consider e-scooters as a primary transportation method.

## Question 6: Why did you or did you not complete trip 1 and trip 2?

Question 6 was a simple question used to measure tendencies of e-scooter usage. As a note, all participants in the experiment were university students, which could skew the results of this question. All participants were

asked about their reasoning for making or failing to complete their trips. The primary reason given by six of the participants for making the trips was "*university commute/get to class*". One subject cited his reason for making the programmed trips as "*work commute*". Meanwhile, another individual made a trip for "*buying groceries*". One individual did not complete one trip because it was raining and made the other trip citing "*commitment*" to the experiment. Two individuals completed trips solely for the incentive, while another two participants did not complete any trips.

*Trip Specific Questions*

Question 1: Was the completed trip(s) planned or it was motivated by the incentive?

The first question of this section measured the direct impact the financial incentive had on participants. Out of the 11 participants, five stated they were "*motivated*" to complete the trips because of the incentive. Another three participants referred to themselves as being "*highly motivated*" by the incentives offered. Meanwhile, one participant stated to be "*indifferent*" to the incentive, stating he "*sympathized with the investigation and was committed to participate regardless*". The remaining two participants did not completed trips and were not asked this question.

Question 2: Do you have any memories of the trips?

The consensus among the participants was that of having some sort of memory tied to the trips completed. Six participants cited having a memory regarding at least one of the completed trips, while three stated not having any memories. Importantly, this interview was conducted approximately six months after the completion of the experiment. The remaining two participants did not completed trips and were not asked this question.

Question 3: Do you remember the purpose of the trip(s)?

Responses were basically the same provided for Question 6 of Section 1.

Question 4: Would you describe the trips as routine or occasional?

The answers offered by the participants regarding this question were unilateral and seemingly identical. Most participants regarded these trips as "*occasional*" with eight participants describing the trips as so, and only one participant described the experience as "*routine*". Furthermore, eight participants stated that the trips were of "*routine destination and purposes, but the use of e-scooter was occasional*".

Question 5: Do you consider the offered incentive amount to be too much, sufficient, or would you have taken less incentive?

The answers for this question were categorized as "*sufficient*", "*insufficient*", "*would have taken less incentive*", and "*indifferent*". Most participants describe the incentives as "*sufficient*", with six participants in consensus. Only one participant described the incentive as "*insufficient*". Meanwhile, three participants "*would have taken less incentive to complete the trip*". Furthermore, the same individual who was indifferent towards the incentive maintained his position.

## Question 6: What other kind of incentive would you have accepted?

This question helped to understand which substitutes would have been acceptable for participants in the absence of a monetary incentive. Most participants were unable to answer this question without substantial thought. However, key substitutes were repeated among the participants. Most notably, five participants stated that "*food*", be it as a coupon for a free meal, would be an acceptable substitute. The next incentive substitute with the most repetition was "*free rides*" with four participants citing it as acceptable. Two participants also stated that a monthly subscription model in which a user receives unlimited rides during said month would also be acceptable. One participant stated a "*gift card*" would be an acceptable substitute. Another participant recommended a contradictory option stating that a guaranteed "*parking spot*" (for the car) would also be an acceptable substitute, which in essence would contradict the need for the travel incentive altogehter.

## Question 7: What was the reason for not taking your incomplete trip?

Responses were repeated as the ones provided for Question 6 of Section 1.

## Question 8: Was the incentive insufficient to motivate you to take a trip on a e-scooter?

This question was only asked to the four participants that completed one of the two scheduled trips. Three subjects found the incentive "*sufficient*" to motivate them, while one participant deemed it "*insufficient*".

## Question 9: Would you have failed to complete the trip anyway, regardless of the offered incentive?

Out of the four participants which only made one of the two scheduled trips, all of them would have been willing to complete them for a certain amount of incentive. Two participants would have made the trip for the offered incentive, while the remaining two participants would have made the trip for a larger incentive.

### *Section 3: Post-experiment Changes in Usage of E-scooters*

## Question 1: After the experiment have you used e-scooters more or less frequently?

This question was made to measure if the experiment had any lasting effect on the participants' e-scooter usage. Answers were varied with two participants stating they have "*less frequent usage*", two participants saying they had "*no change*" in e-scooter usage from prior of the experiment, four participants stated, "*no further usage*", and one participant stated "*more frequent use*". Furthermore, one participant did not fit into any long-term category stating to use the e-scooter 2-3 more times in sporadic instances; however, this participant showed interest in purchasing a private e-scooter soon. Similarly, another participant increased the use of the alternative travel mode given that he bought a private e-scooter after the experiment.

## Question 2: After the experiment, are you more willing to use a e-scooter over your automobile?

During this question most participants showed conditional willingness to use e-scooters over their automobiles. Eight participants were willing to use an e-scooter over a automobile. The most stated conditions for changing their transportation mode were "*cost*" and "*trip purpose/length*". The remaining participants answered as follows: one participant was "*indifferent*" and two participants were unwilling to change the use of their automobile for an e-scooter.

## Question 3: Regarding the last question, why?

The last question of the interview called for a further explanation regarding Question 2 of Section 3. Generally, answers lacked a majority overlap as participants listed multiple reasons as to why they were or were not willing to use the e-scooter over their automobile. Notably, safety was not mentioned as one of the factors by any of the participants. Participants who were willing to make the change cited: "*gasoline costs*", "*environmental impact of automobiles*", "*convenience*" and "*saving time*" as reasons to change to the e-scooter. Furthermore, the "*proximity of e-scooters*", "*nature of the trip/distance*", and "*e-scooter cost*" were all cited as reasons for not willing to swap to e-scooters. One participant also listed their transportation preferences, stating they preferred walking over e-scooters, and e-scooters over automobiles.

Most participants (8) had used an e-scooter before the experiment but finding them depended on their location. Safety was a major consideration. While some stated safety (4) or relative safety (6) were important, others expressed concerns about general unsafety (1). Street conditions (8) and traffic (5) were seen as the biggest safety risks. The lack of dedicated lanes (3), weather (2), and even initial acceleration (1) were also mentioned. Related to the perception of e-scooter cost, opinions were divided on base cost (low: 6, reasonable: 2, expensive: 2). However, many participants (10) found the cumulative cost for frequent use of an e-scooter to discourage them from using the shared rental service as their main mode of transport. The purpose of the trip included university/class trips as the most common (6), followed by work (1) and personal errands (2). Interestingly, some participants were motivated by the incentive itself (2), while others couldn't participate due to rain (1) or weren't part of the main study (2). The incentive generally motivated participants to make the trip. Most felt it was sufficient (6), with some reporting high motivation (3) or simply being motivated (5). One participant was indifferent but participated anyway in the experiment. While some participants felt the amount of the incentive was good (6), one thought it was insufficient, and three would have accepted a smaller incentive. Alternative incentives mentioned included food, free trips, gift cards, and even a guaranteed car parking spot. Patters of the use of e-scooters after the experiment were mixed. Some used them less frequently (2) or not at all (2), while others maintained their usage (2). However, there were positive lasting changes for some participants: four reported no other use before, one used them more sporadically but wanted to buy an e-scooter, and one even purchased one. Notably, eight participants expressed willingness to use e-scooters again, with four mentioning conditions like cost and trip purpose. Still, one participant remained indifferent, and two refused to switch from theirprivate vehicles.

Overall, the interviews suggest that the incentive program seems was effective in motivating the initial use of the e-scooters as an alternative mode, but a long-term (or enduring) adoption might require addressing cost concerns and potential safety improvements.

# Experts Opinion Survey

The panel of experts provided answers to 23 questions that included summarized relevant results from the WTA survey and the field experiment of financial incentives. The four initial questions in the survey were related to the expertise and qualifications of the experts. Questions 5-23 were related to the study findings. The responses to the questions were grouped into three categories: statements in favor, statements against, and other statements. The questions #10-12, 14, 18, 19 and 23 asked for an explanation from the experts, rather than agreement type questions, therefore the responses were presented in the category of "Other Statements".

The responses and opinions from the experts about the use of financial incentives for promoting alternative transportation modes instead of private automobiles were mixed. Tables 9-27 presents the statements provided by the experts to each of the questions related to the study findings. A summary of the relevant responses is provided after the tables.

### Table 9. Responses to Question 5 About Mode Choice

| *Do you think there are other important factors, in addition to those already mentioned, that users take into account when making a choice of their mode of transport?* | |
|---|---|
| Statements in favor | • The time you use the service, access to other means of transportation.<br>• The frequency and itinerary of service and conditions of the access infrastructure.<br>• Certainty of availability and of actually arriving on time.<br>• Comfort, privacy and individual freedom.<br>• "Habit" means they repeat the habits they know and practice without trying other means.<br>• The marketing of the product and the access of age groups to this type of transportation through cell phone technologies. The spatial distribution in different parts of the city contributes to the easy access of this mode of transportation.<br>• Reliability, punctuality, convenience and accessibility.<br>• Reliability (it arrives on time, when it says it will arrive), reduced headway, and access (getting you to ALL or almost all the places you need or might need to go). |
| Statements against | None. |
| Other statements | None. |

### Table 10. Responses to Question 6 About E-scooter Selection Factors

| *The three most IMPORTANT factors for e-scooter selection were weather, safety, and fare. Do you think that the decision to use an electric e-scooter as an alternative to a private car for a daily trip depends mainly on these factors?* | |
|---|---|
| Statements in favor | • Yes.<br>• Yes.<br>• Yes, but I think a very important factor is the travel time from one place to another.<br>• It is very probable. |
| Statements against | • No. I think that the e-scooter is not a safe vehicle. First, there is no adequate infrastructure for this type of vehicle. Second, many share the road with motor vehicles, which makes driving them dangerous. Third, in the case of use of e-scooters on sidewalks, their speed creates dangers for pedestrians. The speed of e-scooters is higher than that of people walking, which poses a risk to pedestrians. A fact that in my opinion is aggravated when you mix that PR is an aging population, with age people walk a little slower.<br>• No. |
| Other statements | • I understand that the distance of the trip could also be a determining factor, as well as the route of the trip.<br>• It depends on where they live and the type of trip, as well as the profile. For trips to the university, they probably do not have a car or alternatives, and we will have to see where 63% of those subjects in the survey live. |

**Table 11. Responses to Question 7 About Transit Selection Factors**

| | *In the case of public transportation, the factors most identified as IMPORTANT were safety, travel time, and parking availability. Do you think that the decision to use public transportation as an alternative to the private car depends on these factors?* |
|---|---|
| Statements in favor | • Yes, depending on parking availability. Proximity to the service (stop location) could also be an element. The time in which you use the service could be another decision factor for the user.<br>• Yes.<br>• The parking availability option is interesting. Perhaps it denotes that it is understood that the automobile will be used as part of a multimodal transportation strategy.<br>• Definitely.<br>• It is very probable.<br>• Yes, however I understand that meteorological factors affect the use of this type of services. |
| Statements against | None. |
| Other statements | • It depends on those and other factors such as reliability and punctuality, convenience and accessibility to name a few. |

**Table 12. Responses to Question 8 About Transferability of Mode Selection Factors**

| | *Do you think that the importance assigned to the factors in the mode decision indicated by travelers in the survey corresponds to the factors taken into account by travelers from other cities in the world?* |
|---|---|
| Statements in favor | • In general terms yes. However, in the case of Puerto Rico, the almost absolute absence of public transportation alternatives contrasts with most cities in developed countries or in the North of the planet. That is a fundamental difference.<br>• If they correspond and are comparable with other cities.<br>• Yes. A very high group of the sample are people who in some way are linked to one of the most important university centers in PR. This population is much more educated and likely to visit or learn about other cities in the world. |
| Statements against | • No<br>• No |
| Other statements | • Public transportation in Mayagüez is free but is not offered with a high frequency, while other cities in the world have paid public transportation but with a high frequency. I would think that the user decision factors would be different.<br>• It seems to me that there will be a stronger correlation with States of the United States than with other countries given the high dependence on the island on these as a model. |

**Table 13. Responses to Question 9 About WTA of Older Participants**

| Older participants were more willing to accept a smaller monetary incentive for using alternative modes to their car. Do you think age is a factor in accepting an incentive to switch from a private car to another mode of transportation? | |
|---|---|
| Statements in favor | • Yes, age is a factor. However, this could be linked to other factors such as the employment status of this population and the main source of income in the home.<br>• Yes.<br>• Yes<br>• I agree with the premise<br>• Yes. Increasing age produces changes in people's physical capacity, which causes people to decide to use transportation methods that are tailored to their physical reality.<br>• I think it is a factor.<br>• Yes, as much as it implies a different lifestyle (profile), with greater economic security, especially in this sample who most likely have a pension and insured social security, and a mortgage home payed. They do not have similar needs to younger people. |
| Statements against | None. |
| Other statements | • I think age would have to be correlated with income level to be able to offer a definitive answer to this question. A poor person over 50 years of age is likely to have a strong inclination to accept a smaller monetary incentive. |

**Table 14. Responses to Question 10 About WTA of Low-Income Subjects**

| Low-income participants tend to accept greater incentives to select alternative modes to the private car for their daily trips. What do you think is the reason for this behavior? | |
|---|---|
| Statements in favor | Not applicable. |
| Statements against | Not applicable. |
| Other statements | • There may be a correlation of income with age.<br>• Dependency on the private car to travel to different jobs.<br>• They perceive alternative transportation as a luxury.<br>• If that is an empirical data obtained as a finding from the survey, I think it may be due, precisely, to the reasoning that "I have a real probability of obtaining a higher income because it is available, that is, they can offer it to me, and that additional income turns out to be significant, as a proportion of my total income.<br>• Economic need.<br>• The high costs related to the acquisition and maintenance of a private automobile.<br>• They are more receptive to considering transportation options and considering public transportation or other more affordable alternatives.<br>• You have fewer options to provide transportation, less economic security, less income and uncertainty. Possibly the younger you are, the greater the elasticity of transportation costs. It is worth seeing if PRITA (agency in charge of the operation) has the data of Tren Urbano and AMA bus users in these months that have been free to triangulate. |

**Table 15. Responses to Question 11 About Preference of Tren Urbano**

| | *In general, the Tren Urbano heavy rail was the most preferred mode by the participants (lower incentive required) compared to their private car. Why do you understand that the Tren Urbano resulted in a lower incentive requirement?* |
|---|---|
| Statements in favor | Not applicable. |
| Statements against | Not applicable. |
| Other statements | • System visibility, better performance and greater reliability, when compared to bus routes.<br>• It offers the highest degree of reliability to the system user.<br>• Perception of socially positive or preferred response.<br>• Due to the comfort, accessibility, speed with which it reaches destinations, and relatively low price of the service.<br>• Daily users trust the service.<br>• The sample surveyed belongs in some administrative or academic way to the UPRM. This academic profile is prone to traveling and learning about other cities with successful systems, similar to the Tren Urbano.<br>• Because Tren Urbano is appreciated as a mode of greater reliability, punctuality and "comfort".<br>• For those who can use it (live nearby, reach their desired destinations, etc.) it is more comfortable (less stress), reliable, they do not need to find parking, pay a monthly payment of $300+. |

**Table 16. Responses to Question 12 About Preference of Buses and E-scooters**

| | |
|---|---|
| *In the case of buses and e-scooters, people preferred on average a greater amount of money to change their usual decision of selecting their mode of transport. What are the reasons behind requiring a greater incentive to use the bus and e-scooters?* | |
| Statements in favor | Not applicable. |
| Statements against | Not applicable. |
| Other statements | • Idiosyncrasy in favor of the private automobile. Buses have a worse reputation in terms of performance. In the case of e-scooters, it seems that the difference is more marked among adults over 50 years of age, who have less ability to operate an e-scooter.<br>• The increased incentive could compensate for the loss of income from not being able to move between multiple jobs.<br>• Some reasons may be perceived operating capacity (e-scooter) and certainty of availability and on time performance with the bus.<br>• The bus in Puerto Rico has a "bad reputation" for being inefficient in terms of travel time and punctuality on schedule. In the case of e-scooters it seems there is a positive correlation between the safety assumption and the age of the user. That is, the older the age, the greater the insecurity in the use of this mode.<br>• For their economic needs.<br>• Buses: For many years the bus system in PR has been identified with the poorest social strata and many people do not like the use of these systems due to this possible economic class conflict. Furthermore, for many years the vision of citizens is to distrust a system that for a long time is not reliable in its frequency and coverage. E-scooters: Dangers associated with the use of these.<br>• Security and reliability.<br>• The bus is less reliable, but useful at all. This assuming the current level of service. It is very difficult to have buses, except for one route. E-scooters are only in some particular areas, access is limited. Using a e-scooter still requires you to have other options for longer trips, or places without access to e-scooters. The e-scooter can be more for part of a trip and for very short trips. |

**Table 17. Responses to Question 13 About Financial Positive Incentives**

| | *On average, the accepted incentives range was from $8 to $22 per trip. Do you think that the population would really change the use of private cars if they were granted an incentive within this range?* |
|---|---|
| Statements in favor | • I'm not very clear on how frequent this payment is. Is it proposed as a daily, weekly or monthly thing? If it is something daily, the answer is yes.<br>• It is possible that yes, but it will depend on many more variables than just those considered in this study.<br>• I think that this range, even the minimum value, means a really high additional income for an average user, and even more so if it is for each trip made in the week.<br>• It is very probable.<br>• Yes, if it is to make public policies that generate substantial changes. It is important to have persuasive elements, such as these monetary incentives, or as deterrent elements, such as increasing the price of gasoline, parking, closing accesses, etc. However, one issue that must be taken into account is how regressive the deterrent policy may be. Another thing is that perhaps for people with lower incomes, it may be an uncertainty that they will not be able to leave the car because they may not even have it as they are captive passengers of transit. |
| Statements against | • No. The strategy has to be tied to efficient expansion and planning of transportation systems.<br>• No |
| Other statements | • It depends on how reliable the system manages to be. |

**Table 18. Responses to Question 14 About Incentivized Alternative Modes**

| | *According to the survey results, 57.17% of the respondents are willing to use an alternative mode because of the incentive offered. The e-scooter was the least selected mode. What do you think is the reason for this low selection percentage?* |
|---|---|
| Statements in favor | Not applicable. |
| Statements against | Not applicable. |
| Other statements | • The distance of the trip, the route of the trip and the weather conditions of a tropical country.<br>• I think it is a way more focused on the first and last mile of a trip.<br>• The variables identified above would explain this attitude quite a bit.<br>• Mainly the security element, but also the weather may have had to do with that low percentage.<br>• They are not used to this mode of transportation.<br>• "I understand that the operation of e-scooters can be perceived as dangerous."<br>• Less knowledge, the age of the participants and accessibility.<br>• In addition, the respondents' assumptions about the services must be taken into account. When we measure willingness, these assumptions are key. |

**Table 19. Responses to Question 15 About Stated Preferences**

| | |
|---|---|
| *The stated preference results show that the percentage of choosing an alternative mode vs. the automobile increases when the incentive increases. Do these results correspond to reality?* | |
| Statements in favor | • The economic incentive can move the population to change a habit, so it can be real.<br>• I think so.<br>• If a large proportion of the sample is made up of low- and lower-middle-income people, this finding makes a lot of sense. However, for high-income people, the freedom, comfort and independence that the automobile represents should have a great weight in this decision.<br>• If they meet your economic needs.<br>• Yes, the high costs associated with the acquisition and maintenance of a private car make it attractive to accept a good economic offer. |
| Statements against | • They don't seem to be significant. Probably, in the short term it will motivate. In the longer term, other factors may come into play. Costs usually become inelastic in the long run. |
| Other statements | • There could be bias due to the characteristics of the surveyed population.None. |

**Table 20. Responses to Question 16 About Stated Preferences**

| | |
|---|---|
| *The stated preference results show that the percentage of choosing the alternate mode vs. the automobile increases when travel time savings increase. Do these results correspond to reality?* | |
| Statements in favor | • If the alternative mode provides savings in travel time, its use can increase, so it must correspond to reality.<br>• Yes.<br>• This makes a lot of sense, no matter the income level of the person interviewed.<br>• I agree with the premise that the shorter the travel time, the greater the acceptance of the alternative method.<br>• Yes. There is increasing awareness of the economic, physical and mental costs of traveling for many hours in a private vehicle.<br>• We understand that yes, savings in travel time is an important variable, once recognized. |
| Statements against | • I do not think.<br>• They don't seem to be significant. |
| Other statements | None. |

**Table 21. Responses to Question 17 About Effectiveness of Financial Incentives**

| | |
|---|---|
| *What do you think about the effectiveness of offering a financial incentive to generate a change in the pattern of transportation mode choice?* | |
| Statements in favor | • I agree.<br>• This option can be a great alternative for important sectors of our society.<br>• It is a strategy that must be considered as state public policy.<br>• It can generate certain changes. |
| Statements against | • As long as the alternatives to the private vehicle are only for captive users, with a low level of service, and the origins and destinations are distant with no alternative transportation available, this incentive will do little.<br>• It seems that economic incentives fall short when compared to the systemic and structural characteristics of urban transportation in PR. The money is not worth it. |
| Other statements | • I think it would be beneficial to promote public transportation but there has to be an efficient and reliable service.<br>• It would only work with the planning and efficient expansion of transportation systems. An incentive is worthless if it is not supported by a reliable public transportation system. |

**Table 22. Responses to Question 18 About Trips Incentivized**

| | |
|---|---|
| *A smaller percentage of trips can be seen with a greater incentive offered. What could be the cause of this percentage of trips?* | |
| Statements in favor | Not applicable. |
| Statements against | Not applicable. |
| Other statements | • It could be due to the student's travel decisions: weather factors, if the student had to make a trip in the morning hours (classes), the days they traveled. They may be factors not included in the information in the table.<br>• It is not specified if they were the same hours in the morning and afternoon.<br>• There could be several explanations. The first is that the sample was not necessarily large enough to be able to reach conclusions about this behavior. The second is that a considerable number of the 14 students may have had setbacks or changes in their plans, which prevented them from completing the two trips. It is possible that within the sample there are several high-income students who were indifferent to the marginal (additional) income of the second trip. The latter would have to be verified with the income levels of those 14 students.<br>• "The particular obligations they had that day."<br>• A sample of 14 people may not be representative to demonstrate the movement pattern you want to study.<br>• Being students, those who had more money to spend did so in the afternoon, after fulfilling their responsibilities, which generated more trips. |

**Table 23. Responses to Question 19 About Afternoon Trips Incentivized**

| | |
|---|---|
| *Likewise, a higher percentage of trips made in the afternoon period is observed. What could be the cause of this percentage of trips?* | |
| Statements in favor | Not applicable. |
| Statements against | Not applicable. |
| Other statements | • These percentages may be due to student decisions that are not controlled by the study (day of the week in which the student travels, usual time at which the student usually travels, weather conditions, destination of the afternoon trip, etc.)<br>• There could be greater availability of e-scooters than in the morning hours.<br>• Possibly the nature of mobility in the afternoon gives rise to the greater uncertainty in the certainty of arrival that is mostly associated with the more regulated morning work regime.<br>• That during the morning the students have planned in advance in the semester the most convenient method to get to the university. That in the afternoon the mobility alternatives are reduced, which opens the possibilities of accepting alternative means of transportation.<br>• I speculate that they are more likely to use transportation back to their home or place of origin because they don't have a limit.<br>• A sample of 14 people may not be representative to demonstrate the movement pattern you want to study.<br>• See response to question 18. |

**Table 24. Responses to Question 20 About Feasibility of E-scooters as Alternative Mode**

| | |
|---|---|
| **Do you think that using an e-scooter as an alternative mode is feasible to reduce miles traveled by private car and reduce congestion on the roads?** | |
| Statements in favor | • If the environment exists that favors its use - for example, separate lanes for bicycles and e-scooters - it could be an alternative to short-distance trips.<br>• Yes.<br>• In a certain population, with economic incentives and improvements to the infrastructure system to address the security issue perhaps.<br>• It is feasible, but probably not as much as it could be in theory, due to security and infrastructure factors, among others, mentioned in the answers above.<br>• I agree with the premise.<br>• Yes, as well as other modes such as bicycles.<br>• Yes. |
| Statements against | • No. It is complementary. Furthermore, the profile of the elderly population, and the projection, is not favorable for this mode of transportation. It is good for tourists during student season (Spring Break). However, for local students it is expensive. A bicycle is probably cheaper. |
| Other statements | None. |

**Table 25. Responses to Question 21 About Unnecessary Trips**

| | *Do you think offering the incentive motivated participants to make unnecessary trips?* |
|---|---|
| Statements in favor | • Yes.<br>• Yes.<br>• In part maybe yes.<br>• I agree with the premise.<br>• Yes. |
| Statements against | • Not necessarily. The daily agenda of the students is quite specific, from the point of view of their specific commitments.<br>• No.<br>• Not necessarily. |
| Other statements | None. |

**Table 26. Responses to Question 22 About Adequateness of Inventive Program**

| | Do you consider that an incentive program (between $15 and $30) is enough to generate a permanent change in behavior in the population's choice of transportation mode? If you disagree with this premise, what other strategy would you recommend to reduce VMTs? |
|---|---|
| Statements in favor | • It may be feasible, but in conjunction with other changes such as separation of vehicular traffic, increase in restrictions on the use of private cars in the area (higher fare, for example), creation of passive vehicular traffic routes and speed control.<br>• As I mentioned, if those are the minimum and maximum values, there is no doubt that there will be a large number of low-income and middle-income students who will accept it.<br>• I agree with the premise but it wouldn't hurt to offer, let's say, an e-scooter as a prize to the person who has traveled the most miles. |
| Statements against | • I do not think this is enough based on the premise that a user paying between 3-5.00 dollars to use an e-scooter, the incentive does not yield much.<br>• No. We must improve the infrastructure that can accommodate e-scooters and significantly improve the city's transportation network.<br>• No. Improvement of the accessibility and quality of the public transport service, and prioritization of public transport. |
| Other statements | • It is essential to have one or more transportation alternatives other than cars in order to encourage something that works. Otherwise, any measure will be very elastic but only in the short term.<br>• I believe that there should be greater emphasis on providing a comfortable, efficient and safe public transportation system, accompanied by higher costs and limitations on vehicular traffic. The cost of traveling by private vehicle should be significantly higher than public transportation and compete in travel times to encourage greater use. |

**Table 27. Responses to Question 23 About Congestion Public Policy Recommendations**

| *What public policy recommendations do you think would be most effective to implement to reduce congestion on the roads?* | |
|---|---|
| Statements in favor | Not applicable. |
| Statements against | Not applicable. |
| Other statements | • Increase investment in public transportation services, with high frequencies on fixed routes, densification of urban spaces, creation of separated lanes and sidewalks to avoid conflicts with motor vehicles, tax incentives when purchasing monthly passes.<br>• It is essential to rescue the sidewalks and limit free parking spaces, which would represent less parking supply, higher costs and would present public transportation as a viable alternative.<br>• It is necessary to increase and stratify this sample as well as include new variables that do not only have to do with "WTA" type studies only.<br>• Definitely promote mass transportation as the main mobility alternative. This is going to require a huge investment in infrastructure and citizen education, which should result in a change in the way people move from one place to another.<br>• Fine drivers who go alone on express lanes.<br>• Creation of bicycle or e-scooter lanes (it is not safe for them to share the sidewalk space with pedestrians and the use of e-scooters on the roads should not be encouraged due to criteria of their condition and the safety of e-scooter users. Establish lanes exclusive for mass transportation, effective implementation of remote work, effective coordination of all existing means of mass transportation, control of urban sprawl, promote growth poles in different parts of the country that distribute the excessive concentration of employment in the Metropolitan Area of San Juan and provide opportunities for people to work near their town of residence.<br>• Increase investment in public transportation and develop transportation-oriented land use policies.<br>• Tie policies to climate change, support the development of public transportation and others, and not electric cars. Since Tren Urbano is located in the San Juan Metro Area, some monetary incentive policies can be tested along with parking policies, etc. Take into account the Downs-Thomson paradox. Combine incentives with deterrents. |

The Expert Panel provided important feedback and opinions based on their diverse range of expertise. There were questions that obtained a full agreement from the eight experts. The statements in favor show us the agreement level the experts had with the results represented on each question. A summary of the main relevant feedback and opinions on each question is provided as:

- **Additional factors for selecting the transportation mode:** There was an unanimous agreement in the panel about additional mode selection factors beyond those presented in the survey.
- **Factors affecting e-scooter use:** Half the panel (4) agreed weather, safety, and fare are the main decision factors. Two experts disagreed and stated skepticism about whether weather, safety, and fare alone are sufficient to sway e-scooter usage and offered alternative decision factors.
- **Factors affecting transit use:** Six panel members agreed safety, travel time, and parking availability are key factors, with one member adding other reasons.
- **Transferability of mode decision factors:** There was a divided opinion on the panel about the potential for transferability of the decision factors from the survey to other locations. Three members  agreed

that the factors identified by travelers align with those considered by travelers from other cities. Two members disagreed with the statement that the factors identified by travelers in the survey align with those considered by travelers from other cities. Two members were not sure the local mode decision factors apply to other locations.

- **Tendency of accepting a lower incentive with age:** There is total agreement on the panel that age influences the willingness-to-accept incentives for mode switch from a private car to another mode of transportation, indicating a consensus on age-related preferences.
- **WTA incentive range from $8 to $22 per trip**: Five members agreed that incentives within the $8-$22 range could change the decision to use private automobile. Two members stated that the population would not change the use of private cars if they were granted an incentive within this range.
- **Increasing likelihood of selection of alternate modes with increasing incentive and travel time savings:** High agreement of the panel (six members) the results correspond to reality. One of the panel members does not think that the likelihood of the decision to switch to an alternative mode increases as the incentive or the travel time increase.
- **Effectiveness of incentives for changing transportation habits:** Only one panel member agreed the incentives could have a lasting effect. Most panel members (6) were not certain about the potential long-term impact of the incentives. One member was certain that offering a financial incentive would not generate a change in the pattern of transportation mode choice.
- **Potential of e-scooters for reducing congestion:** There was a strong agreement on the panel (7 members) that e-scooters can be a feasible alternative to reduce road congestion. One expert stated against the belief that using e-scooters as an alternative mode is realistic for reducing miles traveled by private cars and reducing congestion on the roads.
- **Incentives will stimulate extra trips:** A panel majority (5) agreed that offering incentives to people might encourage unnecessary trips. Three panel members disagreed and reflected their doubt that offering the incentives motivated participants to make unnecessary trips in the experiment.
- **Effectiveness of incentive programs for permanent change:** Half the panel (4) stated an incentive program is enough to generate a permanent change in behavior in the choice of transportation mode in the population. Three members disagreed with that premise but offered no alternative strategies. One expert was against the idea that an incentive program is enough to generate a permanent change in behavior in the population's choice of transportation mode.

The opinion of the expert panel about the effectiveness of offering a positive financial incentive to change transit mode choice is summarized as follows:

- The implementation of financial incentives is a public policy strategy that must be considered for Puerto Rico.

- The incentive program would be beneficial to promote transit, but the transit network has to be efficient and provide a reliable service to the population.

- The amount of economic incentives in the experiment are low when compared to the systemic and structural characteristics of urban transportation in Puerto Rico.

- The option of financial incentives can be a great alternative for important sectors of our society and can generate changes in the population.

- The incentive program would only work if it is done along with the planning and efficient expansion of transit systems. An incentive program will be insignificant  if it is not supported by a reliable transit system.

The expert panel stated their opinion about the effectiveness of an incentive program between $15 and $30 as follows:

- The incentive program may be viable, but in conjunction with other changes such as the separation of vehicular traffic, increase in travel restrictions on the use of private cars in the urban area, creation of passive vehicular traffic routes and speed control.

- There should be greater emphasis on providing a comfortable, efficient, and safe transit system, accompanied with demand management by higher costs and limitations on vehicular traffic.

- Considering the minimum and maximum values, there is no doubt that there will be a large number of low-income and middle-income students who will accept it.

- It is essential to have one or more transportation alternatives other than private automobiles in order to encourage something that works.

# Chapter 5. Conclusions and Recommendations

This research studied the level of acceptability and effectiveness of the use of positive financial incentives to promote alternative transportation modes that can assist in reducing auto VMTs. The study conducted a survey on opinions about alternative transportation modes and to determine their willingness-to-accept (WTA) monetary incentives to promote transit and micromobility options. A convenience sample of 406 participants was obtained. A field experiment was performed on May 2023 with fourteen students from the University of Puerto Rico at Mayagüez to explore the effectiveness of financial incentives in the selection of e-scooters as a transportation mode. Post-experiment interviews were conducted with the participants to assess their involvement and decisions during the experiment and to identify any potential lasting effects in their use of e-scooters. The final data collection activity included assembling a panel of eight experts with different professional disciplines and experiences to obtain their reactions and comments about the research results and the effectiveness of the potential use of financial incentives and to provide public policy suggestions that can assist in the reduction of auto VMTs. The suitability and significance of the study results relate to the mobility preferences of a local population that markedly uses the automobile as the predominant mode of transportation.

The conclusions of the travelers' WTA survey include the following:
- The automobile is the locally-preferred mode of transportation for about 80% of the survey respondents. The sample included participants with a high use of e-scooters (20.6%), which was attributed to a large share of respondents younger than 21 years old (39%) and students (60%). Transit users were represented by 17% of the sample.
- The shared e-scooter service received a better outlook than the service provided by the two transit modes, particularly from males with a high-school education and of a young age, markedly demostrating the larger appeal the micromobility option has on the younger population.
- The lowest service ratings given to the transit options came from subjects with income over $75,000 and with 25-49 years old.
- The decision to use the shared e-scooter service as an alternative mode to the private automobile for a commute trip depends on factors such as weather conditions, road-related safety risks, and the e-scooter fare. Safety risks from the use of e-scooters are present on a road network with no dedicated facilities for micromobility vehicles. The e-scooter service pricing fees represent a limiting factor for their long-term use as a sustainable travel mode option.
- In contrast, the top three factors with no importance in the decision to use e-scooter are the gas price, parking conditions, and traffic congestion.
- The factors most deemed important by commuters in their decision to select transit as an alternative mode includes the transit travel time, parking conditions, and travel security. The importance of transit travel time, an internal factor, suggests a low perception of efficiency of transit to compete with a similar automobile trip. Parking availability is an external factor recognized as an automobile demand control.
- In contrast, the top three factors stated to have no importance in the decision to use transit are weather conditions, gas price, and service fare. The gas price is a significant external factor, which might represent the high preference for the automobile, or the local aversion to transit in the community. The meaning of the service fare as a relevant internal factor might be ambiguous as municipal buses are offered locally with no service fare to users.
- When analyzing the required monetary incentives per mode, Tren Urbano had the lowest value ($17.30) of the three alternative modes. This finding could signify that participants assigned more utility

to the service provided by the Tren Urbano heavy rail option as an alternative mode to the automobile, compared to the service level provided by municipal buses and e-scooters.

- The level of service and ineffectiveness of municipal buses and the safety risks and pricing scheme of the shared e-scooter services limit the potential of people changing their decision of using the automobile for commuter trips no matter the amount of incentive offered.
- Older persons consistently requested a lower monetary incentive to use alternative modes instead of the automobile, which represents a higher willingness to accept the monetary incentives to select alternative modes compared to other population groups.
- People in the lower income group requested higher monetary incentives to select alternative modes for their commute trips. Overall, both age and income positively influence the willingness of people to switch from cars to other modes of transportation, but the effect is not consistent across all modes, and it was most pronounced for Tren Urbano, which provides the higher level of service for commuter trips of the three alternative modes included in the survey.
- The stated preference models showed that the differences in travel time between the automobile and the alternative modes have a strong effect on the mode selection decision. As the travel time on an alternative mode exceeds the travel time on a similar trip on the automobile, the probability of the person choosing the alternative mode over their automobile decreases. Providing the monetary incentive helps to increase the probability of people selecting the Tren Urbano as an option. Although the positive effect of providing the monetary incentive was also present in the logit models for the municipal buses and e-scooters the effect did not achieve statistical significance.

The conclusions of the field experiment include the following:
- The field experiment was a valuable tool for testing the effectiveness of monetary incentives for the use of e-scooters on members of the student population at the University of Puerto Rico at Mayagüez. Fourteen students agreed to participate that offered incentives of $15 or $30 for the decision to use an e-scooter to complete two trips during the morning or the afternoon periods of a typical weekday. Sixteen of the twenty-four scheduled trips (57%) were completed. Five students (36%) did both incentived trips, six students (43%) completed one of the trips, and three students (21%) did not make any of the incentived trips.
- The results from the field experiment of monetary incentives suggest that e-scooters have potential to become an important travel alternative for the student population, especially if proper riding safety measures and long-term cost considerations are taken. The incentive program seems to have been successful in motivating the willingness of using or acquiring an e-scooter on many of the participating students.

The conclusions of the expert panel survey include the following:
- The panel of experts convened to analyze the main results from the study considerably agreed on the importance of the selection factors for alternative modes to the automobile, but insisted there are a larger combination of internal and external factors of the transportation options that affect the mode selection factors of the population.
- The majority of the panel understand the mode selection decision is based primarily on local attitudes and factors and resisted against the transferability of the decision factors from the survey to other locations.
- Five members of the panel (62%) agreed that monetary incentives within a range of $8-$22 per trip on an alternative mode could change the decision to use a private automobile on most groups of the local population.

- Six members of the panel agreed that there is an increasing likelihood of selecting an alternate mode to the automobile with increases in the incentive and in travel time savings, although the long-term impact after the incentive is no longer available was put into question by seven members of the panel.
- Nevertheless the amount of the incentive offered to people, the effectiveness of implementing a positive financial incentive program to reduce the amount of auto VMTs will depend on the reliability and efficiency of the public transit systems.
- A program of monetary incentives by itself might not be sufficient to make a permanent change in the mode selection behavior in an population with a high dependence for automobile travel, like Puerto Rico, unless the implementation is done alongside transportation service and policy enhancements.

The following recommendations are derived from the study results:
- The implementation of financial incentives is a public policy strategy that should be considered for Puerto Rico. The incentive program would be beneficial to promote transit and micromobility modes, but the transit network has to first be redesigned to provide an effective and reliable service to the population, and the road infrastructure would need to allocate exclusive space for micromobility use.
- The survey results suggest the population has a low opinion of the capacity of transit to efficiently compete with a similar trip in an automobile. The view of reduced transit service quality severely limits the feasibility of positive financial incentives as the amount required of the incentive would reduce the amount of people that could receive it. Therefore, the investment in transit would provide more utility to commuters if the resources are directed toward improvements in the quality of service of existing services than to increase the service supply or the coverage area or to provide an incentive for the use of a degraded or ineffective transportation option.
- The recommendations offered by the expert panel about potential public policies toward the reduction of vehicle miles traveled and traffic congestion include:
  - Increase investment in public transit services, with high frequencies on fixed routes, densification of urban spaces, creation of separated lanes and sidewalks to avoid conflicts with motor vehicles, tax incentives when purchasing monthly passes.
  - Rescue the sidewalks and limit free parking, which would mean less parking supply, higher costs and would present public transportation as a viable alternative.
  - Promote transit as the main mobility alternative. This approach requires a huge investment in infrastructure and citizen education, which should result in a change in the way people move from one place to another.

Future studies should consider an experimental procedure to test the validity of the WTA of monetary incentives in the decision-making of commuter trips in Puerto Rico. It is necessary to increase and stratify the sample of the study as well as include new variables that do not only have to do with "WTA" type studies.

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# Appendix A: IRB Approval and Travelers' WTA Survey

**Comité para la Protección de los Seres Humanos en la Investigación**
**CPSHI/IRB 00002053**
Universidad de Puerto Rico – Recinto Universitario de Mayagüez
Decanato de Asuntos Académicos
Call Box 9000
Mayagüez, PR 00681-9000

## Aprobación de Protocolo

| | |
|---|---|
| **Fecha de Aprobación** | *15 de diciembre de 2022* |
| **Número de Protocolo** | *2022110036* |
| **Título de Protocolo** | *Disposición a utilizar modos de transporte alternativos al automóvil privado.* |
| **Investigador Principal** | *Dr. Carlos Antonio del Valle González* |
| **Tipo de Revisión** | *Project Request* |
| **Aprobación** | *Expedito* |
| **Categoría(s)** | *7* |
| **Dispensa(s)** | *Dispensa de la hoja de consentimiento de adultos para investigaciones con menores.* |
| **Fecha de Vencimiento** | *14 de diciembre de 2023* |

*Cualquier cambio al protocolo o a la metodología deberá ser revisado y aprobado por el CPSHI antes de su implantación, excepto en casos en que el cambio sea necesario para eliminar algún riesgo inmediato para los participantes. El CPSHI deberá ser notificado de dichos cambios tan pronto le sea posible al investigador. El CPSHI deberá ser informado de inmediato de cualquier efecto adverso o problema inesperado que surgiera con relación al riesgo de los seres humanos, de cualquier queja sobre esta investigación y de cualquier violación a la confidencialidad de los participantes.*

**CPSHI / IRB - RUM**
**No. 00002053**
**APROBADO**

**Dr. Betsy Morales Caro**
**Decana de Asuntos Académicos**

**Teléfono**: (787) 832 - 4040 x 3807, 3808 – **Fax**: (787) 831-2085 – **Página Web**: www.uprm.edu/cpshi
**Email:** cpshirum@uprm.edu

# Appendix B: IRB Approval and Survey for Field Experiment

**Institutional Review Board**
**CPSHI/IRB 00002053**
University of Puerto Rico – Mayagüez Campus
Dean of Academic Affairs
Call Box 9000
Mayagüez, PR 00681-9000

## Protocol Approval

| Approval Date | March 28, 2023 |
|---|---|
| Protocol Number | 2023030006 |
| Protocolo Title | Willingness to use alternative modes of transportation to the private car |
| Main Researcher | Prof. Carlos Antonio del Valle Gonzalez |
| Type of Review | Project Request |
| Approval | Expedited |
| Category(ies) | 7 |
| Exemption Request(s) | Exemption of use of adult consent for research with minors form |
| Expiration Date | March 27, 2024 |

Any modifications or amendments to the approved protocol or its methodology must be reviewed and approved by the IRB before they are implemented, except in cases where the change is necessary to reduce or eliminate a potential risk for participants. The IRB must be informed immediately if an adverse event or unexpected problem arises related to the risk to human subjects. The IRB must also be notified immediately if there is any complaint about the research or if a breach of confidentiality has ocurred.

**Dr. Betsy Morales Caro**
**Dean of Academic Affairs**

**CPSHI / IRB - RUM**
No. 00002053
**APPROVED**

**Telephone:** (787) 832 - 4040 x 6277, 3807, 3808 – **Fax:** (787) 831-2085 –**Webpage:** www.uprm.edu/cpshi
**Email:** cpshirum@uprm.edu

# Disponibilidad para participar en el estudio "*Financial Incentives to Reduce Vehicle-Miles Traveled.*"

CONSENTIMIENTO INFORMADO:

1. ¿QUÉ ES ESTE FORMULARIO?
La siguiente información se le provee para que pueda tomar una decisión informada sobre su participación en este estudio. Debe tener 18 años o más para dar el consentimiento informado.

2. ¿QUIÉN ES ELEGIBLE PARA PARTICIPAR?
Individuos de 18 años o más que sean parte de la comunidad universitaria del RUM pueden participar.

3. ¿CUÁL ES EL PROPÓSITO DEL ESTUDIO?
Estudiar la disposición de las personas para usar modos de transporte alternativos al automóvil privado para llevar a cabo sus viajes diarios.

4. ¿CUÁNTO DURA LA PARTICIPACION?
Participar en este estudio debe tomarle aproximadamente de 15 a 25 minutos.

5. ¿QUÉ SE ME PEDIRÁ HACER?
A los participantes se le preguntará su disposición para usar una e-scooter para hacer un viaje en un momento particular a cambio de un incentivo monetario. Cada participante tendrá que tomar la decisión de aceptar o no el incentivo monetario a cambio de hacer el viaje en una e-scooter.

6. ¿EXISTE ALGÚN RIESGO ASOCIADO CON SU PARTICIPACION?
No se prevé ningún riesgo adicional a los participantes del estudio de los que tienen los usuarios del servicio de e-scooters en Mayagüez. Cada participante le será asignado un código en el estudio. Los datos y los resultados del estudio serán publicados de manera agregada por lo cual no se podrá identificar a un individuo en particular.

7. ¿QUIÉN VERÁ LOS RESULTADOS DE ESTE ESTUDIO?
Los resultados podrían ser publicados en revistas o presentados en conferencias. Los datos recopilados serán guardados en un servidor del Recinto Universitario de Mayagüez de la Universidad de Puerto Rico y solo serán accesibles a los investigadores autorizados.

8. ¿RECIBIRÉ ALGUN TIPO DE COMPENSACION MONETARIA POR PARTICIPAR DE ESTE ESTUDIO?
Los participantes que voluntariamente decidan hacer el viaje en una e-scooter recibirán un incentivo monetario luego de completado el estudio.

9. ¿QUÉ PASA SI TENGO UNA PREGUNTA?
Preguntas sobre su participación en la encuesta puede dirigirlas al Sr. Jorge J Quiles Merle, asistente de investigación, al correo electrónico jorge.quiles1@upr.edu.

### 10. ¿QUÉ PASA SI ME NIEGO A PROVEER MI CONSENTIMIENTO?

Su participación es voluntaria, por lo tanto, usted puede negarse a participar o puede retirar su consentimiento y dejar de participar en el estudio en cualquier momento y sin penalidad alguna.

### 11. DECLARACIÓN DE CONSENTIMIENTO VOLUNTARIO DEL SUJETO

Al oprimir el botón llamado "ACEPTO PARTICIPAR EN ESTE ESTUDIO", acepto que he leído y entiendo este formulario de consentimiento, accedo a ser un participante en el estudio y confirmo que acepto el propósito y los procedimientos del estudio, sus beneficios, así como los posibles riesgos que puedo experimentar.

## Información del participante.

Por favor conteste las siguientes preguntas.

1. ¿Vive o se hospeda usted dentro del área marcada en azul en la imagen que identifica la zona de servicio de las e-scooters en Mayagüez?
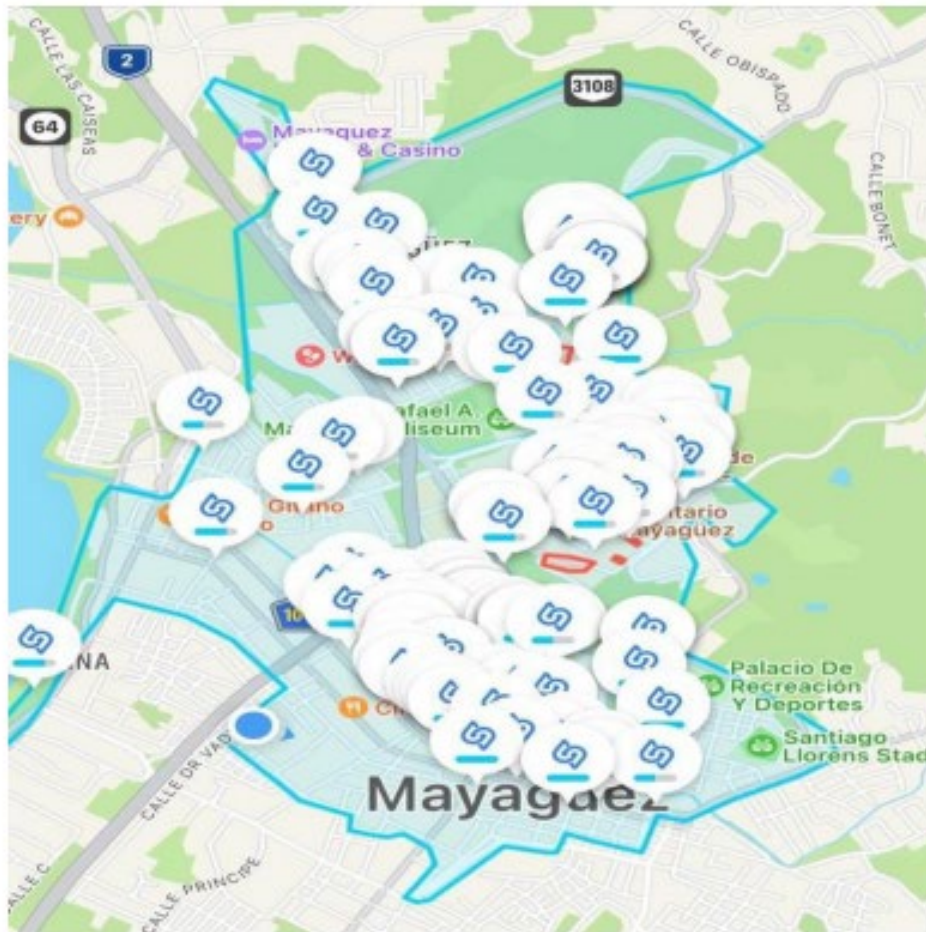


_ Si

_ No

_ No estoy seguro

2. ¿Vive o se hospeda en alguno de los siguientes barrios, urbanizaciones o lugares de Mayagüez?

_ Barrio París

_ Boulevard- Edualdo Baez García

_ Calle Mendez Vigo o Calle de la Candelaria

_ Cond. El Colonial

_ Ensanche Martínez ( Calle Bosque y otros)

_ Ensanche Ramirez

_ Mayagüez Pueblo (Centro Urbano Tradicional)

_ No vivo en ninguno de estos lugares

_ Paseos de Miramar

_ Residencial Candelaria

_ Residencial Columbus Landing

_ Residencial El Carmen

_ Sector Balboa

_ Sector Barcelona

_ Sector Cristy

_ Sector Dulces Labios

_ Sector Trastalleres

_ Urb. La Riviera

_ Urb. Mansiones de España

_ Urb. Mayagüez Terrace

3. ¿Que medio de transporte típicamente usa para sus viajes de su casa/hospedaje al Recinto Universitario de Mayagüez de la UPR?

_ "Carpooling" (pon)

_ "e-sccoter"

_ A pie

_ Automóvil privado

_ Bicicleta

_ Otro

_ Transporte colectivo ("trolley")

4. ¿Cuantos viajes típicamente hace usted en una semana hacia el Recinto Universitario de Mayagüez de la UPR?

5. Indique el género con el que más se identifica.

_ Masculino

_ Femenino

# Appendix C: IRB Approval for Follow-Up Interviews

**Institutional Review Board**
**CPSHI/IRB 00002053**
University of Puerto Rico – Mayagüez Campus
Dean of Academic Affairs
Call Box 9000
Mayagüez, PR 00681-9000

## Protocol Approval

| | |
|---|---|
| **Approval Date** | *November 9, 2023* |
| **Protocol Number** | *2023110001* |
| **Protocolo Title** | *Seguimiento del proyecto Willingness to Use Alternative Modes ofTtransportation to the Private Car (2023030006).* |
| **Main Researcher** | *Carlos Antonio del Valle Gonzalez* |
| **Type of Review** | *Project Request* |
| **Approval** | *Expedited* |
| **Category(ies)** | *7* |
| **Exemption Request(s)** | *Exemption of use of adult consent for research with minors form* |
| **Expiration Date** | *November 7, 2024* |

*Any modifications or amendments to the approved protocol or its methodology must be reviewed and approved by the IRB before they are implemented, except in cases where the change is necessary to reduce or eliminate a potential risk for participants. The IRB must be informed immediately if an adverse event or unexpected problem arises related to the risk to human subjects. The IRB must also be notified immediately if there is any complaint about the research or if a breach of confidentiality has ocurred.*

**Dr. Nancy V. Vicente Vélez**
**Interim Dean of Academic Affairs**

**CPSHI / IRB - RUM**
**No. 00002053**
**APPROVED**

**Comité para la Protección de los
Seres Humanos en la Investigación**

**Phone:** (787) 832 - 4040 x 6277, 3807, 3808
**Fax:** (787) 831 - 2085
**Web Page:** www.uprm.edu/cpshi
**Email:** cpishrum@uprm.edu

**Encuesta de seguimiento experimento sobre incentivos financieros**
**Cuestionario 1. Ambos viajes realizados**
**ID Individuo:**

**A) Cuestionario de seguimiento experimento.**
¿Muy buenos días, conversamos con _____ ?  Se comunica con usted _____ de NICR (National Institude for Congestion Reducction). La razón de nuestra llamada es porque usted figura como parte de las personas que participaron en un experimento sobre el uso de los scooters. El objetivo de este contacto es para realizarle una pequeña encuesta con relación a su experiencia en dicho experimento. Dispone usted de algunos minutos para responder:

| SI | | NO | |
|----|----|----|----|

**B) Preguntas generales.** Queremos saber sobre cuál es su opinión relacionada con la experiencia en el experimento utilizando las scooters.
1. ¿Ha usado el sistema de scooter con anterioridad?
2. ¿Qué tan fácil es usarla aplicación que da acceso al sistema?
3. ¿Qué tan fácil es encontrar las scooters?
4. ¿Es seguro el uso de las scooters?
5. ¿Es el costo de uso atractivo?
6. ¿De los dos viajes programados, porque realizó ambos viajes?

**C) Preguntas relacionadas al viaje realizado.** Queremos saber sobre cuál es su opinión relacionada con el viaje utilizando las scooters.
1. ¿Usted tenía programado realizar ese viaje como sea, o se sintió usted motivado a realizarlo debido al incentivo?
2. ¿Tiene algún recuerdo particular relacionado con el viaje realizado?
3. ¿Recuerda el propósito del viaje?
4. ¿Fue un viaje rutinario u ocasional?
5. Sobre la cantidad de incentivo ofrecida: ¿Fue Mucho, Suficiente o Realizaría el viaje por menos?
6. ¿Que otro tipo de incentivo estaría dispuesto a aceptar?

**D) Preguntas relacionadas al cambio en los patrones de viaje.** Queremos saber si el experimento ha producido cambios en sus patrones de viaje.
1. ¿Después de esta experiencia, ha usado más o ha usado menos el scooter?
2. ¿Después de esta experiencia, estaría dispuesto a usar mas a menudo el scooter en lugar de su automóvil?
3. ¿Sobre la pregunta anterior, por qué?

**N I C R**
**NATIONAL INSTITUTE FOR CONGESTION REDUCTION**

**Encuesta de seguimiento experimento sobre incentivos financieros**
**Cuestionario 2. Un solo viaje realizado**
**ID Individuo:**

**A) Cuestionario de seguimiento experimento.**
¿Muy buenos días, conversamos con _____ ? Se comunica con usted _____,
de NICR (National Institude for Congestion Reducction). La razón de nuestra llamada es porque usted
figura como parte de las personas que participaron en un experimento sobre el uso de los scooters. El
objetivo de este contacto es para realizarle una pequeña encuesta con relación a su experiencia en
dicho experimento. Dispone usted de algunos minutos para responder:

| SI | | NO | |
|----|----|----|----|
| | | | |

**B) Preguntas generales.** Queremos saber sobre cuál es su opinión relacionada con la experiencia
en el experimento utilizando las scooters.
1. ¿Ha usado el sistema de scooter con anterioridad?
2. ¿Qué tan fácil es usarla aplicación que da acceso al sistema?
3. ¿Qué tan fácil es encontrar las scooters?
4. ¿Es seguro el uso de las scooters?
5. ¿Es el costo de uso atractivo?
6. ¿De los dos viajes programados, porque realizó ambos viajes?

**C) Preguntas relacionadas al viaje realizado.** Queremos saber sobre cuál es su opinión relacionada
con el viaje utilizando las scooters.
1. ¿Usted tenía programado realizar ese viaje como sea, o se sintió usted motivado a
realizarlo debido al incentivo?
2. ¿Tiene algún recuerdo particular relacionado con el viaje realizado?
3. ¿Recuerda el propósito del viaje?
4. ¿Fue un viaje rutinario u ocasional?
5. Sobre la cantidad de incentivo ofrecida: ¿Fue Mucho, Suficiente o Realizaría el viaje por
menos?
6. ¿Que otro tipo de incentivo estaría dispuesto a aceptar?

**D) Preguntas relacionadas al viaje no realizado.** Queremos saber sobre cuál es su opinión
relacionada con el viaje no realizado.
1. ¿Cuál fue la razón de no hacer el viaje en scooter?
2. ¿Fue el incentivo insuficiente para motivarlo para hacer un viaje en scooter?
3. ¿No iba a hacer el viaje no importa la cantidad de dinero ofrecida?

**E) Preguntas relacionadas al cambio en los patrones de viaje.** Queremos saber si el experimento
ha producido cambios en sus patrones de viaje.
1. ¿Después de esta experiencia, ha usado más o ha usado menos el scooter?
2. ¿Después de esta experiencia, estaría dispuesto a usar más a menudo el scooter en lugar
de su automóvil?
3. ¿Sobre la pregunta anterior, por qué?

**NICR**
**NATIONAL INSTITUTE FOR**
**CONGESTION REDUCTION**

**Encuesta de seguimiento experimento sobre incentivos financieros**
**Cuestionario 3. Ningún viaje realizado**
**ID Individuo:**

**A) Cuestionario de seguimiento experimento.**

¿Muy buenos días, conversamos con _____? Se comunica con usted _____, de NICR (National Institude for Congestion Reducction). La razón de nuestra llamada es porque usted figura como parte de las personas que participaron en un experimento sobre el uso de los scooters. El objetivo de este contacto es para realizarle una pequeña encuesta con relación a su experiencia en dicho experimento. Dispone usted de algunos minutos para responder:

| SI | | NO | |
|---|---|---|---|

**B) Preguntas generales.** Queremos saber sobre cuál es su opinión relacionada con la experiencia en el experimento utilizando las scooters.
1. ¿Ha usado el sistema de scooter con anterioridad?
2. ¿Qué tan fácil es usarla aplicación que da acceso al sistema?
3. ¿Qué tan fácil es encontrar las scooters?
4. ¿Es seguro el uso de las scooters?
5. ¿Es el costo de uso atractivo?
6. ¿De los dos viajes programados, porque realizó ambos viajes?

**C) Preguntas relacionadas al viaje no realizado.** Queremos saber sobre cuál es su opinión relacionada con el viaje no realizado.
1. ¿Cuál fue la razón de no hacer el viaje en scooter?
2. ¿Fue el incentivo insuficiente para motivarlo para hacer un viaje en scooter?
3. ¿No iba a hacer el viaje no importa la cantidad de dinero ofrecida?

**D) Preguntas relacionadas al cambio en los patrones de viaje.** Queremos saber si el experimento ha producido cambios en sus patrones de viaje.
1. ¿Después de esta experiencia, ha usado más o ha usado menos el scooter?
2. ¿Después de esta experiencia, estaría dispuesto a usar mas a menudo el scooter en lugar de su automóvil?

# Appendix D: IRB Approval and Expert Opinion Survey

**Institutional Review Board**
**CPSHI/IRB 00002053**
University of Puerto Rico – Mayagüez Campus
Dean of Academic Affairs
Call Box 9000
Mayagüez, PR 00681-9000

## Protocol Approval

| | |
|---|---|
| **Approval Date** | *February 22, 2024* |
| **Protocol Number** | *2024020004* |
| **Protocolo Title** | *Financial Incentives to Reduce Motor-Vehicle Miles Traveled - Expert Opinion Survey* |
| **Main Researcher** | *Carlos Antonio del Valle Gonzalez* |
| **Type of Review** | *Project Request* |
| **Approval** | *Expedited* |
| **Category(ies)** | *7* |
| **Expiration Date** | *February 19, 2025* |

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**Dr. Nancy V. Vicente Vélez**
**Interim Dean of Academic Affairs**

**CPSHI / IRB - RUM**
No. 00002053
**APPROVED**

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# FORMULARIO DE CONSENTIMIENTO INFORMADO

**Proyecto:** Financial Incentives to Reduce Motor-Vehicle Miles Traveled

**Investigadores:** Dr. Carlos del Valle González (PI), Dr. Alberto Figueroa Medina y Dr. Daniel Rodríguez Román.

1. **¿QUÉ ES ESTE FORMULARIO?**

   Este Formulario de Consentimiento Informado le provee información acerca de este estudio para que usted pueda tomar una decisión informada sobre su participación. Debe tener 18 años o más para dar el consentimiento informado.

2. **¿QUIÉN ES ELEGIBLE PARA PARTICIPAR?**

   Individuos con 18 años o más pueden participar.

3. **¿CUÁL ES EL PROPÓSITO DE ESTE ESTUDIO?**

   Recopilar la opinión y percepción de funcionarios públicos y profesionales expertos en economía, transportación o planificación urbana sobre la viabilidad y eficacia del ofrecimiento de incentivos financieros a la población para reducir las millas viajadas en vehículos de motor ("vehicle-miles traveled" o VMT).

4. **¿CUÁNTO DURA LA ENCUESTA?**

   Completar este formulario debe tomar aproximadamente de 15 a 20 minutos.

5. **¿QUÉ SE ME PEDIRÁ HACER?**

   Se le pedirá completar un cuestionario, con preguntas abiertas, que se utilizará para obtener su opinión y percepción sobre los resultados de una encuesta y un experimento de campo que fueron usados para estimar la disponibilidad de los individuos de aceptar un incentivo financiero para seleccionar modos alternativos de movilidad en reemplazo a su vehículo de motor.

6. **¿EXISTE ALGÚN RIESGO ASOCIADO CON SU PARTICIPACIÓN?**

   No se prevé ningún riesgo con su participación en este estudio. Ningún participante será identificable por su nombre. Los resultados serán presentados de manera anónima por lo cual de la información ofrecida no se podrá identificar a un individuo en particular. Los nombres de los expertos que participen aparecerán en el informe final pero sus respuestas no estarán atadas a los nombres.

7. **¿QUIÉN VERÁ LOS RESULTADOS Y/O MI DESEMPEÑO EN ESTE ESTUDIO?**

   Los resultados de esta investigación serán publicados en revistas de investigación científica y serán presentados en conferencias y simposios de entidades científicas profesionales. Los resultados podrían ser utilizados por los investigadores aprobados para propósitos internos. Las respuestas de ningún participante serán identificadas por nombre en los reportes o publicaciones. Para mantener la confidencialidad de los archivos y los datos colectados mediante cuestionarios, los investigadores utilizarán códigos para identificar cada sujeto en vez de su nombre. Los datos serán asegurados por el PI y guardados en un repositorio de NICR y serán accesibles por el investigador principal y cualquier otro investigador aprobado para el estudio.

   *Es posible que su archivo de investigación, incluyendo información sensitiva y/o información de identificación, pueda ser inspeccionado y/o copiado por agencias federales o del gobierno estatal, en el curso del desempeño de sus funciones. Si su archivo es inspeccionado por alguna de estas agencias, su confidencialidad será mantenida en la medida permitida por la ley.*

8. **¿RECIBIRÉ ALGÚN TIPO DE COMPENSACIÓN MONETARIA POR PARTICIPAR DE ESTE ESTUDIO?**

   No. Su participación en este estudio es completamente voluntaria.

1

### 9. ¿QUÉ PASA SI TENGO UNA PREGUNTA?

Si tiene alguna pregunta sobre el estudio o cualquier otro asunto relativo a su participación, puede comunicarse con el PI, Dr. Carlos del Valle González al teléfono (787) 217-6125 o al correo electrónico carlosa.delvallegonzalez@upr.edu. Si durante o después del estudio, usted desea discutir su participación o preocupaciones en cuanto al mismo con una persona que no participe directamente en la investigación puede comunicarse con el Comité para la Protección de los Seres Humanos en la Investigación del Recinto Universitario de Mayagüez al (787) 832-4040 ext. 6277 ó 6347 o cpshirum@uprm.edu. En caso de que el participante lo desee, una copia de este formulario de consentimiento informado será proveída para que la guarde en sus archivos.

### 10. ¿QUÉ PASA SI ME NIEGO A PROVEER MI CONSENTIMIENTO?

Su participación es voluntaria, por lo tanto, usted puede negarse a participar o puede retirar su consentimiento y dejar de participar en el estudio en cualquier momento y sin penalidad alguna.

### 11. DECLARACIÓN DE CONSENTIMIENTO VOLUNTARIO DEL SUJETO

Al firmar abajo, yo, el participante, confirmo que el investigador me ha explicado el propósito de la investigación, los procedimientos del estudio a los que voy a someterme y los beneficios, así como los posibles riesgos que puede experimentar. He leído y entiendo este formulario de consentimiento.

_____          _____

Nombre en letra de molde del participante          Fecha

_____

Firma del participante

2

## Cuestionario de Opinión de Expertos (Expert Opinion Survey)

**Proyecto:** Financial Incentives to Reduce Motor-Vehicle Miles Traveled

**Investigadores:** Dr. Carlos del Valle González (PI), Dr. Alberto Figueroa Medina, y Dr. Daniel Rodríguez Román

**ID Cuestionario:** _____

### A. Resumen del proyecto e introducción del cuestionario

Este proyecto estudia la aceptabilidad y el impacto en la selección de modos de transporte de la posible implementación de incentivos financieros positivos con el objetivo de reducir las millas viajadas en vehículos de motor privados (VMT). El proyecto llevó a cabo una encuesta para estimar la disponibilidad de los viajeros de aceptar un incentivo ("willingness-to-accept", WTA) para cambiar su comportamiento y aceptar alternativas de reducción de VMT por medio de preguntas de preferencia declarada y análisis de elección discreta. Un experimento de campo evaluó la aceptabilidad y eficacia de los incentivos financieros positivos para la promoción de alternativas de micro-movilidad para reducir el VMT de los vehículos motorizados privados.

Usted ha sido identificado como recurso experto para completar este cuestionario dada su profesión o ámbito de desempeño profesional en temas relacionados a economía, transportación o planificación urbana. El propósito de este cuestionario es obtener su opinión sobre la viabilidad y eficacia de ofrecer incentivos financieros a los usuarios del sistema de transporte para que estos elijan dejar sus vehículos de motor en el hogar y opten por la utilización de modos alternativos (transporte colectivo o micro-movilidad).

### B. Profesión y experiencia

¿Cuál es su profesión titular o ámbito de desempeño profesional?

¿Cuánto tiempo lleva desempeñándose en esta capacidad?

### C. Encuesta a los viajeros

La encuesta en línea fue administrada del 16 de noviembre de 2022 al 6 de febrero de 2023 y se obtuvieron 407 respuestas de sujetos voluntarios. El 78.8% de la muestra corresponde a personas que viven en Mayagüez, 71.1% trabaja o estudia en el Recinto Universitario de Mayagüez (RUM) y el 62.9% se identificó como estudiante.

1. **Factores de selección del modo de transporte.** A los viajeros se les solicitó que identificaran la importancia de factores en su decisión de seleccionar el transporte colectivo o las e-scooters como modo de transporte. Las gráficas en la Figura 1 muestran los porcentajes obtenidos para la importancia de cada factor en la decisión de seleccionar las e-scooters o el transporte colectivo, respectivamente.



**Figura 1. Factores de importancia**

3

**Preguntas:**

1. ¿Piensa que hay otros factores importantes, además de los ya mencionados, que los usuarios toman en cuenta a la hora de hacer una elección de su modo de transporte?

2. Los tres factores más identificados en la categoría de BIEN IMPORTANTE para la selección de e-scooters fueron el clima, la seguridad y la tarifa. ¿Piensa que la decisión de utilizar un e-scooter eléctrico como alternativa al uso del automóvil privado para un viaje diario depende principalmente de estos factores?

3. En el caso del transporte colectivo, los factores más identificados como BIEN IMPORTANTE fueron la seguridad, el tiempo de viaje y la disponibilidad de estacionamiento. ¿Piensa que la decisión de utilizar transporte colectivo como alternativa al automóvil privado depende de estos factores?

4. ¿Piensa que la importancia asignada a los factores en la decisión del modo indicada por los viajeros en la encuesta corresponde a los factores tomados en cuenta por viajeros de otras ciudades del mundo?

2. **Disponibilidad de aceptar ("Willingness-To-Accept", WTA) incentivos financieros**
El WTA es definido como la cantidad monetaria mínima que una persona estaría dispuesta a aceptar como compensación por usar un bien o servicio ofrecido. En la encuesta a los viajeros se les preguntó sobre la cantidad mínima de dinero que estarían dispuestos a aceptar como incentivo por dejar su vehículo privado y optar por el uso de transporte colectivo (bus o el Tren Urbano) o un servicio de micromovilidad (e-scooter). Los valores promedio del WTA obtenidos en la encuesta se muestran en la Tabla 1.

**Tabla 1. WTA promedio por modo, por edad y por categoría de ingreso**

| Variable | Nivel | Bus | Tren Urbano | E-scooter |
|---|---|---|---|---|
| | < 22 años | 19.3 | 19.67 | 19.82 |
| Edad | 22-50 años | 22.6 | 19.57 | 21.27 |
| | >50 años | 8.68 | 8.01 | 12.94 |
| | Bajo: < $25,000 | 20.9 | 20.51 | 21.88 |
| Ingreso | Mediano | 13.5 | 10.26 | 13.67 |
| | Alto: > $75,000 | 11.6 | 8.66 | 9.84 |
| | Muestra | 18.3 | 17.1 | 18.9 |

**Preguntas:**

1. Los participantes de mayor edad resultaron estar más dispuestos a aceptar un incentivo monetario menor por utilizar modos alternativos a su automóvil. ¿Piensa que la edad es un factor que influye en aceptar un incentivo para cambiar del automóvil privado a otro modo de transporte?

2. Los participantes de ingreso bajo tienden a aceptar mayores incentivos para seleccionar modos alternativos al automóvil privado para sus viajes diarios. ¿Cuál piensa sea la razón de este comportamiento?

3. En general, el Tren Urbano fue el modo más preferido por los participantes (menor incentivo requerido) frente a su automóvil particular. ¿Por qué entiende que el Tren Urbano resultó con un requisito de menor incentivo?

4. En el caso de los autobuses y los e-scooters, las personas prefirieron en promedio una mayor cantidad de dinero para cambiar su decisión habitual de la selección de su modo de transporte. ¿Cuáles son las razones para aceptar un incentivo mayor para usar el autobús y las e-scooters?

4

5. En promedio, los incentivos aceptados fluctuaron entre $8 y $22. ¿Piensa que realmente la población cambiaría el uso del automóvil privado si se le otorga un incentivo dentro de este rango?

3. **Preferencias Declaradas del Modo de Transporte**

En esta sección de la encuesta a los viajeros se les plantearon diferentes escenarios de selección entre el Tren Urbano vs. automóvil, bus vs. automóvil y e-scooter vs. automóvil, con diferentes incentivos y tiempos de viaje según se muestra en la Figura 2. Los resultados de las preguntas de preferencias declaradas se muestran en las Tablas 2-5.
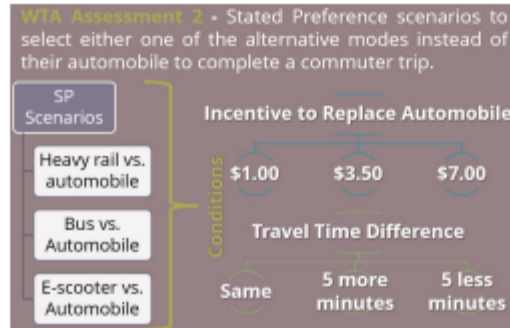


**Figura 2. Escenarios de selección entre modos de transporte**

**Tabla 2. Porciento general de selección**

| No hicieron cambio de modo | % Cambio de modo | | |
|---|---|---|---|
| Automóvil | E-scooter | Bus | Tren |
| 42.83% | 11.77% | 22.39% | 23.01% |

**Pregunta:**

1. Según los resultados en la Tabla 2, el 57.17% de los encuestados está dispuesto a usar un modo alternativo por el incentivo ofrecido. El e-scooter fue el modo menos seleccionado, ¿Cuál piensa es la razón para este bajo porcentaje de selección?

**Tabla 3. Porcentaje de elección entre e-scooter vs. automóvil**

| Cambio en tiempo de viaje (min) | Incentivo (US$) | | |
|---|---|---|---|
| | 1 | 3.5 | 7 |
| 5 más en e-scooter | 7.79% | 7.79% | 8.01% |
| 0 | 10.82% | 11.26% | 12.55% |
| 5 menos en e-scooter | 13.85% | 13.85% | 14.07% |

5

**Tabla 4. Porcentaje de elección entre bus vs. automóvil**

| Cambio en tiempo de viaje (min) | Incentivo (US$) | | |
|---|---|---|---|
| | **1** | **3.5** | **7** |
| 5 más en bus | 8.76% | 9.10% | 9.33% |
| 0 | 10.92% | 12.51% | 12.06% |
| 5 menos en bus | 11.60% | 13.31% | 12.40% |

**Tabla 5. Porcentaje de elección entre Tren Urbano vs. automóvil**

| Cambio en tiempo de viaje (min) | Incentivo (US$) | | |
|---|---|---|---|
| | **1** | **3.5** | **7** |
| 5 más en tren | 9.41% | 9.63% | 10.08% |
| 0 | 10.85% | 11.63% | 11.96% |
| 5 menos en tren | 11.63% | 12.40% | 12.40% |

<u>Preguntas:</u>

2. En las Tables 3-5 se observa que el porcentaje de elección del modo alterno vs. el automóvil aumenta cuando aumenta el incentivo. ¿Estos resultados responden a la realidad?

3. En las Tablas 3-5 se observa que el porcentaje de elección del modo alterno vs. el automóvil aumenta cuando aumenta el ahorro en tiempo de viaje. ¿Estos resultados responden a la realidad?

4. ¿Qué piensa acerca de la efectividad de ofrecer un incentivo económico para generar un cambio en el patrón de elección del modo de transporte?

**D. Experimento de Campo**

El experimento de campo se llevó a cabo en mayo de 2023 con 14 estudiantes del RUM, donde se les ofreció un incentivo económico a cada uno por la oportunidad de completar un viaje usando una e-scooter en un momento del día. A los sujetos se les ofreció un incentivo de 15 o 30 dólares para realizar dos viajes: uno en la mañana y otro en la tarde, respectivamente, con la finalidad de que estos no usaran su vehículo de motor privado. El experimento fue diseñado con 14 sujetos voluntarios y 28 viajes programados, de los cuales los sujetos completaron el 57.14%. Los resultados de viajes completados por periodo e incentivo se muestran en la Tabla 6.

**Tabla 6. Viajes completados en el experimento de campo**

| Incentivo (US$) | Periodo del Dia | | Total |
|---|---|---|---|
| | **am** | **pm** | |
| 15 | 31.25% | 25.00% | 56.25% |
| 30 | 12.50% | 31.25% | 43.75% |
| **Total** | **43.75%** | **56.25%** | **100.00%** |

<u>Preguntas:</u>

1. Se puede apreciar un porcentaje menor de viajes con un incentivo mayor ofrecido. ¿Cuál podría ser la causa de este porcentaje de viajes?

2. De igual forma se observa un mayor porcentaje de viajes realizados en el periodo de la tarde. ¿Cuál podría ser la causa de este porcentaje de viajes?

6

Los 14 sujetos que participaron del experimento fueron invitados seis meses después a contestar una encuesta de seguimiento. El propósito de la encuesta de seguimiento fue entender la mentalidad de los participantes y su recepción en el uso de los e-scooters. Además, se quería verificar si hubo cambios en el patrón de uso de las e-scooters luego de que los participantes ya no tenían disponibles los incentivos monetarios. Once participantes accedieron a completar la encuesta de seguimiento. Las respuestas a las preguntas relevantes se presentan a continuación:

Experiencia general con e-scooters:
- 8 participantes tenían experiencia previa con el uso de e-scooters.
- La facilidad para encontrar una e-scooter depende de donde ellos se encontraban.

Seguridad de los e-scooters:
- SEGUROS - 4 participantes
- SEGURIDAD RELATIVA - 6 participantes
- INSEGUROS - 1 participante

Factores identificados como riesgo para la seguridad en el uso de los e-scooters:
- Las condiciones de la calle y su mantenimiento - 8 participantes
- El tráfico vehicular - 5 participantes
- La falta de infraestructura dedicada para e-scooters - 3 participantes
- El clima y la lluvia - 2 participantes
- La aceleración inicial de los e-scooters - 1 participante

Razonabilidad del costo por el uso de los e-scooters:
- POCO COSTO - 6 participantes
- RAZONABLE - 2 participantes
- CARO - 2 participantes
- 10 participantes indicaron que el aspecto cumulativo del pago por el uso repetitivo de las e-scooters los desmotivan para considerar las e-scooters como un modo de transporte principal.

Propósito principal de hacer los viajes:
- llegar a la universidad/clase - 6 participantes
- ir al trabajo - 1 participante
- buscar comida - 1 participante
- por el incentivo - 2 participantes
- no hicieron los viajes - 2 participantes
- estaba "comprometido" con el experimento - 1 participante
- no completó debido a la lluvia - 1 participante

Comentarios sobre el incentivo:
- "muy motivados" por el incentivo - 3 participantes
- "motivados" a completar los viajes por el incentivo - 5 participantes.
- "indiferente" respecto al incentivo - 1 participante ("simpatiza con la investigación y estaba comprometido a participar de todos modos")

- "incentivo fue suficiente" - 6 participantes
- "insuficiente"- 1 participante
- "hubieran tomado menos incentivo" - 3 participantes

- Otros tipos de incentivos que los participantes hubieran aceptado: "comida", "viajes gratis", "tarjetas de regalo" y un "estacionamiento garantizado para su carro"

Cambios en patrones de uso de e-scooters después del experimento:
- "uso menos frecuente" - 2 participantes
- "no habían tenido cambios" - 2 participantes
- "ningún otro uso" - 4 participantes

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- usaba con mayor frecuencia - 1 participante
- usado 2-3 veces más esporádicamente y mostró interés en comprarse un e-scooter - 1 participante
- había comprado un scooter privado - 1 participante
- dispuestos a usar e-scooters sobre el automóvil - 8 participantes (4 participantes indicaron condiciones para el cambio de método de transporte: "costo", "propósito del viaje/largo del viaje
- "indiferente con cambiar su automóvil para usar e-scooter - 1 participante
- "negativos a cambiar su automóvil por un e-scooter - 2 participantes

**Preguntas:**

1. ¿Piensa que usar una e-scooter como modo alternativo es viable para lograr reducir las millas viajadas en automóvil privado y reducir la congestión en las carreteras?

2. ¿Piensa que ofrecer el incentivo motivó a los participantes a hacer viajes innecesarios?

3. ¿Considera que un programa de incentivos (entre $15 y $30) sea suficiente para generar un cambio permanente de conducta en la elección del modo de transporte de la población? Si no está de acuerdo con esta premisa, ¿Qué otra estrategia recomendaría para reducir los VMTs?

4. ¿Qué recomendaciones de política pública piensa que sería más efectiva implementar para lograr reducir la congestión en las carreteras?

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# NICR
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The National Institute for Congestion Reduction (NICR) will emerge as a national leader in providing multimodal congestion reduction strategies through real-world deployments that leverage advances in technology, big data science and innovative transportation options to optimize the efficiency and reliability of the transportation system for all users. Our efficient and effective delivery of an integrated research, education, workforce development and technology transfer program will be a model for the nation.

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