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OPEN

# Examining the effects of climate change perception and commuting experience on the willingness to pay for micro-transit service in Tampa, FL

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As cities increasingly look for sustainable transportation options to alleviate congestion and solve the “first mile, last mile” problem, micro-transit has emerged as a promising solution. However, to ensure the long-term success of micro-transit programs, it's essential to establish sustainable funding strategies. This research aims to investigate what factors influence people's willingness to pay for micro-transit, with a particular focus on their perceptions of climate change and their commuting experiences. Additionally, the study explores the differences in experiences between current micro-transit users and non-users. Using the Downtowner service in downtown Tampa as a case study, we conducted online surveys in July 2020, gathering responses from 706 micro-transit users and 311 non-users. We then applied statistical analysis to understand the factors affecting willingness to pay. This study sheds light on the relatively underexplored topic of willingness to pay for micro-transit and its connection to climate change perceptions, contributing to existing research. Furthermore, recognizing differences in preferences between these groups provides valuable insights for tailoring strategies to encourage willingness to pay. As policymakers and transportation agencies aim to combat climate change and promote sustainable transportation, understanding these factors becomes increasingly important for developing effective and eco-friendly mobility solutions.

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## Introduction

In recent times, micro-transit has emerged as a potential solution to alleviate congestion caused by single-occupancy vehicles and address the “first mile, last mile” problem in urban centers (Alonso-Mora et al., 2017). Micro-transit operates like jitneys, providing flexible routes and schedules, and is defined by the U.S. Department of Transportation as a privately owned shared transportation system with both fixed and on-demand options (U.S. DOT, 2017). Transit agencies are partnering with transportation firms to experiment with micro-transit services, such as Chariot in San Francisco and TransLoc in California, with the aid of technology. However, sustainable financing strategies are essential to ensure the long-term viability of micro-transit programs (Hawkins, 2019).

Understanding the effectiveness of micro-transit is complex because it combines aspects of ride-hailing services and public transit. While ride-hailing services can complement public transport by extending service hours and reaching areas with limited coverage, they may also compete with public transit during certain hours and in well-covered areas (Alonso-González et al., 2018; Jin et al., 2019). To make informed decisions about pricing and funding, assessing people’s willingness to pay (WTP) for micro-transit is crucial. WTP represents the maximum price a consumer is willing to pay for a product (Nyga et al., 2020). Table 1 indicates the typical examples of WTP research for ride-hailing, public transit, and other emerging mobility services. Existing studies have primarily focused on the WTP of current service users, leaving a gap in understanding WTP among individuals who have not used the service yet. As non-users could be potential target audiences for micro-transit services, it is essential to separately investigate their WTP to understand their preferences and potential adoption of the service.

Moreover, climate change perceptions also influence people’s attitudes towards sustainable transportation options. Major transportation network companies (TNCs) have shown commitment to climate and environmental responsibilities by implementing emission-mitigating measures (Brugger and Watts, 2021; Kong et al., 2023), which may increase individuals’ willingness to invest in climate change mitigation. However, as indicated in Table 1, relevant WTP research has not considered climate change perceptions in their research. Positive willingness to pay for public transit services has been driven not only by a desire to donate to charities but also by a recognition of responsibility for climate change and its impacts on future generations (Lorenzoni et al., 2007; Kwan and Hashim, 2016). Given the growing concern over climate change, it is pertinent to investigate how climate change perceptions may influence people’s willingness to pay for micro-transit services, which are more sustainable and eco-friendly modes of transportation.

To address this research gap, this study aims to understand the determinants of WTP for micro-transit and develop a sustainable funding mechanism for micro-transit agencies. Specifically, two

research questions are explored: (1) Do climate change perceptions influence people’s WTP for micro-transit? (2) Do commuting experiences affect people’s WTP for micro-transit? By separately considering the perspectives of both users and non-users, this research seeks to comprehensively answer such research questions. To this end, we conducted surveys to gather insights into people’s WTP for micro-transit. By understanding the factors influencing WTP, policymakers and micro-transit agencies can develop pricing strategies that cover operational costs and attract more users.

## Literature review

**Willingness to use and pay for ride-hailing.** Several studies have explored WTP for ride-hailing services from different perspectives. First, sociodemographic characteristics have been found to be crucial determinants of WTP for ride-hailing services. Laws (2009) found that students and retired people are dominant users, while female respondents tend to be more hesitant due to security and privacy concerns (de Souza Silva et al., 2018). Alemi et al. (2018) conducted their investigation by employing binary logit models, using the California Millennials Dataset to analyze the adoption patterns of Uber and Lyft among this particular demographic group. The study’s findings shed light on the preferences and trends of well-educated and higher-income individuals, providing valuable insights into the ride-hailing phenomenon within this specific segment of the population. Häme (2013) proposed mathematical models that can be used to simulate the operations of public transport services in a wide range of scenarios, from paratransit services for the elderly and disabled to large-scale demand-responsive transport services designed to compete with private car traffic. Häme’s models take into account a crucial assumption: the influence of private car ownership on users’ willingness to pay (WTP) for ride-hailing services as an alternative to using their own vehicles. Additionally, older people in rural areas have a higher WTP for ride-hailing services, but they do not always prefer the most flexible options (Schwarzlose et al., 2014; Li et al., 2022).

Second, commuting and travel behavior also play a significant role in WTP for ride-hailing. Less frequent transit users are more likely to choose ride-hailing over frequent transit users. However, potential long-term effects such as increased vehicle miles traveled and congestion may affect people’s WTP for ride-hailing services (Rodier et al., 2016; Wenzel et al., 2019; McCoy et al., 2016). Specific preferences for ride-hailing are observed in customers traveling to commercial districts and airports (Feigon and Murphy, 2016; Rayle et al., 2016), and demand-response transport services are commonly used for social activities and shopping in spare time (ActiveAge, 2008). Regarding micro-transit specifically, as a relatively new type of ride-hailing service, researchers have explored various tools and methods to

**Table 1 A summary of findings from the literature.**

Authors (Year)	Willingness to pay	Determinants
Nickkar et al. (2023)	Shared automated vehicles	Travel time, walking to the meeting point, convenience, delay and waiting time, privacy
Alemi et al. (2018)	Uber	Education, age, land-use mix, regional accessibility by car, distance of trip
Schwarzlose et al. (2014)	Public transit	Type of route, days of operation choice, Hours of operation choice
Hou et al. (2020)	Ride-hailing trips	Income level, day of week, duration
Waluyo et al. (2022)	Motorcycles for ride-hailing	Maximum coverage distance, employment status
Wang et al. (2021)	Autonomous vehicle	Age, family members’ health conditions, commuting conditionals, and household incomes
Tsouros et al. (2021)	Mobility-as-a-service	Employment, flexibility of work, income, age, gender, education
Dong (2020)	Uber and Public transit	Gender, income, trip duration, waiting time
Awad-Núñez et al. (2021)	Public transit	Mobility habits, sociodemographic

understand individuals' willingness to use these services. Rudloff and Straub (2021) developed the MyTrips survey tool for collecting stated preference-off-revealed preference (SP-off-RP) data based on respondents' actual mobility behavior. Miah et al. (2020) identified barriers to adopting on-demand micro-transit, such as difficulties in accessing and using the system. Expanding the micro-transit service area may encourage more riders to switch from paratransit to micro-transit. Liu et al. (2019) proposed a unified framework to design, optimize, and analyze mobility-on-demand operations within a multimodal transportation system, considering passenger capacities and mode choice predictions.

Third, ecological motivations and climate change mindsets lead to a different WTP for ride-hailing services (Nyga et al., 2020). Specifically, major Transportation Network Companies (TNCs) have implemented various emission-mitigating measures, such as introducing car-pooling services in major cities, incentivizing hybrid and electric vehicles, and offering carbon-offset purchases for rides (Pratt et al., 2019). Interestingly, the general public's willingness to invest in climate change mitigation may be higher than commonly assumed. Research by Brugger and Watts (2021) found that the main motivation for a positive WTP for ride-hailing is not just a desire to donate to charities and causes but rather a recognition of responsibility and accountability for climate change, driven by a genuine belief in the detrimental effects of climate change on future generations.

Moreover, looking into the future, climate change not only leads to overall warming temperatures but also increases the frequency of extreme weather events (Almazroui et al., 2021). The Sierra Nevada Mountain range, in particular, may experience more extreme rainfall and snow events, which could have significant impacts on the TNC business, affecting the companies, individual drivers, and customers (Wang and Kotamarthi, 2015). These changes have shown varying impacts on drivers and customers. Some drivers may prefer not to operate under unfavorable weather conditions, such as extreme heat or rainfall, while customers are more likely to rely on TNCs instead of driving their own cars during such times (Yang et al., 2021). Consequently, during periods of fewer available drivers, the demand for TNC services increases (Shokoohyar et al., 2020). This aligns with previous research, which identified heat conditions in arid hot climates as a major deterrent for customers using public transport (Dzyuban et al., 2021).

**Willingness to use and pay for public transit.** The existing literature extensively examines the impact of sociodemographic characteristics on WTP for public transit, but the findings remain debated. High income has been associated with lower usage of public transit (Jou and Chen, 2014). Some studies suggest that females are more inclined to use public transit (Nurdden et al., 2007), while others find that female users are less likely to pay for public transit (Farber et al., 2014). Moreover, better-educated, higher-income, and older individuals are more likely to pay for on-demand transit services (Dong, 2020). However, the age of adults between 18 and 55 seems to have no significant effect on their choice of public transit (Chee and Fernandez, 2013; Bai et al., 2021; Zhai et al., 2019B), while other studies suggest that older age groups are less likely to pay for public transit (Farber et al., 2014). The relationship between age and WTP for public transit is complex, as each age class may have a different level of dependency on public transport. For example, elderly people may be more willing to pay for public transit due to safety concerns related to driving (Dellinger et al., 2002). Nonetheless, the findings from these studies are not consistent, and Schade and Schlag (2003) argue that the effects of

income and related socio-economic variables on WTP are expected to be relatively low.

Furthermore, individuals' experiences with public transit and car ownership significantly influence their WTP for public transit. Although public transit users may be price-sensitive, they are willing to pay more for accurate transport information services provided through webpages or Apps (Denant-Boëmout and Petiot, 2003; Molin and Timmermans, 2006). Car ownership may reduce perceived dependence on public transport, leading to lower WTP for public transit. Price discounts can have substantial short-term effects on increasing adoption, such as offering free rides during specific periods (Sharaby and Shiftan, 2012; Zhai et al., 2019A). However, the long-term effect of fare discounts on attracting more users to use and pay for public transit is limited (Goodwin, 1992).

**Research gaps.** The concept of micro-transit has experienced significant growth in recent years, yet there is a noticeable lack of research concerning the willingness to pay (WTP) for such services. Micro-transit can be seen as an extension of ride-hailing, while also sharing similarities with traditional public transit due to its larger capacity. Existing literature primarily focuses on studying the WTP of current customers or users of ride-hailing and public transit. However, there is limited research on understanding the WTP of potential users who have not frequently utilized these services. Policymakers face the challenge of attracting non-users to embrace micro-transit when devising pricing strategies. Moreover, as electric vehicles gain traction in ride-hailing and micro-transit, the impact of individuals' climate change perceptions on their WTP for micro-transit services remains unexplored. This aspect is crucial to comprehend, given the increasing adoption of eco-friendly transportation options. Additionally, little is known about how people's prior experiences with ride-hailing and public transit influence their WTP for micro-transit services. Understanding these relationships is essential for policymakers to effectively integrate pricing strategies for ride-hailing and public transit while embracing micro-transit.

### Research design

**City context.** Tampa, nestled within Hillsborough County, Florida, holds the distinguished position of being the county seat. Boasting a population of 393,264 as of 2023, it stands tall as the third-largest city in Florida and ranks as the 50th-largest city across the entire United States. A testament to its allure and appeal, Tampa continues to experience steady growth, with an annual increase of 0.8% in population. In recent times, since the last census conducted in 2020, the city has witnessed a notable rise of 2.42% in its population, which surged from 383,980 to its current numbers. To accommodate the steady population growth, Tampa boasts a robust and extensive public transit network, spearheaded by the Hillsborough Area Regional Transit (HART), which operates a diverse fleet of buses. Presently, HART offers an impressive array of transit options, including 26 local bus routes, 7 express bus routes, 1 heritage streetcar route known as The TECO Streetcar, 5 HartFlex Van Routes, and the MetroRapid BRT line, a "light" Bus Rapid Transit (BRT) service that was inaugurated on May 28, 2013. However, it's important to note that most of these services are not specifically tailored to cater to downtown areas, and none of them currently function as on-demand mobility services.

The increasing demand for micro-mobility services in Tampa has led to a rise in alternative short-distance travel options, including electric scooters, bicycles, and shared ride-hailing services. The Downtowner service, launched in October 2016,

stands out as a pioneering initiative in Florida and one of the nation's few free micro-transit services. Its mission is to bridge mobility gaps, ease parking challenges, and support the local economy's revitalization. Operating seven days a week, it primarily serves Downtown Tampa, including the business district, Channel District, River Arts District, the University of Tampa area, and the north end of Harbour Island. This service exclusively uses 100% electric vehicles, offering convenient online booking via a dedicated smartphone app. Downtowner vehicles depart from locations chosen by users, allowing flexibility in choosing starting and ending points.

As of July 1st, 2023, the Downtowner service had amassed an impressive user base of 45,934 individuals, and a total of 512,836 rides had been completed, highlighting its popularity and effectiveness. Despite its undeniable success, the Downtowner service faced financial challenges due to its free-of-charge model. The Tampa Downtown Partnership, the organization behind the service's creation, found it unsustainable to continue operating the service on its own after 2018. In response, they sought assistance from the Hillsborough Area Regional Transit Authority (HART) and the Florida Department of Transportation, who provided funding to sustain the service for an additional eight months. However, funding became scarce again in 2019, with only a \$360,000 grant from the Florida Department of Transportation, contingent upon matching funds from a local source, keeping the service afloat (Brezina-Smith, 2020).

In a bid to secure long-term sustainability, the Tampa Downtown Partnership actively seeks public and private partnerships to maintain the Downtowner service until at least October 2020. Their ultimate goal is to develop a more sustainable model for the program's continuity (Rozyła, 2020). This highlights the significance of understanding the WTP for the micro-transit service among users. Policymakers need to determine if implementing a nominal fare could help partially close the funding gap, as seen with 16.8% of the public transit budget in the city of Tampa.

**Data collection.** To investigate the general public's willingness to pay for a new micro-transit service in the downtown area, we conducted online surveys. To ensure comprehensive coverage, we employed two distinct survey distribution methods. First, we collaborated with the Downtowner company, which provided us with access to their user base, and we sent out the survey via email to their users. Second, to encourage participation from individuals who had not used the micro-transit service, the Tampa Downtown Partnership distributed the survey to their members residing in the downtown area through email. The Tampa Downtown Partnership is a private, not-for-profit organization dedicated to cultivating vibrant and diverse multi-use neighborhoods, and it plays a pivotal role in creating a thriving 24-h urban center that encourages learning, living, working, and leisure. Third, to disseminate information about the survey more widely, the research team also shared the survey link on social media: Twitter, LinkedIn, and Facebook. To maximize survey participation, we sent out the survey questionnaires on three separate dates: July 1, July 15, and July 22, 2020. To prevent multiple submissions from the same participant in the first and second channels, we selectively sent the survey questions only to those who did not respond in the previous call.

The survey takes approximately 10 min to complete, taking into consideration the potential use during short rides. The questionnaire was crafted based on a thorough review of existing literature and the expertise of our research team. Before the survey's official launch, we pilot-tested the questionnaire with two participants to ensure its effectiveness. Eligibility for the survey

was open to all individuals aged 18 and above, without any specific screening criteria or quotas applied. In total, we received 706 responses from micro-transit users, with 704 valid questionnaires, and 311 responses from non-users, of which 310 were valid. The survey questions covered various influential attributes, divided into sections such as demographic and socioeconomic characteristics, travel behavior, and user satisfaction with the service. To gauge people's willingness to pay for the micro-transit service, we specifically asked about the maximum fare respondents were willing to pay.

**Data description.** Table 2 presents the sample profiles for both the user-based and non-user-based surveys. Analyzing the social-demographic variables of Downtowner users, we find that the majority (56.6%) are downtown residents, with the largest age group being between 35 and 64 years old (62.9%), indicating a significant presence of middle-aged individuals. Female users account for 60.2% of all respondents, slightly surpassing the city's overall female percentage of 50.4%. Additionally, 27.9% of users fall between the ages of 18 and 35, while 9.3% are 65 and older, which is slightly lower than the city's percentage of 12.8% for this age group. Regarding household income, 38.6% of users fall into the highest income bracket of over \$100,000. In terms of race, white individuals make up the majority of respondents (59.5%), slightly higher than the overall white percentage in Tampa.

The sociodemographic characteristics of non-users are notably similar to those of users. There is a higher proportion of younger respondents (39.4%) in the non-user survey compared to the user survey. Notably, white individuals are overrepresented among non-users (74.7%) compared to the city's white percentage of 64.9%.

Regarding climate change perceptions, we observe that 36.4% of users and 38.4% of non-users believe human activities contribute to climate change, while 20.4% of users and 22.4% of non-users do not believe in climate change. Additionally, the majority of users (63.4%) and non-users (57.2%) believe that petrol cars contribute to climate change.

Among users, only 10.4% would use Downtowner exclusively on weekends, and the vast majority (94%) have used the service within the past three months. When asked about their alternative modes of transportation within the downtown area when Downtowner is not available, the highest percentage opt for walking (38.9%), followed by driving (27.4%), with ride-hailing services like Uber/Lyft coming in at 19.6%. Notably, 5.6% of users use E-scooters as a form of micro-mobility in the downtown area. More than 90% of user respondents express satisfaction ("Satisfied" and "Very satisfied") with the Downtowner service, emphasizing the need for increased funding to sustain the program.

Among non-users, a significant portion have one car (41.3%) or two cars (39.1%). To assess whether their usage of ride-hailing and public transit affects their WTP for micro-transit, we asked them about their transportation habits within the downtown area. Walking remains the most popular mode (38.3%), with 14.2% using ride-hailing services like Uber/Lyft, and 8.4% utilizing public transit. Among the 310 non-user respondents, 58% express a negative stance ("Neutral," "Dissatisfied," and "Very dissatisfied") on the public transit service, potentially explaining the low rate of public transit usage.

In both surveys, respondents were asked about the maximum fare they would be willing to pay for Downtowner. Interestingly, a larger proportion of users (22.6%) are not willing to pay compared to non-users (14.1%). This could be attributed to users being accustomed to the free usage of Downtowner, making it more challenging for them to consider paying for the service.

**Table 2 Description of the sample.**

User (N = 704)		Non-user (N = 310)	
Variable	%	Variable	%
<b>Where the respondent is from</b>		<b>Where the respondent is from</b>	
Work in downtown but live outside of downtown	26.6	Work in downtown but live outside of downtown	19.9
Resident of downtown Tampa	56.6	Resident of downtown Tampa	58.3
Student living in downtown Tampa	3.6	Student living in downtown Tampa	7.1
Visitor of downtown Tampa	10.7	Visitor of downtown Tampa	9.3
Other (reference)	2.5	Other (reference)	5.4
<b>Age</b>		<b>Age</b>	
18-34	27.8	18-34	39.4
35-64	62.9	35-64	48.4
65+ (reference)	9.3	65+ (reference)	12.2
<b>Gender</b>		<b>Gender</b>	
Female (reference)	60.2	Female (reference)	57.4
Male	39.8	Male	42.6
<b>Household Income</b>		<b>Household Income</b>	
>\$100,000	38.6	>\$100,000	38.1
\$50,000-\$99,999	32.5	\$50,000-\$99,999	34.0
\$25,000-\$49,999	16.6	\$25,000-\$49,999	17.6
Below \$25,000 (reference)	12.3	Below \$25,000 (reference)	10.2
<b>Ethnicity/race</b>		<b>Ethnicity/race</b>	
African	7.2	African	5.4
Asian	5.7	Asian	3.8
Latino/Hispanic	13.1	Latino/Hispanic	13.1
White	59.5	White	74.7
Other (reference)	14.5	Other (reference)	2.9
<b>When use Downtowner</b>		<b>Private cars</b>	
Weekday (reference)	30.1	0 (reference)	6.4
Weekend	10.4	1	41.3
Weekday and Weekend	59.5	2	39.1
		>2	13.1
<b>Most recent time using Downtowner</b>		<b>Travel to downtown every week</b>	
Within the past 6 months (reference)	6.0	0-2 times (reference)	27.9
Within the past 3 months	22.7	3-5 times	29.2
Within the past month	48.4	6-8 times	21.2
Within the past week	22.9	>8 times	21.8
<b>Alternative mode if Downtowner is not available</b>		<b>How to travel within downtown</b>	
Bicycle	4.0	Bicycle	12.5
Driving	27.4	Driving	15.1
E-scooter	5.6	E-scooter	10.5
Public transit	4.0	Public transit	8.4
Uber/Lyft	19.6	Uber/Lyft	14.2
Walk	38.9	Walk	38.3
Other (reference)	0.6	Other (reference)	1.0
<b>Satisfaction of Downtowner</b>		<b>Satisfaction of public transit</b>	
Dissatisfied	1.4	Dissatisfied	11.5
Satisfied	22.9	Satisfied	34.3
Neutral (reference)	5.5	Neutral (reference)	22.8
Very dissatisfied	1.0	Very dissatisfied	23.7
Very satisfied	69.2	Very satisfied	7.7

**Table 2 (continued)**

User (N = 704)		Non-user (N = 310)	
Variable	%	Variable	%
<b>Climate change belief</b>		<b>Climate change belief</b>	
No climate change happening (reference)	20.4	No climate change happening(reference)	22.4
Climate change not human-related	18.9	Climate change not human-related	21.9
Unsure of climate change	24.3	Unsure of climate change	17.3
Climate change caused by humans	36.4	Climate change caused by humans	38.4
<b>Contribution of petrol cars to climate change</b>		<b>Contribution of cars to climate change</b>	
Yes	63.4	Yes	57.2
No (reference)	36.6	No(reference)	43.8
<b>Maximum fare willing to pay</b>		<b>Maximum fare willing to pay</b>	
\$0 (reference)	22.6	\$0 (reference)	14.1
\$1	21.4	\$1	21.8
\$2	28.1	\$2	34.0
\$3	15.2	\$3	13.5
\$4	12.5	\$4	16.3

Ultimately, for both user and non-user surveys, most respondents express a willingness to pay \$2.

**Methods.** We used the case study method (Fidel, 1984; Rashid et al., 2019), which delves deeply into a specific instance or situation to gain a comprehensive understanding of its complexities. By closely examining real-life scenarios, this method allows researchers to explore intricate details, context, and interactions that contribute to a phenomenon. Case studies offer valuable insights into the dynamics of a particular context and can be used to explore, analyze, and derive broader implications for theory and practice. The case study method holds significance for our research on willingness to pay for micro-transit in Tampa due to its ability to provide in-depth insights into the complex interplay of factors influencing individuals' preferences and decisions.

The study also employs ordinal logistic regression, a statistical analysis approach, to model the relationship between the ordinal response variable "Maximum fare willing to pay" and more explanatory variables. Since the outcome variable has four ordered categories, namely "\$1," "\$2," "\$3," and "\$4," an ordinal logistic regression model is deemed appropriate. This modeling technique is particularly useful for estimating the odds of the response variable being equal to or below a specific level (Alrumaidhi and Rakha, 2022). For example, if we denote the ordinal outcome levels as "j," then the model makes (j-1) predictions, each estimating the probability of the odds being equal to or below the j-th level, considering the outcome variable. These cumulative odds are crucial in the analysis. The proportional odds model is expressed in the logit form, as detailed in Liu (2022). Under the assumption of parallel lines or proportional odds, the model assumes similar odds ratios across all categories for each predictor.

This type of regression is suitable when the outcome has multiple levels with a clear rank order and when the intervals between these levels may not be equally spaced. We can analyze the relationship between the independent variables and the likelihood of respondents being willing to pay different fare levels

for the micro-transit service. Moreover, to address the research questions, we controlled participants' home locations and demographic information as predictors in the model. This allowed for a separate examination of the effects of climate change perceptions and participants' commuting experiences downtown, considering both micro-transit and other mobility services. Additionally, to determine whether the experience of using micro-transit plays a significant role, separate models were run for both users and non-users. By employing ordinal logistic regression and accounting for various factors, we aimed to gain insights into the factors influencing participants' willingness to pay for the micro-transit service and how experiences and perceptions impact this willingness.

## Results

**User's willingness to pay.** Table 3 presents the regression results based on the user survey questions, offering valuable insights into the factors influencing users' willingness to pay for the micro-transit service.

Both regression models highlight that users with higher household incomes are more inclined to pay a higher fare. The odds ratio reveals that users with household incomes greater than \$100,000 have a 2.072 times higher likelihood of paying more fare compared to users with incomes less than \$100,000 while keeping all other variables constant. Additionally, white users show a greater tendency to pay a higher fare. However, age and gender do not show statistically significant correlations with fare willingness. An interesting finding is that users who work in downtown but live outside of downtown are less likely to pay higher fares in both models.

Turning to climate change perceptions, column (1) reveals a noteworthy trend. Downtowner users who believe that climate change is related to human activities are more likely to pay a higher fare (coeff = 0.136,  $p < 0.05$ ). Furthermore, users who are convinced that cars directly contribute to climate change demonstrate an even stronger probability of paying for the micro-transit service (coeff = 0.275,  $p < 0.01$ ).

Regarding the user's commuting experience, column (2) uncovers some insightful relationships. Users who utilize Downtowner for recreation or entertainment purposes are more likely to pay a higher fare. Additionally, users who express satisfaction with the Downtowner service show a greater likelihood of paying higher fares. Notably, the user's experience with ride-hailing services positively impacts their willingness to pay for micro-transit. Specifically, users who prefer to take Uber/Lyft when Downtowner is unavailable exhibit odds 11.588 times higher than users who would not choose Uber/Lyft, suggesting a strong correlation between ride-hailing and fare willingness. However, the effect of public transit on fare willingness is not statistically significant.

**Non-user's willingness to pay.** Table 4 provides insights into the sociodemographic variables of non-users and their willingness to pay for the Downtowner service. Younger individuals (aged 18–35) are found to be less inclined to pay more for Downtowner compared to older adults. Conversely, a higher household income (>\$100,000) exhibits a significant positive correlation with the probability of paying more for Downtowner. Interestingly, no significant variables are observed in the race/ethnicity category, indicating that race does not play a significant role in fare willingness among non-users.

Regarding climate change perceptions, we find that non-users who believe climate change is not related to human activities are less likely to pay for the micro-transit service. Conversely, non-users who believe that climate change is caused by human

activities show a greater willingness to pay. Additionally, those who believe that cars contribute to climate change also display a higher likelihood of paying for Downtowner.

In terms of non-users' commuting experiences, individuals who express disinterest in taking Downtowner show negative coefficients on their willingness to pay for the service. On the other hand, non-users who frequently use Uber/Lyft are more likely to pay. This can be attributed to the fact that, despite Downtowner charging a certain fee, it remains a more cost-effective option compared to Uber/Lyft. However, for those who heavily rely on public transit, the result is not statistically significant. The attitudes of non-users towards public transit further support this finding.

Interestingly, non-users who do not regularly use E-scooters but still favor them for travel are found to be less inclined to accept a higher fare. This discrepancy may be due to non-users familiarizing E-scooters as a more convenient mode of transportation in the downtown area than micro-transit. This observation requires further investigation for a more comprehensive understanding. Similarly, non-users who frequently commute within the downtown area through walking are also less likely to pay a higher fare.

## Discussion

**Policy implications.** Based on the findings from the regression analyses and the factors influencing users' and non-users' willingness to pay for the Downtowner service, we proposed the following policy recommendations. First, the micro-transit service needs to cater to different income groups, consider implementing a fare differentiation strategy, since users with higher household incomes are more willing to pay higher fares, offer flexible fare options that accommodate both higher-income users and those with lower incomes.

Second, policymakers need to have more tailor marketing and outreach efforts to specific demographic groups. Younger individuals (18–35 years old) are less willing to pay higher fares. Utilizing social media platforms, influencers, and engaging content can be instrumental in reaching and resonating with younger audiences, ultimately encouraging them to see the value in paying higher fares for the Downtowner service.

Third, to encourage a higher willingness to pay for the Downtowner service, it is crucial to emphasize its convenience, environmental benefits, and cost-effectiveness compared to alternative transportation options, as also recommended by Yang et al. (2021). Furthermore, promoting the environmental sustainability of micro-transit to both users and non-users can be effective, as individuals who believe in climate change and its human-related causes are more likely to pay for such services, as demonstrated by Brugger and Watts (2021).

Fourth, policymakers need to be mindful of the differences and similarities between users and non-users when they aim to incentivize usage. Shared across both groups is the role of climate change perceptions in influencing fare willingness, underscoring the importance of incorporating environmental messaging in promotional efforts. For users, higher household incomes are linked to an increased willingness to pay, suggesting that fare structures should consider income diversity to ensure accessibility while capturing revenue potential. Among non-users, a similar trend underscores the potential to attract higher-income individuals, emphasizing the value proposition of the service to this demographic.

**Contributions.** We also make several valuable contributions to the existing literature. First, we fill a crucial gap by focusing on the relatively unexplored area of willingness to pay (WTP) for

**Table 3 User-based results using ordinal logistic regression models.**

	(1) Maximum fare willing to pay			(2) Maximum fare willing to pay		
	Coefficient	SE	Odds ratios	Coefficient	SE	Odds ratios
<b>Background</b>						
Work in but live outside of downtown	-0.968**	-0.457	0.379	-0.887*	(-0.516)	0.411
Resident of downtown	-0.656	-0.449	0.519	-0.795*	(-0.482)	0.451
Student	-0.25	-0.604	0.778	-0.267	(-0.681)	0.765
Visitor/Tourist	-0.388	-0.485	0.678	-0.692	(-0.526)	0.5
<b>Age</b>						
18-35	-1.674	-1.532	0.187	-0.744	(-1.617)	0.475
35-64	-1.204	-1.528	0.3	-0.153	(-1.62)	0.858
<b>Gender</b>						
Male	-0.015	-0.148	0.985	-0.069	(-0.155)	0.933
<b>Household income</b>						
\$25,000-\$49,999	0.671**	-0.295	1.956	0.501	-0.309	1.649
\$50,000-\$99,999	0.367	-0.275	1.443	0.016	-0.299	1.015
>\$100,000	0.729***	-0.277	2.072	0.401*	-0.22	1.493
<b>Ethnicity</b>						
African American	-0.081	-0.315	0.922	-0.114	(-0.326)	0.892
Asian	0.237	-0.347	1.267	0.283	(-0.352)	1.326
Hispanic	0.192	-0.27	1.211	0.186	(-0.279)	1.203
White	0.482**	-0.211	1.619	0.452**	(-0.222)	1.571
<b>Climate change belief</b>						
Climate change not human-related	0.139	0.204	1.098			
Unsure of climate change	0.230	0.172	1.212			
Climate change caused by humans	0.136**	0.064	1.323			
<b>Contribution of petrol cars to climate change</b>						
Yes	0.275***	0.053	1.775			
<b>When use Downtowner</b>						
Weekday, Weekend				0.3	(-0.203)	1.349
Weekend				0.039	(-0.294)	1.039
<b>Most recent usage of Downtowner</b>						
Within the past 3 months				0.267	(-0.339)	1.306
Within the past month				-0.034	(-0.329)	0.966
Within the past week				-0.154	(-0.353)	0.857
<b>Travel purpose of most recent trip</b>						
Bank				-0.3	(-0.198)	0.74
Hotel				0.132	(-0.241)	1.141
Recreation/Entertainment				0.391**	(-0.166)	1.478
Restaurants				-0.203	(-0.184)	0.816
Work				0.101	(-0.175)	1.106
Transportation				-0.043	(-0.374)	0.957
Hospital/Doctors				0.387	(-0.29)	1.473
School				-0.017	(-0.391)	0.983
Shopping/Errands				-0.354**	(-0.17)	0.701
<b>Satisfaction of Downtowner</b>						
Dissatisfied				-0.676	(-0.752)	0.508
Satisfied				0.597*	(-0.359)	1.816
Very dissatisfied				-0.03	(-0.784)	0.97
Very satisfied				0.920***	(-0.34)	2.509
<b>Alternative travel mode to Downtowner</b>						
Bicycle				0.959	(-1.252)	2.608
Driving				1.322	(-1.223)	3.749
E-Scooter				2.450*	(-1.39)	11.588
Public Transit				1.02	(-1.261)	2.773
Uber/Lyft				2.627**	(-1.222)	13.833
Walk				1.547	(-1.218)	4.698
N	710			710		
AIC	2125.41			2068.75		
Pseudo R-squared	0.23			0.25		

\*p < 0.1; \*\*p < 0.05; \*\*\*p < 0.01.

micro-transit. By investigating WTP for micro-transit services, this research enhances the understanding of consumer preferences and behaviors in this emerging transportation option. Second, we contribute to the fields of environmental psychology

and sustainable transportation theories by exploring how individuals' climate change perceptions influence their WTP for micro-transit. Third, we delve into the influence of prior commuting experiences with ride-hailing and traditional public



**Table 4 Non-user-based results using ordinal logistic regression models.**

	(1) Maximum fare willing to pay			(2) Maximum fare willing to pay		
	Coefficient	SE	Odds ratios	Coefficient	SE	Odds ratios
<b>Background</b>						
Work in but live outside of downtown	-0.491	-0.499	0.612	-0.057	(-0.551)	0.944
Resident of downtown	-0.131	-0.466	0.877	0.337	(-0.525)	1.4
Student	1.791***	-0.669	5.998	1.629**	(-0.796)	5.097
Visitor/Tourist	-0.422	-0.56	0.655	-0.328	(-0.632)	0.72
<b>Age</b>						
18-35	-0.682*	-0.359	0.505	-0.384*	(-0.215)	0.68
35-64	-0.522	-0.337	0.593	-0.253	(-0.374)	0.776
<b>Gender</b>						
Male	-0.149	-0.214	0.861	0.082	(-0.253)	1.085
<b>Household income</b>						
\$25,000-\$49,999	0.888*	-0.485	2.43	0.487	(-0.589)	1.627
\$50,000-\$99,999	0.897*	-0.473	2.452	0.655	(-0.597)	1.925
>\$100,000	1.516***	-0.488	4.551	0.881*	(-0.531)	2.413
<b>Ethnicity</b>						
African American	0.285	-0.778	1.329	-0.339	(-0.915)	0.712
Asian	0.294	-0.829	1.341	-0.045	(-0.94)	0.956
Hispanic	0.484	-0.677	1.622	-0.359	(-0.791)	0.698
White	0.404	-0.642	1.497	-0.14	(-0.747)	0.869
<b>Climate change belief</b>						
Climate change not human related	-0.153**	0.073	0.732			
Unsure of climate change	0.192	0.099	1.432			
Climate change caused by humans	0.104***	0.035	1.230			
<b>Contribution of cars on climate change</b>						
Yes	0.203***	0.054	1.203			
<b>Number of private vehicles</b>						
>2				-0.137	(-0.668)	0.872
1				-0.586	(-0.587)	0.556
2				-0.01	(-0.622)	0.989
<b>Frequency to downtown per week</b>						
>8 times				-0.172	(-0.412)	0.841
3-5 times				-0.135	(-0.332)	0.873
6-8 times				-0.079	(-0.376)	0.923
<b>Willingness to use</b>						
No				-1.844***	-0.675	0.158
Yes				-0.045	-0.31	0.955
<b>Satisfaction of transit in downtown</b>						
Dissatisfied				-0.176	(-0.3)	0.838
Satisfied				-0.052	(-0.308)	0.949
Very dissatisfied				-0.05	(-0.476)	0.951
Very satisfied				-0.332	(-0.426)	0.717
<b>How to travel within downtown</b>						
Bicycle				0.217	(-0.286)	1.241
Driving				-0.159	(-0.259)	0.852
Uber/Lyft				0.876***	(-0.259)	2.402
Transit				-0.371	(-0.353)	0.69
E-Scooter				-1.022***	(-0.298)	0.36
Walk				-0.623*	(-0.332)	0.536
N	310			310		
AIC	934.63			909.81		
Pseudo R-squared	0.31			0.34		

\*p < 0.1; \*\*p < 0.05; \*\*\*p < 0.01.

transit on WTP for micro-transit. By investigating the patterns in commuting behavior and preferences, we contribute to a more comprehensive understanding of how micro-transit users and non-users transition between different modes of transportation.

**Research limitations.** While acknowledging limitations in interpreting the findings, we also highlight areas for future research improvement. First, while the online survey format allowed efficient data collection and wide reach, future studies

should explore alternative data collection methods to reduce potential biases. Second, the study's simplicity in assessing maximum fare willingness facilitated participant responses but future research should consider more comprehensive pricing scenarios to align with real-world decision-making. Third, the hypothetical survey approach may overestimate willingness to pay, yet it serves as an initial step to understand preferences. Future studies can complement this with real-world observations for a nuanced understanding of user behavior. Fourth, the case study method's effectiveness is constrained by its narrow

real-world representation; future research should address this limitation to uncover further insights.

## Conclusion

In conclusion, our research sheds light on the willingness to pay for the Downtowner micro-transit service in downtown areas. Through online surveys, we identified several important factors influencing users' and non-users' fare willingness. Users with higher household incomes and those who believe in climate change and its human-related causes are more likely to pay higher fares. Additionally, positive experiences with the Downtowner service, as well as frequent use of ride-hailing services like Uber/Lyft, contribute to higher fare willingness among users. On the other hand, younger individuals and non-users who prefer alternative modes of transportation, such as walking or E-scooters, exhibit lower fare willingness. The digital divide among older individuals and the hypothetical nature of the survey responses must be considered when interpreting the findings. This research not only advances the understanding of WTP for micro-transit but also sheds light on the interplay between climate change perceptions and transportation choices, and the impact of prior commuting experiences on the adoption of micro-transit.

## Data availability

The raw dataset analyzed during the current study is not publicly available due to a confidentiality agreement with the funder, but a processed final dataset used in this study is available for the replication of results only by contacting the corresponding author (if permission of the funder is granted).

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## Author contributions

WZ contributed to the data analysis, research design, and manuscript writing. SG contributed to the research design and manuscript revision. ML contributed to data analysis. DW contributed to the manuscript writing.

## Competing interests

The authors declare no competing interests.

## Ethical approval

This study was approved by the Ethics Committee of the International Center for Adaptation Planning and Design, University of Florida (clearance number: 21-05). The procedures used in this study adhere to the tenets of the Declaration of Helsinki.

## Informed consent

We confirm that informed consent was obtained from all participants. The informed consent process involves three key features: (1) disclosing to potential research subject's information; (2) facilitating the understanding of what has been disclosed; and (3) promoting the voluntariness of the decision about whether or not to participate in the research.

## Additional information

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