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The role of travel satisfaction and attitudes toward travel modes in the prospect of adoption of urban air taxis: Evidence from a stated preference survey in Tehran

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ABSTRACT

Urban air mobility (UAM) is a new mode of transportation which has the potential to curb congestion in urban areas by providing a fast alternative that bypasses surface-level traffic by employing low altitude urban airspace. However, the successful adoption of this innovation among other modes of transportation remains a critical challenge, as public acceptance plays a pivotal role in the uptake of any emerging technology or service. To transcend traditional ground transportation, it is imperative to investigate the factors that drive a transition from current modes, particularly private cars, to the utilization of urban air taxis (UATs). While prior research has explored different aspects of UAM adoption, there is a notable dearth of studies examining the influence of travel satisfaction and attitudes towards travel modes on the preference for UAM. Notably, existing transportation literature has established that both satisfaction and attitudes significantly shape travel behavior. To achieve this, a stated preference survey was conducted in the Tehran metropolitan area, and a multinomial logit model incorporating latent variables was developed to assess the influence of socio-demographic and psychological factors on UAM adoption in hypothetical scenarios with predetermined travel times and costs. The findings highlight the pivotal role of service cost and affordability, with individuals of higher incomes exhibiting a significant inclination toward UAT adoption. The adoption of UAT is significantly higher when the cost is comparable to the existing modes. Moreover, satisfaction components, specifically enjoyment and time-saving benefits, exert a significant influence on UAT preference. Unfavorable perceptions towards private cars and ride-hailing services positively contribute to the likelihood of preferring UAT, with a greater impact observed for negative attitudes towards ride-hailing. The study explicitly underscores the influence of travel satisfaction and attitudes towards conventional modes of transportation on the adoption of innovative alternatives such as air taxis within the context of mode choice scenarios.

1. Introduction

Urbanization and population growth have led to the proliferation of vast metropolitan areas, contributing to the exacerbation of traffic-related issues. Growing congestion around the world has increased interest in innovative time-saving alternatives and has also resulted in increasing commuters' propensity to pay higher prices for time-efficient mobility options (Rothfeld et al., 2018). The

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assessment of novel transportation services and examination of potential obstacles assumes greater importance in many big cities. For example, Tehran as the 24th most populous nation worldwide, has a high reliance on cars as the primary mode of transportation, experiencing over 17 million daily vehicular trips (Heger and Sarraf, 2018), which has resulted in noticeable challenges of traffic congestion and air pollution. The city accommodates a population of approximately nine million inhabitants, where on average, each resident spends 31 min daily in traffic, resulting in a cumulative total of 4.65 million hours per day, and exceeding 1.5 billion hours annually (Financial Tribune, 2021).

Recent technological advancements for a new class of electric vertical takeoff and landing (eVTOL) craft have the potential to enable urban air taxis (UATs) as a solution for many problems such as traffic congestion and environmental issues for both intra-urban and inter-urban travel (Straubinger et al., 2020). However, various factors may be considered as barriers to public acceptance of UAT, including technical issues such as noise and altitude, as well as safety concerns (Cohen et al., 2021; Yedavalli and Mooberry, 2019; Straubinger et al., 2020), it is important to analyze how UAT can compete with traditional ground transportation modes in common scenarios and understand individuals' preferences while integrating UAT within transportation systems. As is the case with autonomous vehicles (AVs), Kolarova and Cherchi (2021) suggest that understanding the factors that affect users' preferences for these technologies is crucial for developing precise and varied scenarios about their impact on travel demand and mode choices. The same applies to UAT, since this perspective is crucial for studying public acceptance of UATs and passenger demand, especially given that human-operated ground vehicles still dominate the transportation landscape (Rothfeld et al., 2018).

With the idea of probable integration of UATs in urban mobility and its corresponding characteristics, the question must be asked: Is there a possibility that ground motorized modes as the primary modes of transportation will eventually be supplanted by UAT, thereby alleviating the congestion that plagues the streets below? What is the impact of factors like time and cost on the decision-making process of individuals when selecting UAT as a transportation option? Furthermore, how do attitudes and past experiences relate to alternative travel modes influence the preference for UAT?

In light of the numerous variables that have the potential to influence individuals' inclinations toward UAM, it is imperative to gain insights into the underlying causes of variability in UAM preferences. This understanding is vital for crafting more nuanced and realistic scenarios concerning how UAM might influence transportation mode choices and overall travel demand. The present study seeks to make a meaningful contribution to the existing body of literature by examining the impact of travel experiences (specifically, satisfaction with daily travel) and attitudes toward various travel modes within a hypothetical context on preferences for air taxis. Additionally, this research aims to provide empirical substantiation regarding the degree to which these factors, along with the socio-economic characteristics that underlie them, shape individuals' preferences for UAM. This paper provides insight into these concerns to develop and validate a framework that can be scaled to evaluate the competitiveness of urban air taxis against conventional transportation modes. In other words, the objective is to evaluate the utility of UAT in comparison to traditional ground transportation modes, which are major contributors to traffic congestion and air pollution. This study examines the mode preferences of individuals in hypothetical situations that involve UAT, private cars, and ride-hailing, with respect to the influence of overall current travel satisfaction, and attitudes towards each alternative as the latent variables. The two ground transportation modes were chosen based on their significant share of the commuting market, (Lesteven and Samadzad, 2019), and comparability with UAT in terms of travel cost, comfort, and convenience. The significant disparity in pricing between public transport and UAT, with the former being heavily subsidized in Tehran (Heger and Sarraf, 2018) and the latter being almost 50 times more expensive, renders these two modes of transport incomparable. Consequently, with public transport being used for the shortest distances (Kreimeier and Stumpf, 2017), it was excluded from consideration in this analysis.

The paper is organized as follows. Section 2 presents a review of the relevant literature on autonomous transportation, UAT adoption, and the value of time. Section 3 discusses the surveying process and the methodology of the paper. Section 4 provides the statistical analysis of the survey data, as well as the definition of the latent variables by factor analysis of the indicators and the analysis of the latent constructs by structural equation modeling. Section 5 characterizes the choice of travel mode using a multinomial logit model and examines user preferences including the value-of-time estimates. Finally, Section 6 discusses the results and concludes with recommendations for the integration of urban air mobility within the general context of an urban mobility system.

2. Literature review

In recent years, the development of autonomous vehicle (AV) technology has brought attention to the concept of Urban Air Mobility (UAM) and the utilization of urban air taxis (UAT). The advancement of fully autonomous aircraft may not be directly aided by the development of autonomous vehicles for road travel, although there is substantial overlap in the underlying technologies required for both (Holden and Goen, 2016). Recent advancements in electrification, automation, and electric vertical take-off and landing (eVTOL) aircraft have catalyzed the development of urban aviation, leading to the emergence of innovative aircraft designs, services, and business models (Cohen et al., 2021). The convergence of these trends has opened up new possibilities for on-demand aviation in terms of passenger mobility and goods delivery within urban areas, as noted by Patterson et al. (2018). It is currently widely recognized that smaller electric propulsion aircraft equipped with vertical take-off-and-landing capabilities, which can operate from heliports or similar infrastructure, have the potential to serve on-demand mobility missions (Garrow et al., 2018).

2.1. Urban air mobility and its adoption

Several research studies have examined the various impediments to the successful implementation of eVTOL technology which can be considered as community acceptance and the critical determinants of its adoption (Al Haddad et al., 2020; Karami et al., 2024;

Vascik and Hansman, 2017). According to Garrow et al. (2020), the viability of an urban air taxi service is dependent not only on technical proficiency but also on the level of consumer demand. Al Haddad et al. (2020) conducted a stated-preference survey to evaluate the perception of users regarding the adoption of UAM. The study revealed that several factors were critical in determining the adoption of UAM, including safety and trust, the preference for automation, social attitude, as well as socio-demographic characteristics. Choi and Ji (2015) also mentioned the significance of trust in the adoption of AVs. In another study, Winter et al. (2020) found six major determinants of customer desire to ride autonomous air taxis: familiarity, value, enjoyment, new technology wariness, fear, and happiness. In the evaluation of the viability of UAM services, Hasan (2019) identified affordability and consumer willingness to pay as potential impediments to the practicability of UAM operations. Similar to Garrow et al. (2021), who mentioned that while providing service levels that surpass those of existing modes of transportation, UAM must also be priced at a point that is deemed reasonable by individuals. A survey conducted with the objective of investigating the acceptance of UAM among European citizens (EASA, 2021) highlighted that the primary apprehensions voiced by respondents pertained to safety, security, and environmental considerations.

Using the technology acceptance model, Johnson et al. (2022) explored the expectations and perceptions of passengers regarding the use of passenger air vehicles (PAVs). Respondents expected PAVs to meet the same safety standards as conventional aircraft, including features like seatbelts and air quality. Bansal et al. (2016) investigated the potential advantages of AVs and the factors that may affect their adoption. They found that male urban residents and individuals with higher income, technological proficiency, younger age, and greater accident experience exhibit greater interest and willingness to pay for novel technologies. Based on an exploratory survey conducted in five metropolitan regions: Houston, Los Angeles, the San Francisco Bay Area, New York City, and Washington, D.C., Shaheen et al. (2018) ascertained that a robust determinant affecting individuals' inclination to use UAM services, as well as their ultimate decision to embark on a UAM journey, is their level of familiarity with the UAM concept. They underscored the vital significance of public educational initiatives in the process of ushering in UAM as an emergent and innovative mode of transportation.

Hohenberger et al. (2016) found that women exhibit lower interest in the adoption of autonomous vehicles compared to men. Similarly, in a study of the UAM market barriers in the United States, Goyal et al. (2018) concluded that male respondents are more willing to utilize UAM services. Shaheen et al. (2018) also found that men, younger respondents, and wealthier participants displayed a higher willingness to utilize UAM services. EASA (2021) revealed that certain demographic segments exhibited a more favorable disposition towards UAM. These segments encompassed younger individuals, specifically those aged 25–34, males, individuals with higher income levels, and those who were familiar with and accustomed to using other innovative services.

While the majority of studies have focused on the factors affecting the perception of individuals towards using UAM, there is a lack of research on the adoption of UAM in a mode choice scenario. According to Haan et al. (2021), air taxi services could be profitable in the early stages of launch in markets such as New York City and Los Angeles, as revealed through their mode choice analysis. Rimjha et al. (2021) conducted an estimation of the demand for UAM within the airport ground access sector of Los Angeles International Airport and found that it has the potential to capture approximately 3.6 % of the market share in airport access trips. In a study by Fu et al. (2019), four transportation alternatives were included in mixed logit, multinomial logit, and nested logit models using an SP survey in Munich metropolitan region. These alternatives were private car, public transport, autonomous taxi, and autonomous flying taxi. The results of the study revealed that travel time, travel cost, and safety were crucial factors in determining the adoption of UAM and that the potential customers may have a higher willingness to pay for using these services. Furthermore, socio-demographic characteristics were found to be highly influential in UAM adoption, with younger individuals and those with higher incomes being more likely to use. Similarly, Castle et al. (2017) also observed that younger individuals with higher levels of education exhibit a greater propensity to utilize pilotless aircraft.

The significance of psychological factors and perceptions of potential users in the assessment of AVs and UAT has been well-established in the literature. Some studies have underscored the significance of safety in the acceptance of autonomous aerial vehicles (MacSween, 2003; Fu et al., 2019; Al Haddad, 2020) and AVs (Yap et al., 2016). The literature has also extensively addressed trust in technology as a determining factor in UAM adoption (Al Haddad, 2020) and AV use (Yap et al., 2016). Ashkrof et al. (2019) highlights that trust in autonomous vehicle technology is one of the most significant psychological factors that influence individuals' willingness to ride AVs. Additionally, the impact of travel experience in AV adoption has been explored in the literature (Ghazizadeh et al., 2012; Pudāne et al., 2019). (Kim et al., 2022) indicate a positive relationship between trust and the intention to utilize UAM. Moreover, among the factors contributing to the trustworthiness of UAM, safety perception emerges as the most influential factor.

Numerous studies in the field of transportation have assessed travel mode attitudes by inquiring about the extent to which respondents associate positive attributes such as relaxation, safety, and enjoyment with specific modes of travel (De Vos et al., 2022; Kroesen et al., 2017). Meanwhile, travel satisfaction encompasses both emotional experiences during travel and cognitive evaluations of the entire journey or specific stages of the journey after completion (De Vos, 2018; De Vos et al., 2022). Regardless of the mode of transportation, a trip will elicit a range of affective reactions that will ultimately determine how satisfied travelers are with their travel experience (Ettema et al., 2010). The existing body of literature in the field of transportation explores the relationship between travel behavior and travel satisfaction (Cao and Ettema, 2014; De Vos, 2019; De Vos and Witlox, 2017; Mouratidis et al., 2019). The literature has also extensively discussed the significant impact of attitudes toward various travel modes on travel behavior and mode choice (Cao et al., 2009; Molin et al., 2016; Ton et al., 2020; Habib et al., 2014). Vahedi et al. (2021) utilized structural equation modeling to demonstrate that satisfaction and attitudes, played a significant mediating role between background variables and active commuting. However, the current state of research in the area of UAM indicates a shortage of studies that have investigated the impact of travel satisfaction and attitudes toward different travel modes on mode choice scenarios.

Concerning factors that can influence an individual's perception of travel satisfaction and their overall attitude towards the mode of transportation they use, Ye and Titheridge (2019) found that individuals with lower income levels tend to experience lower levels of satisfaction with their travel. According to Anable and Gatersleben (2005) and Smith (2013), individuals who utilize bicycles experience a greater level of satisfaction with their travel experiences. Smith (2013) also discovered that the job status of commuters and the travel time of their commute are significant factors that influence their level of travel satisfaction. In their study, Morris and Guerra (2014) found that bicycling was associated with the most positive emotional outcomes, whereas driving a car elicited slightly less positive satisfaction. On the other hand, individuals who relied on public transport, such as buses and trains, experienced the most negative emotional responses. Mao et al. (2016) discovered that bicycle riders report higher levels of satisfaction. They also highlighted that individuals who possess a greater degree of flexibility in their commuting patterns tend to exhibit higher levels of satisfaction, as they are afforded a greater range of options when selecting their preferred mode of transportation.

Within the framework of a developing country, Ilahi et al. (2021) found that UAM exhibits promise for growth within the Greater Jakarta region. However, its feasibility may be limited to affluent residents and long-distance journeys. Notably, the pronounced traffic congestion prevalent in Jakarta offers a distinct advantage to UAM over alternative modes of transportation. In Tehran Karami et al. (2024) found attitude, perceived usefulness, and subjective norm to be the main factors contributing to the UAM usage intention and concluded that UAM can be viably implemented for targeted markets.

2.2. *Value of time*

The literature exploring urban air mobility frequently draws comparisons to the studies carried out on autonomous vehicles due to the shared characteristics and potential effects of these travel modes on urban mobility. For instance, Kolarova and Cherchi (2021) showed that psychological factors, such as travel experience and trust, contribute to the heterogeneity of the value of travel time significantly. Additionally, the study found that gender, age, level of education, and experience with similar systems have direct and indirect effects on the value of time through their influence on individual attitudes. Furthermore, Kolarova and Steck (2019) found that access/egress time was perceived as slightly more onerous than the in-vehicle time while the effect of wait time appeared to be in the same range as that of the in-vehicle time.

By avoiding ground traffic congestion, urban air taxis are expected to demonstrate superior time-saving capabilities compared to autonomous vehicles (Mudumba et al., 2021). Kreimeier et al. (2018) confirmed that the demand for urban air taxi services is influenced by both cost and travel time, significantly. A number of studies have investigated the value of time for individuals who intend to use air taxi services. In Munich, Fu et al. (2019) estimated the value of total travel time – which is the sum of in-vehicle and out-of-vehicle travel times – equal to 55.0 dollars per hour. In Dallas and Los Angeles, Song et al. (2019) evaluated the value of in-vehicle travel time equal to 13.9 dollars per hour, and in New York, Los Angeles, and Washington, D.C., Haan et al. (2021) estimated the value of in-vehicle and out-of-vehicle travel time equal to 25.7 and 15.4 dollars per hour, respectively.

2.3. *Research objectives*

Based on the existing literature, numerous studies have been conducted to explore the impact of behavioral factors and various parameters including time, cost, and sociodemographic characteristics. However, the current state of research in this field still exhibits several shortcomings. A thorough examination of the literature reveals two key issues: (i) most previous investigations have primarily focused on the influence of psychological factors on the intention to use UAM exclusively (Al Haddad et al., 2020; Kim et al., 2022). Nonetheless, concentrating solely on UAM may introduce biases when predicting future travel behavior. Consequently, neglecting the role of different modes hampers our understanding of the state of UAM. (ii) Previous studies have also overlooked the consideration of travel experience in conventional vehicles, which can be viewed as a competitor for UAT. The literature highlights that travel experience, attitudes, and satisfaction significantly impact mode choice. Moreover, while prior research has acknowledged the influence of various factors such as sociodemographic variables, cost, and time, the integration of these factors with psychological elements within a unified framework represents a recent development in the literature. Examining the relative impact of specific psychological concepts and sociodemographic characteristics on the selection of different transportation modes presents an intriguing area of investigation. Understanding the relative significance of these factors in shaping mode choice would contribute to the knowledge in this field.

3. Methodology

Given the unavailability of operational urban air taxis for direct observation or use (Cohen et al., 2021), a Stated Preference (SP) survey interview was conducted using a face-to-face approach from mid-July to early September 2022 in Tehran to develop a mode choice analysis by integrating UAT with conventional ground modes. The survey aimed to determine the primary drivers of urban air taxi UAT adoption by utilizing a questionnaire that included textual and visual explanations of the concept. The implementation of a mode choice model involves estimating the model parameters to maximize the likelihood that an individual chooses to use the observed alternative as a function of the characteristics of the individual and the attributes of the modes.

To conduct the research, a comprehensive framework was established for selecting the specific group of individuals to participate in the survey. In this context, the target group consisted of individuals aged 18 and above residing in Tehran. Individuals under the age of 18 were excluded from the study sample because of their lack of driving experience, which would limit their capacity to make an informed choice among considered alternatives. A random sampling technique was employed to select survey participants. This approach was instrumental in ensuring that the individuals surveyed came from diverse backgrounds and demographics within each subgroup. Before the survey interviews took place, participants were provided proper information about the survey's objectives and purpose. Informed consent was sought and obtained from each respondent before proceeding with the face-to-face survey interviews. These interviews were conducted by trained interviewers, ensuring that the data collected were both detailed and standardized in nature.

3.1. Survey questionnaire

Following data cleaning, the final sample size for analysis consisted of 507 respondents. The questionnaire was structured into four parts. The first part included questions on respondents' current travel patterns, such as the most frequently used transportation modes and the average travel time for the mentioned trips. The second part involved a seven-point Likert scale (Likert, 1932) psychological statements that aimed to assess the perceived satisfaction with the mentioned trips. This part also included five-point Likert scale attitudinal statements that aimed to assess individuals' attitudes toward each travel mode (private car, ride-hailing, and UAT), considering factors such as convenience, comfort, relaxation, safety, and environmental compatibility.

In the third section of the study, eight scenarios present stated choice situations with suggested attributes of the service including trip duration and fare. These scenarios are adapted to Tehran and present a hypothetical trip with three available modal alternatives including private car, ride-hailing, and urban air taxi. Table 1 summarizes the eight scenarios. For private car travel time and cost are the only attributes while for ride-hailing and air taxi alternatives access time is also considered.

The final part of the questionnaire comprised questions regarding the socio-demographic and economic attributes of the participants, including age, gender, education, occupation, and income.

3.2. Mode choice

The approach assumes that mode choices are determined by a decision-making process that incorporates both observed and unobserved factors. Latent variables are utilized to represent unobserved factors that reflect personal psychological perceptions during the daily commute and attitudes toward high-demand ground transportation modes. The Biogeme software package (Bierlaire, 2023) is applicable for estimating multinomial logit models that involve latent variables. Latent variables can be created through structural equation modeling of ordinal logit regression models, which consider the ordered nature of responses. Fig. 1 depicts the modeling framework for this approach, depicting the connections between the latent variables and the observed mode choices. This modeling approach offers a robust and adaptable framework for examining mode choice behavior.

Attitude, considered a central element within the Theory of Planned Behavior (Ajzen, 1991), plays a significant role in influencing behavior. In the present study, we have developed specific attitudinal items, denoted as private car, ride-hailing, and urban air taxi

Table 1
Stated preference survey scenarios.

Mode	Scenarios			
	Scenario 1	**Scenario 2**	**Scenario 3**	**Scenario 4**
	200 thousand tomans **cost** 50 min **travel time**	100 thousand tomans **cost** 60 min **travel time**	200 thousand tomans **cost** 50 min **travel time**	200 thousand tomans **cost** 40 min **travel time**
	200 thousand tomans **cost** 50 min **in-vehicle travel time** 15 min **access time**	100 thousand tomans **cost** 60 min **in-vehicle travel time** 25 min **access time**	200 thousand tomans **cost** 50 min **in-vehicle travel time** 25 min **access time**	200 thousand tomans **cost** 40 min **in-vehicle travel time** 15 min **access time**
	400 thousand tomans **cost** 15 min **in-vehicle travel time** 20 min **access time**	400 thousand tomans **cost** 20 min **in-vehicle travel time** 10 min **access time**	200 thousand tomans **cost** 25 min **in-vehicle travel time** 10 min **access time**	400 thousand tomans **cost** 10 min **in-vehicle travel time** 20 min **access time**
	Scenario 5	**Scenario 6**	**Scenario 7**	**Scenario 8**
	100 thousand tomans **cost** 60 min **travel time**	100 thousand tomans **cost** 70 min **travel time**	100 thousand tomans **cost** 70 min **travel time**	200 thousand tomans **cost** 40 min **travel time**
	100 thousand tomans **cost** 60 min **in-vehicle travel time** 15 min **access time**	100 thousand tomans **cost** 70 min **in-vehicle travel time** 15 min **access time**	100 thousand tomans **cost** 70 min **in-vehicle travel time** 25 min **access time**	200 thousand tomans **cost** 40 min **in-vehicle travel time** 25 min **access time**
	200 thousand tomans **cost** 10 min **in-vehicle travel time** 20 min **access time**	200 thousand tomans **cost** 15 min **in-vehicle travel time** 20 min **access time**	400 thousand tomans **cost** 25 min **in-vehicle travel time** 10 min **access time**	200 thousand tomans **cost** 20 min **in-vehicle travel time** 10 min **access time**

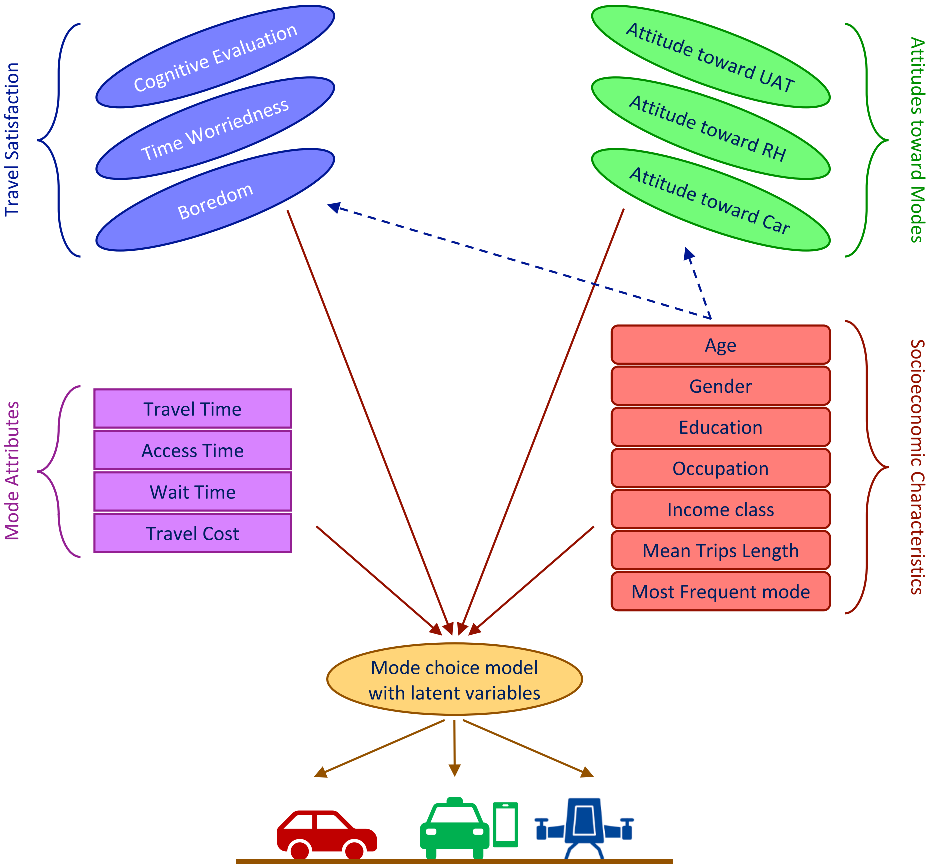

Fig. 1. Modeling framework.

mode-specific attitudes as illustrated in Fig. 1. These items are designed to capture the impact of various aspects and motivations associated with different modes of transportation on individuals' future behavioral choices. The concept of attitude has been used in diverse transportation research contexts, such as travel mode choice (Noblet et al., 2014; Nordfjærn et al., 2014) and the intention to use alternative modes of transportation instead of traditional vehicles (e.g., Buckley et al., 2018; Chen and Yan, 2019; Motak et al., 2017; Sener and Zmud, 2019). For instance, Karami et al. (2023) demonstrated that in a world where fully automated vehicles are prevalent for long-distance travel, individuals' attitudes toward autonomous vehicles, trains, planes, and buses can significantly influence their intention to use such vehicles in the future. Consequently, we formulate our first hypothesis as follows:

H1: Holding favorable attitudes towards urban air taxis, private cars, and ride-hailing services can have a positive impact on individuals' intentions to use these modes in the future. Additionally, having a negative attitude towards traditional modes of transportation can enhance the preference for urban air taxis as a novel transportation option.

In general, it is widely accepted that customer loyalty and behavior are predominantly influenced by satisfaction (Lai and Chen, 2011). Furthermore, numerous studies have consistently identified customer satisfaction as the primary driver of positive behavioral intentions (Chen, 2008). Many previous studies in the literature have examined satisfaction in the context of mode choice (De Vos, 2019; De Vos et al., 2015; Kolarova and Cherchi, 2021; Sivasubramaniyam et al., 2020; Smith, 2017). Therefore, we also assessed the level of satisfaction among survey participants regarding their experiences with current conventional transportation modes. For instance, Kolarova and Cherchi (2021) emphasize the significance of satisfaction with technology, specifically with advanced driver assistance systems, in enhancing trust and fostering a positive assessment of automated driving. Hence, our initial hypothesis is framed as follows:

H2: Individuals who find their daily commutes monotonous and tiring are more likely to consider using Urban Air Taxis (UAT). Also, those who experience concerns about punctuality and have a higher level of time-related stress tend to favor UAT even more, with a more substantial influence on their preference for UAT than fatigue. The research suggests that an overall feeling of dissatisfaction with daily commute experiences increases the preference for UAT as an alternative mode of transportation.

4. Results

4.1. Sample description

The study's sample size comprises 507 individuals. The principal attributes of the participants in the dataset are documented in Table 2. It is noteworthy that the distribution of gender, employment status, and car availability situation aligns fairly well with the demographic statistics of the 2016 Census population of Tehran.

The age distribution of the sample corresponds well with the age distribution of Tehran. The largest age group of the sample is between 25 and 34 years old, with 28.01 % of the participants belonging to this group, followed by the 35–44 years old group at 22.29 %. On the other hand, the smallest age group is represented by participants over 65 years old, accounting for only 8.88 % of the sample. The gender distribution is almost equal, with males comprising 49.90 % of the participants and females accounting for 50.10 %, which is consistent with the census data. In terms of occupation, 54 % of the sample are employed, and the highest proportion belongs to housewives, accounting for 23.08 % of the sample. The difference in employment between the sample and census data can be explained by the fact that self-employed individuals are not included in the official employment in census data. For the education level, the majority of the participants hold a Bachelor's degree, representing 43.39 % of the sample, followed by high school diploma holders at 20.12 %. The most common household income class is equivalent to the public, with 53.65 % of the participants belonging to this group.

In relation to transportation behaviors, the most frequently utilized mode of transportation is the private car passenger, which comprises 40.04 % of the surveyed individuals, followed closely by public transport at 35.11 %. Active modes (walking and cycling),

Table 2
Summary of sample and census data characteristics.

	Total sample (N = 507)		*% in 2016 census of the Tehran city*
Age	18–24	12.82 %	*12.75 %*
	25–34	28.01 %	*29.37 %*
	35–44	22.29 %	*23.62 %*
	45–54	16.17 %	*18.5 %*
	55–64	11.83 %	*13.44 %*
	more than 65	8.88 %	*11.66 %*
Gender	Male	49.90 %	*49.73 %*
	Female	50.10 %	*50.27 %*
Occupation	Full time job	21.30 %	
	Part time job	13.02 %	
	Self employed	18.54 %	
	Housewife	23.08 %	
	University student	7.69 %	
	Retired	8.28 %	
	Unemployed	8.09 %	
Education level	Unfinished high school	10.85 %	
	Highschool diploma	20.12 %	
	Associate degree	11.05 %	
	Bachelor degree	43.39 %	
	Master of science degree	11.05 %	
	Ph.D.	3.55 %	
Household income class in relation to the general public	Much above	5.92 %	
	Above	15.78 %	
	Equal to public	53.65 %	
	Below	18.34 %	
	Much below	5.52 %	
Average daily trips duration	Less than 15 min	8.68 %	
	15–30 min	19.92 %	
	30–45 min	21.89 %	
	45–60 min	20.71 %	
	More than one hour	28.80 %	
Most used travel mode	Private car as driver	12.43 %	
	Private car as passenger	40.04 %	
	Public transport	35.11 %	
	Bicycle	2.96 %	
	Walk	9.47 %	

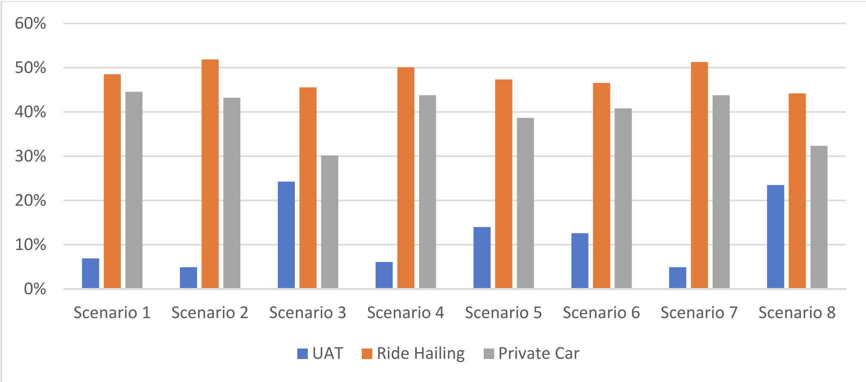

Fig. 2. Adoption of each travel mode in each scenario.

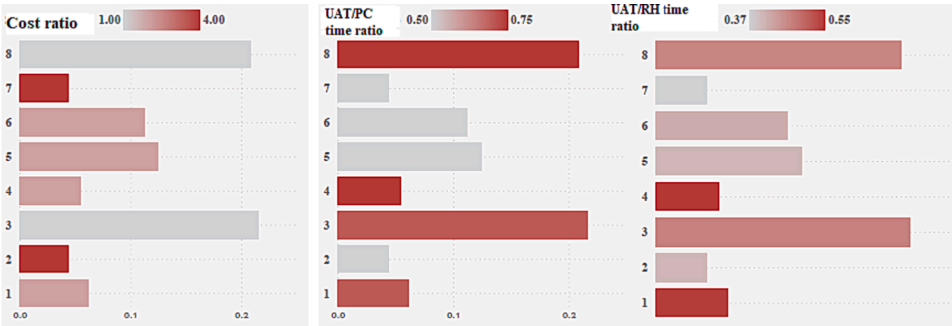

Fig. 3. Adoption of each travel mode in each scenario with specified travel cost and travel time ratios.

also accounts for 12.4 % of the respondents' main transport mode. These outcomes are consistent with the findings of a report from a survey conducted by the Tehran Traffic and Transportation Organization (TTTO) in 2014, which reported that the modal share of public transport and active modes, such as walking and cycling, for commuting is 37.4 % (Mojtehedzadeh, 2019). Furthermore, the average length of daily trips taken by participants varies significantly, with the majority of survey respondents, at 28.80 %, taking trips that exceed one hour, while the smallest proportion of respondents, at 8.68 %, take trips that last less than 15 min.

Fig. 2 shows the choice of mode in each scenario within the study. The results indicate that the highest rate of adoption for UAT is observed in scenarios 3 and 8, where the cost of using UAT is equal to that of private cars and ride-hailing services (see Fig. 1). In contrast, the lowest share of UAT adoption is observed in scenarios 2 and 7, where the cost difference between UAT and other alternatives is the highest, notwithstanding that there exists a noticeable difference in travel time between UAT and the other two modes.

The use of Fig. 3 can facilitate a better comprehension of the present argument. For instance, an examination of graphs 1 and 2 reveals that the cost ratio is at its lowest in scenarios 3 and 8. However, these scenarios exhibit a high ratio of air taxi time to car (and in diagram 3, the ratio of air taxi time to ride-hailing) while simultaneously having the highest acceptance of air taxi. Conversely, scenario 2 and 7 exhibit the least acceptance, despite having a low time ratio (graphs 2 and 3). This is due to the high cost ratio (graph 1) associated with these scenarios. Thus, it can be inferred that the cost factor has a more pronounced influence on the adoption of UAT.

These observations suggest that the cost of using UAT plays a crucial role in the mode choice of individuals, and that a higher rate of adoption can be achieved when the cost of UAT is competitive with other modes of transportation. Kreimeier and Stumpf's (2017) research on consumer adoption in Germany yielded similar results, as they discovered that cost was a crucial factor in determining consumer adoption.

4.2. The satisfaction with travel scale

The assessment of travel satisfaction is primarily centered on cognitive or emotional evaluation of the trip (Singleton, 2019; De Vos et al., 2013). The questionnaire developed by Vahedi et al. (2021) to assess travel satisfaction comprises nine items that measure two emotional dimensions and one cognitive dimension. Respondents are asked to rate their emotional and cognitive experiences on a 7-point Likert scale, ranging from a minimum or negative evaluation of −3 to a maximum or positive evaluation of + 3. This scale has been used in previous research (Singleton, 2019; Ettema et al., 2010) and is commonly used to assess the emotional and cognitive dimensions of various constructs. Participants were instructed to choose the option that most accurately reflected their overall travel experience. This instruction was given in order to elicit an accurate representation of the participants' experiences and to provide

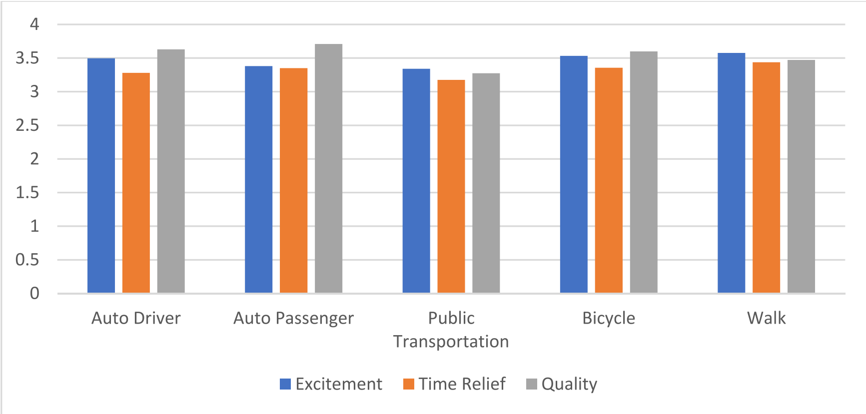

Fig. 4. Travel Satisfaction among users of each travel mode as their dominant travel mode for daily travels.

valuable insights into the factors that contribute to travel satisfaction. The components of travel satisfaction consist of items related to the level of enthusiasm or boredom experienced during travel (BR), the degree of relaxation or worry related to punctuality (WR), and the overall cognitive quality evaluation of their trips (CG). These components were identified as being key factors that contribute to overall travel satisfaction and were integrated into the assessment instrument in order to more accurately measure this construct (Ettema et al., 2010). The respondents indicated their primary mode of transportation for their daily commutes. Fig. 4 depicts their level of satisfaction regarding their daily travel experiences, in relation to the specific mode of transportation employed.

The results indicate that individuals who engage in walking and cycling consistently report heightened levels of enthusiasm. This finding aligns with the previous research conducted by De Vos (2019), which similarly identifies a strong correlation between walking, cycling, and elevated levels of travel satisfaction specifically related to the experience of excitement. Active mode users also experience more time relief compared to users of other modes of transportation, as they avoid congestion and the need to search for parking spaces. Additionally, incorporating physical activity into their daily routine can provide active mode users with a sense of well-being and reduce stress levels. Conversely, public transport users have reported the lowest levels of satisfaction attributes as expected (De Vos, 2019). Private car passengers perceive high levels of quality for their commute trips; however, private car drivers experience low levels of time relief due to traffic congestion and the need to search for parking spaces.

Table 3
Descriptive statistics of item responses on travel satisfaction and mode attitudes.

Latent Variable		Cronbach's Alpha	Item	Mean	SD
Satisfaction	Boredom	0.86	These trips are usually tedious (BR_1)	3.268	1.1365
			I am fed up with taking these trips (BR_2)	3.598	1.0234
			These trips are usually tiring (BR_3)	3.347	0.985
	Worriedness	0.821	These trips are usually rushed (WR_1)	3.239	0.985
			I am usually concerned about being on time when taking these trips (WR_2)	3.191	0.9305
			These trips are usually stressful (WR_3)	3.436	0.9351
	Cognitive	0.845	These trips are worse than what I think (CG_1)	3.584	1.0207
			These trips usually have low standards (CG_2)	3.609	1.0207
			These trips are usually done with difficulty (CG_3)	3.371	1.0183
Attitude	Attitude_UAT	0.938	I think using UAT is comfortable (UAT_1)	2.349	0.9167
			I think using UAT is pleasant (UAT_2)	2.647	1.0038
			I think using UAT creates a good feeling in me (UAT_3)	2.623	1.0283
			I think using UAT is a good idea (UAT_4)	2.663	1.0111
			I believe that using UAT will be safe (UAT_5)	2.801	0.9929
			I think UAT are environmentally friendly (UAT_6)	2.682	0.9999
	Attitude_RH	0.888	I think using ride-hailing is comfortable (RH_1)	1.998	0.7127
			I think using ride-hailing is pleasant (RH_2)	1.923	0.6624
			I think using ride-hailing creates a good feeling in me (RH_3)	1.978	0.7068
			I think using ride-hailing is a good idea (RH_4)	1.913	0.629
			I believe that using ride-hailing will be safe (RH_5)	2.089	0.7426
			I think ride-hailing are environmentally friendly (RH_6)	2.221	0.7792
	Attitude_PC	0.824	I think using private car is comfortable (PC_1)	1.951	0.7382
			I think using private car is pleasant (PC_2)	2.091	0.7516
			I think using private car creates a good feeling in me (PC_3)	2.026	0.681
			I think using private car is a good idea (PC_4)	2.055	0.6418
			I believe that using private car will be safe (PC_5)	2.063	0.6563
			I think private car are environmentally friendly (PC_6)	2.406	0.8647

4.3. Attitudes toward travel modes

The strength of an individual's inclination towards a particular mode of travel is a significant determinant of their ultimate choice, and incorporating this variable into disaggregate choice models can significantly enhance their predictive validity (Ben-Akiva et al., 1999). The attitude towards a travel mode refers to the extent to which an individual evaluates or appraises a particular mode of transportation in a favorable or unfavorable manner (De Vos et al., 2022). Attitudes towards travel modes can be assessed through survey instruments that inquire about the degree to which respondents associate positive attributes, such as relaxation, safety, and enjoyment, with the use of specific modes of transportation (Kroesen et al., 2017; Karami et al., 2022; Samadzad et al., 2023).

The indicators devised to assess the corresponding attitude of individuals towards each mode were formulated utilizing the items employed by Kroesen and Chorus (2020) and Ton et al. (2020). To measure attitudes towards three modes of transportation: urban air taxis (UAT), private cars (PC), and ride-hailing (RH), we employed a survey instrument consisting of six items that assessed respondents' level of favorability towards each mode in terms of relaxation, safety, convenience, and environmental compatibility (Kroesen and Chorus, 2020). The survey items were rated on a 5-point Likert scale ranging from strongly disagree (-2) to strongly agree (+2). This approach allowed for a comprehensive evaluation of attitudes towards each mode of transportation and provided a nuanced understanding of the factors that influence individuals' transportation choices.

Table 3 shows the mean and standard deviation of the responses for each item regarding both travel satisfaction and attitudes

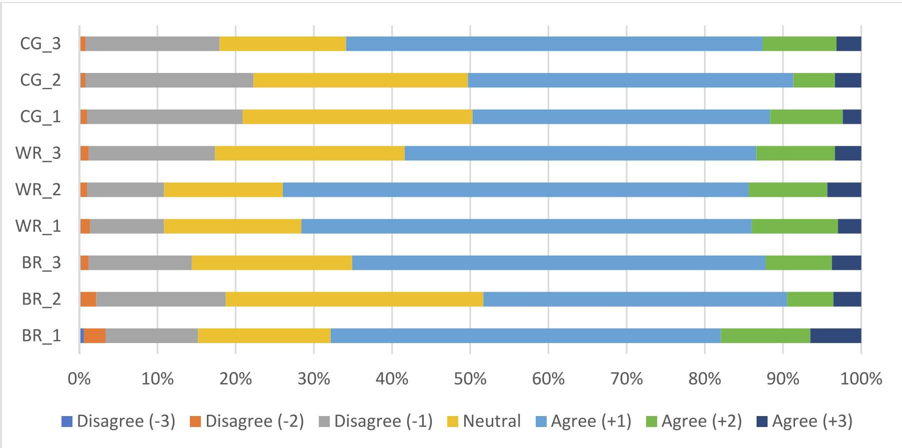

Fig. 5. The distribution of responses to each item of travel satisfaction (disagreement indicates satisfaction).

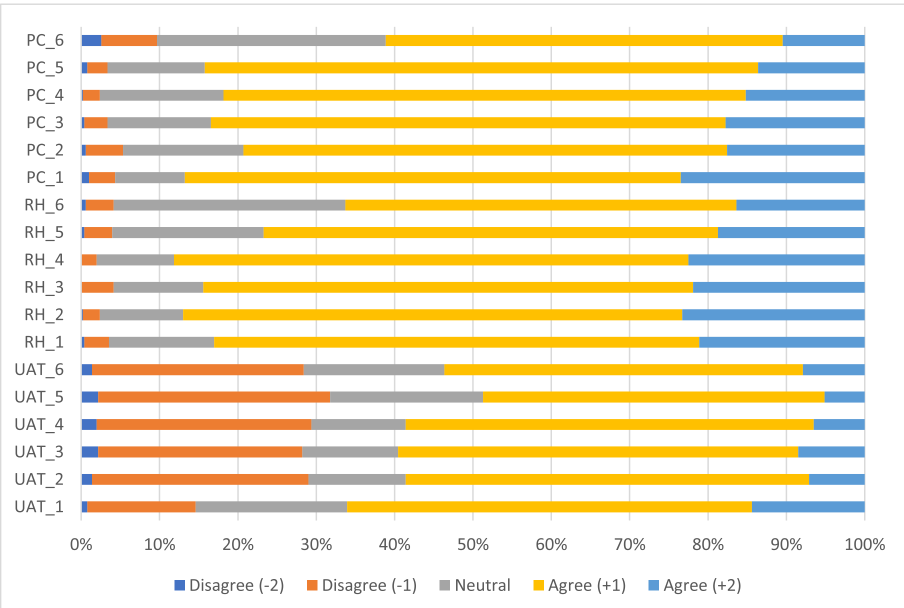

Fig. 6. The distribution of responses to items indicating attitudes toward different travel modes (disagreement indicates unfavorable attitude).

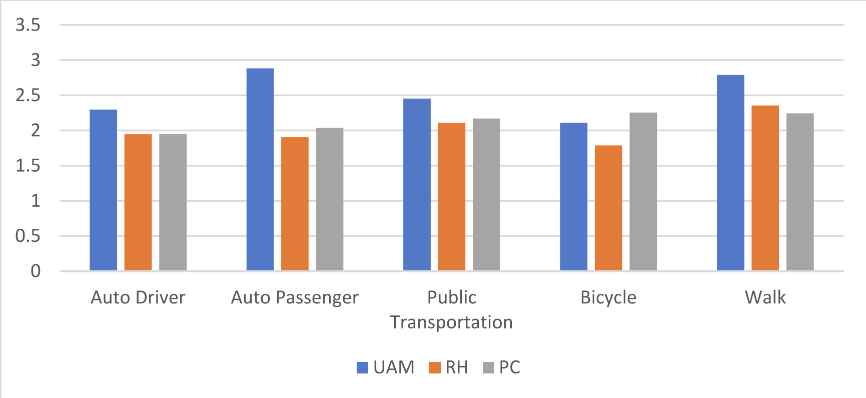

Fig. 7. The attitudes of users of each existing travel mode towards UAT, ride-hailing, and private cars (higher levels indicate greater levels of unfavorable attitude).

toward travel modes. The table also presents Cronbach's alpha values for each latent factor. Furthermore, the distribution of responses for each item for travel satisfaction is visually depicted in Fig. 5.

Fig. 6 serves as a comprehensive depiction of the distribution of responses encompassing individuals' attitudes towards travel modes. Specifically, it showcases the range of agreement or disagreement expressed by participants in response to a series of attitudinal statements pertaining to these modes of transportation.

Fig. 7 represents the level of agreement with positive attitudes towards UAT, ride-hailing, and private car among different existing travel mode users (the grades assigned indicate the extent of disagreement, with higher grades indicating more disagreement). The results indicate that private car drivers and cyclists displayed less disagreement towards UAT compared to private car passengers and walkers. Satisfaction with their current travel modes may be a valid justification.

4.4. Factor analysis

Table 4 presents the results of the exploratory factor analysis conducted on respondents' perceptions of satisfaction and attitudes towards travel. The analysis yielded three factors for each variable, which accounted for a cumulative variance of 68 % and 66 % of the total variance, respectively. Each factor explained more than 10 % of the total variance, which is considered an acceptable level of explanation according to Costello and Osborne (2005).

According to Tabachnick and Fidell (2001) a minimum loading of 0.32 should generally be considered acceptable. However,

Table 4
Exploratory factor analysis of travel satisfaction and mode attitudes: item loadings and factor structure.

Satisfaction				–	Attitudes			
Items	Factor 1	Factor 2	Factor 3		Items	Factor 1	Factor 2	Factor 3
BR_1	0.759				UAT_2	0.924		
BR_2	0.725				UAT_3	0.889		
BR_3	0.767				UAT_4	0.938		
CG_1		0.703			UAT_5	0.821		
CG_2		0.782			UAT_6	0.906		
CG_3		0.659			RH_1		0.745	
WR_1			0.793		RH_2		0.821	
WR_2			0.687		RH_3		0.818	
					RH_4		0.706	
					RH_5		0.710	
					RH_6		0.521	
					PC_1			0.631
					PC_2			0.790
					PC_3			0.801
					PC_4			0.608
					PC_5			0.528
Sum of square of loadings	2.042	1.902	1.541		Sum of square of loadings	4.263	3.712	2.604
Proportion variance	0.255	0.238	0.193		Proportion variance	0.266	0.232	0.163
Cumulative variance	0.255	0.493	0.686		Cumulative variance	0.266	0.498	0.661

Costello and Osborne (2005) suggest that if an item has several strong loaders (0.50 or better) on each factor, it should be dropped from the analysis. Therefore, in this study, items with loadings below 0.5 were excluded from the analysis. As a result, the item UAT_1 was dropped from the factor analysis due to its loading of 0.46. A satisfaction and attitude item (WR_3 and PC_6 respectively) was also omitted from the analysis due to inconsistency with the other factors and anticipated classifications.

Finally, the results of structural equation models, employing ordinal logit models for latent variables are provided in Table 4.

4.5. Structural equation modeling

Following the application of factor analysis to the items, utilizing the Pandas Biogeme package (Bierlaire, 2020), a total of six latent variables were generated from the socio-demographic variables in an ordinal logit model. The outcomes of each latent structure are presented in Table 5.

According to the results, 25–34 year-old women report less overall satisfaction with their travels, while 25–44 year old males report greater boredom on their regular journeys. Individuals within this age group are typically in a stage of life where they are juggling high levels of career and family responsibilities. Consequently, these individuals may experience increased levels of boredom during their regular commutes, as these trips may lack novelty or a sense of freedom. Job status and travel time are also determinant factors, in accordance with Smith (2013). Full-time employees, who often have more rigid work schedules, and individuals whose daily commute exceeds the average duration of one hour are more likely to experience boredom and exhaustion when commuting. Similarly, self-employed individuals and students may feel more bored and exhausted during their commutes, which could be attributed to their youth. Individuals who work part-time jobs or are self-employed express greater concern regarding punctuality during their commute. The issue at hand may pertain to a potential difference in job security between part-time employees and their full-time counterparts, or the scheduling of important meetings. Conversely, high-income individuals tend to experience greater levels of enthusiasm and less boredom during their commutes. This is consistent with Ye and Titheridge (2019), who found lower travel satisfaction among low-income individuals. This may be due to their increased flexibility in work schedules, greater financial resources to invest in transportation, and access to a broader range of transportation options. Finally, those who rely primarily on public transport as their mode of commute tend to experience higher levels of boredom and exhaustion. This aligns with Mao et al. (2016) who found the lowest levels of satisfaction among public transport users. This could be attributed to factors such as crowded conditions and a lack of control over their commute. They are also more concerned with being on time, a result of the unreliability of public transport travel times. Private car drivers and passengers, however, tend to perceive a higher level of cognitive quality in their travel experiences. This is similarly observed among individuals who utilize bicycles for their daily commute which is similar to the finding of Morris and Guerra (2014), who found more satisfaction among private car and bicycle users compared to public transport. Despite the observed positive relationship between the use of bicycles and increased travel satisfaction, our findings do not necessarily align with the literature that suggests the highest level of satisfaction among bicycle users in comparison with other modes (Smith, 2013; Mao et al., 2016).

There is a generally favorable attitude towards the use of UAT, as indicated by the coefficient intercept for the ordinal logit model. Analysis of the socio-demographic factors reveals that young males aged 18 to 24 exhibit a positive attitude towards UAT, whereas those aged 45 to 54 hold a negative attitude. Full-time employed individuals demonstrate a positive attitude towards UAT which is in contrast with housewives' attitude. Furthermore, those who have a high school diploma and belong to high-income groups display a positive attitude towards UAT, whereas individuals with average or low income exhibit unfavorable attitudes. Individuals who primarily use private cars or public transport exhibit a positive attitude towards UAT. Additionally, those whose average commute time ranges from 30 to 45 min express a positive attitude towards the use of UAT.

Similar to UAT, the individual's attitude towards using private cars is affected by various factors such as age, gender, income, education, job status, average trip length, and dominant mode for the commute. The model indicates that middle-aged females tend to exhibit negative attitudes toward using private cars. This could be attributed to their lower tolerance for traffic congestion and car-related issues. On the other hand, individuals with higher incomes and those who travel long distances, more than an hour, exhibit more favorable attitudes towards using private cars. The former group may be better equipped to handle the costs of owning and operating a private car, which can explain this observation. Meanwhile, the latter group may find public transport inconvenient or uncomfortable, especially if their trip involves transfers or standing for extended periods. Private cars, in contrast, offer more comfort and convenience. The results of the model also suggest that private car users exhibit a positive attitude towards using this mode of transportation, confirming a positive correlation between attitudes and travel behavior (Ton et al., 2020).

According to the model, it appears that females between the ages of 35–44 have a favorable attitude toward using ride-hailing services, possibly due to the convenience it offers as a mode of transportation. Lower-income individuals and undergraduates have shown unfavorable attitudes toward using ride-hailing. It is worth mentioning Lesteven and Samadzad (2019) suggesting that ride-hailing use is less prevalent among these two groups of individuals.

Table 5
Structural equation modeling of latent variables.

	Satisfaction_BR		Satisfaction_WR		Satisfaction_CG		Attitude_UAT		Attitude_PC		Attitude_RH	
Variable	Value	t-Statistic	Value	t-Statistic	Value	t-Statistic	Value	t-Statistic	Value	t-Statistic	Value	t-Statistic
Constants												
delta_1	0.348	17.6 (***)	0.327	13.3 (***)	0.378	18.2 (***)	0.251	16.90 (***)	0.366	15.70 (***)	0.495	17.70 (***)
delta_2	1.240	24.9 (***)	1.670	24.6 (***)	1.50	24.5 (***)	1.85	24.70 (***)	1.70	24.10 (***)	1.75	24.30 (***)
delta_3	0.558	12.6 (***)	0.769	10.9 (***)	0.682	11.3 (***)						
sigma_1	1	–	1	–	1	–			1	–	1	–
sigma_2	0.82	55 (***)	1.01	68.90 (***)	0.985	60.10 (***)	1	–	0.886	54.50 (***)	0.568	40.50 (***)
sigma_3	0.783	53.7 (***)			0.989	62.40 (***)	0.765	52.40 (***)	0.763	50.10 (***)	0.643	44.50 (***)
sigma_4							0.572	42.30 (***)	0.729	50.20 (***)	0.636	46.70 (***)
sigma_5							0.790	54.20 (***)	0.828	55.70 (***)	0.772	50.90 (***)
sigma_6							0.672	49.40 (***)	–	–	1.110	62.00 (***)
beta_1	1	–	1	–	1	–			1	–	1	–
beta_2	0.974	42 (***)	1.07	54.10 (***)	0.96	36.70 (***)	1	–	1.04	74.80 (***)	1.050	49.90 (***)
beta_3	0.941	36.6 (***)			0.94	26.20 (***)	1.040	59.90 (***)	1.09	80.90 (***)	1.040	48.40 (***)
beta_4							1.050	64.00 (***)	1.02	79.50 (***)	0.914	45.60 (***)
beta_5							0.909	53.80 (***)	0.993	74.60 (***)	0.979	75.10 (***)
beta_6							1	60.70 (***)	–	–	0.646	29.10 (***)
coef_intercept	−0.198	−3.95 (***)	−0.861	−9.01 (***)	−1.04	−8.38 (***)	−0.553	−7.64 (***)	−1.450	−16.40 (***)	−1.79	−19.00 (***)
Age and gender (Base: More than 65 female)												
18–24 male			0.243	1.62	0.247	1.95(.)	−0.346	−3.34(***)				
18–24 female												
25–34 male	−0.262	−2.69 (**)										
25–34 female	−0.348	−3.62 (***)	−0.28	−2.54 (*)	−0.279	−2.79 (**)						
35–44 male	−0.177	−1.86 (.)										
35–44 female			0.174	1.48							−0.207	−2.52 (*)
45–54 male							−0.226	−2.44(*)				
45–54 female					−0.156	−1.31			0.212	2.83 (**)		
55–64 male												
55–64 female												
more than 65 male												
Occupation (Base: Unemployed)												
Full-time job	−0.128	−1.72(.)			0.396	3.97 (***)	−0.275	−3.83(***)				
Part-time job			−0.401	−3.45 (***)					0.232	3.69 (***)	−0.16	−2.17 (*)
Self-employed	−0.348	−3.77(***)	−0.468	−4.2 (***)							−0.076	−1.40
Housewife					0.55	5.28 (***)	0.264	4.19 (***)				
University student	−0.231	−1.98(*)			0.491	3.49 (***)						
Retired					0.409	3.18 (**)						

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Table 5 (*continued*)

Variable	Satisfaction_BR		Satisfaction_WR		Satisfaction_CG		Attitude_UAT		Attitude_PC		Attitude_RH	
	Value	t-Statistic	Value	t-Statistic	Value	t-Statistic	Value	t-Statistic	Value	t-Statistic	Value	t-Statistic
Education level (Base: PhD)												
Unfinished high school					0.216	1.8(.)			0.144	1.88(.)	0.165	2.09 (*)
Highschool diploma					0.352	3.38(***)	−0.253	−3.99(***)	0.187	2.92(**)		
Associate degree												
Bachelor degree					0.187	2.25(*)			0.415	7.55(***)		
Master of science degree												
Household income class in relation to the general public (Base: Much below)												
Much above							−0.498	−4.26(***)	−0.165	−1.79 (.)		
Above	0.265	2.97 (**)	0.233	1.97 (*)								
Equal to public			0.441	4.57 (***)	0.15	2.19 (*)	0.842	9.67(***)			0.687	7.92 (***)
Below							0.39	4.41(***)	0.667			6.66 (***)
Average daily trips duration (Base: Less than 15 min)												
15–30 min			−0.155	−1.64								
30–45 min			−0.255	−2.72 (**)			−0.289	−4.59(***)	−0.200	−3.78 (***)	−0.151	−3.00 (**)
45–60 min												
More than one hour	−0.123	−1.94 (.)			−0.177	−2.38 (*)			−0.275	−5.42 (***)		
Most used travel mode (Base: Walk)												
Private car driver					0.558	4.73 (***)	−0.247	−3.03(**)	−0.284	−3.98 (***)	0.114	1.73(.)
Private car passenger					0.602	6.54 (***)			−0.156	−3.23 (**)		
Public transport	−0.087	−1.44	−0.23	−2.72 (**)			−0.545	−8.11(***)				
Bicycle					0.388	2.04 (*)					−0.423	−3.42 (***)
Model estimation summary												
Initial Log-Likelihood	−2959.7		−1973.2		−2959.7		−4079.9		−4079.9		−4895.9	
Final Log-Likelihood	−2100.7		−1237.1		−2006.9		−2857.8		−2446.5		−3056.9	
Rho-squared	0.290		0.373		0.322		0.300		0.400		0.370	

Table 6
Multinomial logit model results containing latent variables of satisfaction and attitudes.

	UAT		Ride-hailing		Private Car	
Parameter	Value	t-Statistic	Value	t-Statistic	Value	t-Statistic
Constants	-6.270	-4.82 (***)	–	–	-1.580	−2.28 (*)
Age and gender (Base: More than 65 female)						
18–24 male			−1.570	−8.46 (***)		
18–24 female	1.020	4.68 (***)				
25–34 male	0.605	3.27 (**)	−0.690	−5.38 (***)		
25–34 female						
35–44 male			−0.450	−3.58 (***)		
35–44 female	0.964	4.98 (***)				
45–54 male	0.512	2.44 (*)	−0.565	−3.87 (***)		
45–54 female			−0.379	−2.62 (**)		
55–64 male					0.933	5.65 (***)
55–64 female	−3.74	−3.64 (***)				
More than 65 male						
Occupation (Base: Unemployed)						
Full time job						
Part time job			1.080	8.05 (***)		
Self employed			1.370	5.72 (***)	0.477	2.04 (*)
Housewife	−0.525	−2.66 (**)				
University student					0.447	3.02 (**)
Retired						
Education level (Base: PhD)						
Unfinished high school	−0.536	−1.83 (.)			0.510	3.80 (***)
Highschool diploma						
Associate degree						
Bachelor degree	0.409	2.83 (**)			−0.417	−4.49 (***)
Master of science degree						
Household income class in relation to the general public (Base: Much below)						
Much above	0.950	3.86 (***)			−0.986	−5.19 (***)
Above	1.090	6.09 (***)				
Equal to public						
Below						
Average daily trips duration (Base: More than one hour)						
Less than 15 min			−1.780	−9.69 (***)		
15–30 min						
30–45 min			−0.319	−3.12 (**)		
45–60 min					0.280	2.87 (**)
Most used travel mode (Base: Walk)						
Private car as driver						
Private car as passenger						
Public transport					0.327	3.34 (***)
Bicycle						
Latent variables						
Satisfaction_1	−0.305	−3.02 (**)				
Satisfaction_2	−0.419	−2.00(*)			−0.956	−4.43 (***)
Satisfaction_3			0.348	3.49 (***)		

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Table 6 (*continued*)

	UAT		Ride-hailing		Private Car	
Parameter	Value	t-Statistic	Value	t-Statistic	Value	t-Statistic
Attitude_UAT	−0.545	−11.60 (***)	0.360	10.60 (***)	0.186	6.15 (***)
Attitude_PC	0.140	1.38[a]			−0.393	−4.77 (***)
Attitude_RH	0.589	6.09 (***)	−0.632	−11.40 (***)		
Travel attributes						
In-vehicle time	−0.159	−8.3 (***)	−0.102	−5.44 (***)	−0.091	−4.88 (***)
Travel cost	−0.012	−11.8 (***)	−0.036	−7.49 (***)	−0.037	−8.11 (***)
Model estimation summary						
Initial Log-Likelihood	−172040.1					
Final Log-Likelihood	−98763.7					
Rho-squared	0.425					

[a] The variable was kept despite it being only significant at 0.167 level.

5. Multinomial logit model

A multinomial logit model was developed to assess the impact of socio-demographic and latent variables on the adoption of UAT in the context of mode choice and the results are presented in Table 6. The modeling results indicate that socio-demographic variables, satisfaction with travel, and attitude towards travel modes are significant predictors of mode choice behavior. The summary of the goodness of fit and model estimation results are also included in Table 6.

5.1. *Socio-demographic variables*

The adoption of UATs over ride-hailing services is more prevalent among young males aged 25–34 and males aged 45–54. Males aged 18–24 have also shown a high propensity to use UAT. Middle-aged women aged 55–64, on the other hand, are less likely to use UATs. Age and gender are significant factors in the adoption of novel technologies. Younger individuals tend to be more tech-savvy and familiar with new technologies, which influences their adoption of UATs (Al Haddad et al., 2020). Conversely, women have been found to have a lower intention to use autonomous vehicles compared to men (Hohenberger et al., 2016). Additionally, individuals with higher incomes tend to prefer UATs over other modes of transportation. These findings are consistent with previous research by Fu et al. (2019) regarding the influence of age and income on UAT preference, as well as Castle et al. (2017) regarding the impact of age on UAT preference. Housewives exhibit lower adoption rates of UAT. Consistent with Castle et al. (2017) who indicated a greater preference for UAT among those with higher levels of education, our model demonstrates that individuals with bachelor's degrees exhibit a preference for UAT over private cars. This stands in contrast to the inclination of individuals who have not completed high school, as they exhibit a preference for private automobiles over the use of UAT. Self-employed individuals exhibit a preference for private cars and ride-hailing services, with a greater inclination towards the latter. This can be attributed to their relatively flexible schedules, which facilitate the use of ride-hailing services.

5.2. *Satisfaction and attitudes*

The findings of the study indicate that both satisfaction and attitudes play a significant role in the mode preference scenario that includes the option of using UAT among the available choices. The results suggest that individuals who experience greater levels of boredom during their daily commute exhibit a greater inclination towards utilizing UAT, as it provides a more enjoyable and entertaining travel experience (Al Haddad et al., 2020). The model's results suggest that individuals who perceive their daily commute to be boring and exhausting (STS_1) demonstrate a greater inclination towards utilizing UAT. Individuals who exhibit anxiety towards timeliness and possess a higher degree of time worry (STS_2) tend to display a preference for utilizing UAT, with an even higher impact on UAT utility compared to exhaustion. The study concludes that an overall sense of dissatisfaction with daily commute trips heightens the preference for UAT as an alternative. De Vos et al. (2022) found that a positive attitude towards a particular travel mode is positively associated with the preference for that mode in a mode choice scenario. This relationship is also confirmed by the model, indicating a favorable impact of the latent variable representing individuals' attitudes towards each travel mode on their corresponding mode preferences. The model shows that individuals who hold negative attitudes towards private cars and ride-hailing services are more likely to adopt UAM as a transportation mode. Compared to private car, negative attitudes towards ride-hailing have a more significant impact on the adoption of air taxis.

5.3. Value of travel time

The value of time spent during in-vehicle travel for UAM, ride-hailing services, and private cars are estimated to be 782,000 tomans per hour (equivalent to 26.4 dollars per hour[1]), 170,000 tomans per hour (equivalent to 5.37 dollars per hour), and 148,000 tomans per hour (equivalent to 5.25 US dollars per hour), respectively.

6. Discussion and conclusion

Urban Air Mobility (UAM) is being explored as a potential option for reducing travel times and addressing urban congestion, but its effectiveness and affordability remain subjects of ongoing research. While UAM holds promise in terms of potential benefits, it is important to note that the integration of UAM in urban mobility is currently in its nascent stages and requires further investigation. This is especially with regard to the dominance of conventional ground travel modes in urban mobility, particularly private cars. Consequently, the present study aims to investigate the adoption of UAM in urban mobility by integrating it into a mode choice scenario. Given the considerable significance of current satisfaction with trips and the attitude towards travel modes (De Vos, 2019; De Vos et al., 2022), this study is the first to investigate how these psychological factors impact the mode preference for UAM against two dominant ground travel modes, excluding public transport: private cars and ride-hailing. A survey was conducted to assess the UAM acceptance among the inhabitants of Tehran, a heavily populated metropolitan region in Iran. The questionnaire was developed and distributed to a sample of 507 individuals residing within the city. A hybrid multinomial logit choice model was employed to analyze the data, incorporating various socio-economic characteristics, psychological factors such as travel satisfaction and attitude, as well as travel time and cost. The study found that socio-demographic variables, namely gender, age, education, occupation, and income, as well as current mobility characteristics such as dominant commute mode and average daily commute time, exhibited significant influence on the mode preference of individuals. The findings indicate that socio-demographics play a crucial role in shaping latent attitudes and satisfaction. Additionally, the current mode of transportation may impact individuals' attitude towards air taxis, with private car and public transport users showing a positive attitude towards UAM.

In agreement with Hasan (2019), our findings also corroborate the significant role of affordability in the adoption of UAM. This is evidenced by two observations. Firstly, the only comparable level of UAM adoption in the eight scenarios analyzed was observed in those where the cost of urban air taxi was similar to that of ride-hailing and private cars. The adoption of UAT was also lowest in scenarios where the cost difference between UAT and conventional modes was highest, despite the significant time savings in those scenarios. Secondly, the cost coefficient had a significant impact on the disutility of UAT in mode choice modeling. Additionally, the modeling results evidently suggest that individuals with higher-than-average incomes are more likely to switch from private cars to UAM, which could exacerbate social equity issues. Therefore, policymakers must make a concerted effort to adjust the cost of UAM, as Cohen et al. (2021) have argued that negative community perceptions of UAM as a mode of transport for wealthy households to avoid traffic congestion is a major barrier to its adoption and integration.

The results confirm that, people's satisfaction with their daily travel can have an impact on their travel behavior (De Vos, 2019), demonstrating that the adoption of UAM will be significantly impacted by the satisfaction with routine daily travels. This conclusion was supported by the identification of two components of satisfaction. Individuals who experience boredom during their daily commute and those who express concern regarding punctuality have exhibited a preference for utilizing UATs, with time concern having more impact on UAT preference. This may potentially dissuade individuals who utilize private car who have exhibited the greatest degree of time-consciousness and anxiety for delays during their routine commute. Nonetheless, it is possible that this may not be perceived as impressive to individuals who frequently engage in active modes of transportation, as they have demonstrated greater levels of enthusiasm towards their daily commutes and low levels of concern regarding delays.

The estimated value of time for UAM in Tehran, which is approximately 26.4 dollars per hour, aligns with Haan et al. (2021). Their study determined the value of time for UAM users in New York City, Los Angeles, and Washington, D.C. to be 25.7 dollars per hour. However, in Munich, Fu et al. (2019) estimated a significantly higher value of total time at 55.0 dollars per hour. Conversely, Song et al. (2019) in Dallas and Los Angeles, and Ilahi et al. (2021) in Greater Jakarta estimated significantly lower value of time estimates. These variations in value of time estimates can be attributed to both the methodology of stated preference surveys and the specific characteristics of each context.

The importance of individuals' attitudes towards the modes in question serves as a significant determinant of their decision to adopt UAT in their mode preference. Unfavorable attitudes towards the other two alternatives exert a substantial and noteworthy influence on augmenting the utility of UAT, with higher impact of unfavorable attitude towards ride-hailing. This can be attributed to the fact that even though ride-hailing offers benefits such as comfort, convenience, and time savings over private cars, individuals who hold unfavorable attitudes towards ride-hailing may be seeking a more optimal alternative to avoid ground congestion. Therefore, compared to private car, unfavorable attitudes towards ride-hailing may have a greater effect on the preference for UAT among the available choices. These observations serve as further evidence that holding unfavorable opinions regarding existing alternatives can enhance the demand and desirability of novel ones.

The study's empirical findings highlight the significance of establishing promotional strategies for UAT that respond to various user segments. By taking into account the psychological aspects of prospective users, such as their satisfaction levels with their current

[1] At the time of the survey, the exchange rate between the United States dollar and the Iranian rial was approximately 28,000 tomans per dollar.

travels and their attitudes towards existing options, promotional strategies can be designed to accentuate the advantages of UAT over other alternatives, particularly private cars. The current transportation options available for daily commutes in congested urban areas such as Tehran have resulted in a significant level of dissatisfaction among individuals due to limited choices and various issues with commuting. Urban air mobility has appeared as a new mode of transportation with potential advantages when compared to conventional modes. As Balać et al. (2019) suggest, UAM may have a greater impact on transportation in heavily populated cities with congested ground traffic, compared to small cities like Zurich where its market share may be limited. However, the high cost associated with this mode of transportation can pose a challenge in Tehran, particularly considering the public's elevated cost sensitivity and the issue of social justice. Therefore, further research is necessary to determine the acceptable and affordable cost of urban air mobility services and to ensure their feasibility.

Analyzing the diversities in travel patterns among various demographic groups holds significant significance in the realm of public policy. This examination aids in the more effective allocation of limited resources to accommodate demand, ensures the satisfaction of travel requirements for individuals with limited mobility, and promotes the equitable distribution of policies among distinct population sectors and geographical regions (Garrow et al., 2021). Moreover, the study emphasizes the pivotal role of pricing in the adoption of UAM. Policymakers need to meticulously evaluate and, if necessary, modify the pricing of UAM services to ensure accessibility, taking into consideration the public's sensitivity to costs and concerns related to social equity. This may entail exploring options for financial assistance or innovative pricing structures.

Policy developers should formulate promotional strategies that consider the psychological aspects of potential UAM users, including their satisfaction with current travels and their attitudes toward existing alternatives. These strategies should highlight the merits of UAM, particularly when compared to private automobiles, as a means to mitigate dissatisfaction among commuters in densely populated urban areas. This could include designing messages and information campaigns about the vehicles, and it may involve marketing campaigns that focus on recommendations from trusted family and friends. In line with the insights from Shaheen et al. (2018), educational initiatives directed at the public can serve as a fundamental tool for introducing UAM as a viable transportation mode, particularly in regions with limited prior exposure to such technologies. These campaigns should focus on enhancing awareness and comprehension of UAM among the general populace.

This study has limitations that can provide valuable insights for future research endeavors. Firstly, our sample consisted of participants who had no prior exposure to UAM, and the questions regarding their inclination toward this transportation mode were framed as a hypothetical scenario. Despite providing respondents with comprehensive and precise information about UAM through the online survey, including textual and visual explanations, there is a possibility that their perceptions or preferences toward UAM may change when they actually engage with the system. The use of simulations or practical flight exposure in the context of UAM aircraft could potentially provide survey participants with a higher level of authenticity in understanding UAM travel (Shaheen et al., 2018).

Secondly, the data collection methodology relied predominantly on self-reported responses obtained from the survey participants. This approach is susceptible to biases such as social desirability bias and recall bias, which may influence the accuracy of the study's findings. Additionally, the study cohort was from a societal milieu with limited comprehension of the UAM ecosystem. While this is one of the only studies carried out on UAM in a developing country context, the application of our findings to alternative settings, particularly those marked by divergent socioeconomic characteristics and transportation infrastructures, requires prudence.

While the study examined travel satisfaction and attitudes towards modal alternatives, it focused on only a subset of these variables. Future research should consider a broader range of psychological factors that may influence UAM adoption. Additionally, while the study highlighted the time-saving and travel satisfaction benefits of UAM compared to other modes, it is important for future research to delve deeper into the realm of psychological factors, specifically environmental attitudes. This exploration is crucial for understanding the implications of UAM's advantages, particularly in relation to its adoption as an alternative to private cars. Variables such as noise pollution and greenhouse gas emissions, which have been identified as important factors in prior research (Mudumba et al., 2021), should be taken into account. Understanding and addressing the specific needs and attitudes of different user segments can play a significant role in driving UAM adoption.

This research presented a snapshot of UAM adoption preferences at this point in time, which may undergo changes over time, influenced by evolving societal attitudes, advancements in technology, or alterations in policy frameworks. Such changes can be subject for future research.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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References

Ajzen, I., 1991. The theory of planned behavior. Organ. Behav. Hum. Decis. Process. 50 (2), 179–211.

Al Haddad, C., Chaniotakis, E., Straubinger, A., Plötner, K., Antoniou, C., 2020. Factors affecting the adoption and use of urban air mobility. Transp. Res. A Policy Pract. 132, 696–712. https://doi.org/10.1016/j.tra.2019.12.020.

Anable, J., Gatersleben, B., 2005. All work and no play? The role of instrumental and affective factors in work and leisure journeys by different travel modes. Transp. Res. A Policy Pract. 39, 163–181. https://doi.org/10.1016/j.tra.2004.09.008.

Ashkrof, P., Correia, G.H.D.A., Cats, O., van Arem, B., 2019. Impact of automated vehicles on travel mode preference for different trip purposes and distances. Transp. Res. Rec. 2673, 607–616. https://doi.org/10.1177/0361198119841032.

Balac, M., Rothfeld, R. L., Hörl, S. (2019, October). The prospects of on-demand urban air mobility in Zurich, Switzerland. In 2019 IEEE Intelligent Transportation Systems Conference (ITSC) (pp. 906-913). IEEE. Doi: 10.1109/ITSC.2019.8916972.

Bansal, P., Kockelman, K.M., Singh, A., 2016. Assessing public opinions of and interest in new vehicle technologies: An Austin perspective. Transportation Research Part c: Emerging Technologies 67, 1–14. https://doi.org/10.1016/j.trc.2016.01.019.

Ben-Akiva, M., McFadden, D., Gärling, T., Gopinath, D., Bolduc, D., Borsch-Supan, D., Rao, V., 1999. Extended framework for modeling choice behavior. Mark. Lett. 10 (3), 187–203. https://doi.org/10.1023/A:1008046730291.

Bierlaire, M., 2023. A short introduction to Biogeme. Transport and Mobility Laboratory, ENAC, EPFL. Technical report TRANSP-OR 230620.

Buckley, L., Kaye, S.A., Pradhan, A.K., 2018. Psychosocial factors associated with intended use of automated vehicles: A simulated driving study. Accid. Anal. Prev. 115, 202–208.

Cao, X., Ettema, D.F., 2014. Satisfaction with travel and residential self-selection: How do preferences moderate the impact of the Hiawatha Light Rail Transit line? J. Transp. Land Use 7 (3), 93–108. https://doi.org/10.5198/jtlu.v7i3.485.

Cao, X., Mokhtarian, P.L., Handy, S.L., 2009. Examining the impacts of residential self-selection on travel behaviour: a focus on empirical findings. Transport Rev. 29, 359–395. https://doi.org/10.1080/01441640802539195.

Castle, J., Fornaro, C., Genovesi, D., Lin, E., Strauss, D.E., Waldewitz, T., Edridge, D., 2017. Flying solo – how far are we down the path towards pilotless planes? UBS Global Research, (August), 53. Retrieved from. https://neo.ubs.com/shared/d1ssGmLAVeEB/.

Chen, C.F., 2008. Investigating structural relationships between service quality, perceived value, satisfaction, and behavioral intentions for air passengers: evidence from Taiwan. Transp. Res. A Policy Pract. 42 (4), 709–717.

Chen, H.K., Yan, D.W., 2019. Interrelationships between influential factors and behavioral intention with regard to autonomous vehicles. Int. J. Sustain. Transp. 13 (7), 511–527.

Choi, J. K., Ji, Y. G., 2015. Investigating the importance of trust on adopting an autonomous vehicle. International Journal of Human–Computer Interaction, 31:10, 692-702. https://doi.org/10.1080/10447318.2015.1070549.

Cohen, A.P., Shaheen, S.A., Farrar, E.M., 2021. Urban air mobility: History, ecosystem, market potential, and challenges. IEEE Trans. Intell. Transp. Syst. 22 (9), 6074–6087. https://doi.org/10.1109/TITS.2021.3082767.

Costello, A.B., Osborne, J.W., 2005. Best practices in exploratory factor analysis: Four recommendations for getting the most from your analysis. Pract. Assess. Res. Eval. 10, 1–9. https://doi.org/10.7275/jyj1-4868.

De Vos, J., 2018. Do people travel with their preferred travel mode? Analysing the extent of travel mode dissonance and its effect on travel satisfaction. Transp. Res. A Policy Pract. 117, 261–274. https://doi.org/10.1016/j.tra.2018.08.034.

De Vos, J., 2019. Satisfaction-induced travel behaviour. Transport. Res. F: Traffic Psychol. Behav. 63, 12–21. https://doi.org/10.1016/j.trf.2019.03.001.

De Vos, J., Schwanen, T., Van Acker, V., Witlox, F., 2013. Travel and subjective well-being: A focus on findings, methods and future research needs. Transport Reviews, 33:4, 421-442. https://doi.org/10.1080/01441647.2013.815665.

De Vos, J., Singleton, P.A., Gärling, T., 2022. From attitude to satisfaction: introducing the travel mode choice cycle. Transp. Rev. 42 (2), 204–221. https://doi.org/10.1080/01441647.2021.1958952.

De Vos, J., Witlox, F., 2017. Travel satisfaction revisited. On the pivotal role of travel satisfaction in conceptualising a travel behaviour process. Transp. Res. A Policy Pract. 106, 364–373. https://doi.org/10.1016/j.tra.2017.10.009.

De Vos, J., Schwanen, T., Van Acker, V., Witlox, F., 2015. How satisfying is the scale for travel satisfaction? Transport. Res. Part F 29, 121–130.

Easa, 2021. Study on the Societal Acceptance of Urban Air Mobility in Europe. Retrieved from. https://www.easa.europa.eu/en/newsroom-and-events/press-releases/easa-publishes-results-first-eu-study-citizens-acceptance-urban.

Ettema, D., Gärling, T., Olsson, L.E., Friman, M., 2010. Out-of-home activities, daily travel, and subjective well-being. Transp. Res. A Policy Pract. 44 (9), 723–732. https://doi.org/10.1016/j.tra.2010.07.005.

Financial Tribune, 2021. Tehran Residents Spend 1.5b Hours Annually in Traffic. https://financialtribune.com/node/110239.

Fu, M., Rothfeld, R., Antoniou, C., 2019. Exploring preferences for transportation modes in an urban air mobility environment: Munich case study. Transp. Res. Rec. 2673 (10), 427–442. https://doi.org/10.1177/0361198119843858.

Garrow, L.A., German, B.J., Ilbeigi, M., 2018. Conceptual Models of Demand for Electric Propulsion Aircraft in Intra-Urban and Thin-Haul Markets No. 18–02552.

Garrow, L.A., German, B.J., Leonard, C.E., 2021. Urban air mobility: A comprehensive review and comparative analysis with autonomous and electric ground transportation for informing future research. Transportation Research Part c: Emerging Technologies 132, 103377. https://doi.org/10.1016/j.trc.2021.103377.

Ghazizadeh, M., Lee, J.D., Boyle, L.N., 2012. Extending the technology acceptance model to assess automation. Cognit. Technol. Work 14, 39–49. https://doi.org/10.1007/s10111-011-0194-3.

Goyal, R., Reiche, C., Fernando, C., Serrao, J., Kimmel, S., Cohen, A., Shaheen, S. (2018). Urban air mobility (UAM) market study (No. HQ-E-DAA-TN65181). Retrieved from: https://ntrs.nasa.gov/citations/20190001472.

Haan, J., Garrow, L.A., Marzuoli, A., Roy, S., Bierlaire, M., 2021. Are commuter air taxis coming to your city? A ranking of 40 cities in the United States. Transportation Research Part c: Emerging Technologies 132, 103392. https://doi.org/10.1016/j.trc.2021.103392.

Habib, K.N., Mann, J., Mahmoud, M., Weiss, A., 2014. Synopsis of bicycle demand in the City of Toronto: investigating the effects of perception, consciousness and comfortability on the purpose of biking and bike ownership. Transp. Res. A Policy Pract. 70, 67–80. https://doi.org/10.1016/j.tra.2014.09.012.

Hasan, S., 2019. Urban Air Mobility (UAM) Market Study (No. HQ-E-DAA-TN70296). NASA. https://ntrs.nasa.gov/citations/20190026762.

Heger, M., Sarraf, M. (2018). Air pollution in Tehran. http://hdl.handle.net/10986/29909.

Hohenberger, C., Spörrle, M., Welpe, I.M., 2016. How and why do men and women differ in their willingness to use automated cars? The influence of emotions across different age groups. Transp. Res. A Policy Pract. 94, 374–385. https://doi.org/10.1016/j.tra.2016.09.022.

Holden, J., and N. Goel. Fast-Forwarding to a Future of On-Demand Urban. Air Transportation. San Francisco, Calif., 2016.

Ilahi, A., Belgiawan, P.F., Balac, M., Axhausen, K.W., 2021. Understanding travel and mode choice with emerging modes; a pooled SP and RP model in Greater Jakarta, Indonesia. Transp. Res. A Policy Pract. 150, 398–422. https://doi.org/10.1016/j.tra.2021.06.023.

Johnson, R.A., Miller, E.E., Conrad, S., 2022. Technology adoption and acceptance of urban air mobility systems: Identifying public perceptions and integration factors. The International Journal of Aerospace Psychology 32 (4), 240–253.

Karami, H., Abbasi, M., Samadzad, M., Karami, A., 2024. Unraveling behavioral factors influencing the adoption of urban air mobility from the end user's perspective in Tehran – A developing country outlook. Transport Policy 145, 74–84. https://doi.org/10.1016/j.tranpol.2023.10.010.

Karami, H., Karami, A., Mehdizadeh, M., 2022. The role of psychological factors on the choice of different driving controls: on manual, partial, and highly automated controls. Transp. Res.Part f: Traffic Psychology and Behaviour 86, 316–332. https://doi.org/10.1016/j.trf.2022.03.005.
Karami, A., Karami, H., Mehdizadeh, M., 2023. A world of fully autonomous mobility options: On long-distance travel mode choice. Technol. Forecast. Soc. Chang. 194, 122702 https://doi.org/10.1016/j.techfore.2023.122702.
Kim, Y.W., Lim, C., Ji, Y.G., 2022. Exploring the User Acceptance of Urban Air Mobility: Extending the Technology Acceptance Model with Trust and Service Quality Factors. International Journal of Human-Computer Interaction 1–12. https://doi.org/10.1080/10447318.2022.2087662.
Kolarova, V., Cherchi, E., 2021. Impact of trust and travel experiences on the value of travel time savings for autonomous driving. Transportation Research Part c: Emerging Technologies 131, 103354. https://doi.org/10.1016/j.trc.2021.103354.
Kolarova, V., Steck, F., 2019. Estimating impact of autonomous driving on value of travel time savings for long-distance trips using revealed and stated preference methods. The Role of disruptive technologies, automation, and experimentation, Mapping the Travel Behavior Genome.
Kreimeier, M., Stumpf, E., 2017. Market volume estimation of thin-haul on-demand air mobility services in Germany. In: 17th AIAA Aviation Technology. Integration, and Operations Conference 3282. https://doi.org/10.2514/6.2017-3282.
Kreimeier, M., Strathoff, P., Gottschalk, D., Stumpf, E., 2018. Economic assessment of air mobility on-demand concepts. Journal of Air Transportation 26 (1), 23–36. https://doi.org/10.2514/1.D0058.
Kroesen, M., Chorus, C., 2020. A new perspective on the role of attitudes in explaining travel behavior: a psychological network model. Transp. Res. A Policy Pract. 133, 82–94. https://doi.org/10.1016/j.tra.2020.01.014.
Kroesen, M., Handy, S., Chorus, C., 2017. Do attitudes cause behavior or vice versa? An alternative conceptualization of the attitude-behavior relationship in travel behavior modeling. Transp. Res. Part a: Policy Pract. 101, 190–202. https://doi.org/10.1016/j.tra.2017.05.013.
Lai, W., Chen, C., 2011. Behavioral intentions of public transit passengers—The roles of service quality, perceived value, satisfaction and involvement. Transp. Policy 18 (2), 318–325. https://doi.org/10.1016/j.tranpol.2010.09.003.
Lesteven, G., Samadzad, M., 2021. Ride-hailing, a new mode to commute? Evidence from Tehran, Iran. Travel Behav. Soc. 22, 175–185. https://doi.org/10.1016/j.tbs.2020.09.006.
Likert, R., 1932. A technique for the measurement of attitudes. Archives of psychology.
MacSween, S., 2003. A public opinion survey Unmanned Aerial Vehicles for cargo, commercial, and passenger transportation. 2nd AIAA "Unmanned Unlimited" Conference and Workshop & Exhibit, 15-18 September 2003, San Diego, California. https://doi.org/10.2514/6.2003-6519.
Mao, Z., Ettema, D., Dijst, M., 2016. Commuting trip satisfaction in Beijing: Exploring the influence of multimodal behavior and modal flexibility. Transp. Res. A Policy Pract. 94, 592–603. https://doi.org/10.1016/j.tra.2016.10.017.
Mojtehedzadeh, M., 2019. Assessment of Urban Transport System in Tehran. Suti Assessment Report.
Molin, E., Mokhtarian, P., Kroesen, M., 2016. Multimodal travel groups and attitudes: A latent class cluster analysis of Dutch travelers. Transp. Res. A Policy Pract. 83, 14–29. https://doi.org/10.1016/j.tra.2015.11.001.
Morris, E.A., Guerra, E., 2014. Mood and mode: does how we travel affect how we feel? Transportation 42, 25–43. https://doi.org/10.1007/s11116-014-9521-x.
Mo´tak, L., Neuville, E., Chambres, P., Marmoiton, F., Mo´neger, F., Coutarel, F., Izaute, M., 2017. Antecedent variables of intentions to use an autonomous shuttle: Moving beyond TAM and TPB? European Review of Applied Psychology 67 (5), 269–278.
Mouratidis, K., Ettema, D., Næss, P., 2019. Urban form, travel behavior, and travel satisfaction. Transp. Res. A Policy Pract. 129, 306–320. https://doi.org/10.1016/j.tra.2019.09.002.
Mudumba, S.V., Chao, H., Maheshwari, A., DeLaurentis, D.A., Crossley, W.A., 2021. Modeling CO_2 emissions from trips using urban air mobility and emerging automobile technologies. Transp. Res. Rec. 2675 (9), 1224–1237. https://doi.org/10.1177/03611981211006439.
Noblet, C.L., Thøgersen, J., Teisl, M.F., 2014. Who attempts to drive less in New England? Transport. Res. F: Traffic Psychol. Behav. 23, 69–80.
Patterson, M. D., Antcliff, K. R., & Kohlman, L. W. (2018). A proposed approach to studying urban air mobility missions including an initial exploration of mission requirements. In Annual Forum and Technology Display (No. NF1676L-28586).
Nordfjærn, T., Şimşekoğlu, Ö., Rundmo, T., 2014. The role of deliberate planning, car habit and resistance to change in public transportation mode use. Transport. Res. F: Traffic Psychol. Behav 27, 90–98. https://doi.org/10.1016/j.trf.2014.09.010.
Pudāne, B., Rataj, M., Molin, E.J., Mouter, N., van Cranenburgh, S., Chorus, C.G., 2019. How will automated vehicles shape users' daily activities? Insights from focus groups with commuters in the Netherlands. Transp. Res. Part D: Transp. Environ. 71, 222–235. https://doi.org/10.1016/j.trd.2018.11.014.
Rimjha, M., Hotle, S., Trani, A., Hinze, N., Smith, J. C. (2021). Urban air mobility demand estimation for airport access: A Los Angeles international airport case study. In 2021 Integrated Communications Navigation and Surveillance Conference (ICNS) (pp. 1-15). IEEE. Doi: 10.1109/ICNS52807.2021.9441659.
Rothfeld, R.L., Balac, M., Ploetner, K.O., Antoniou, C. (2018). Initial analysis of urban air mobility's transport performance in Sioux Falls. In: 2018 Aviation Technology, Integration, and Operations Conference. Doi: 10.2514/6.2018-2886.
Samadzad, M., Nosratzadeh, H., Karami, H., Karami, A., 2023. What are the factors affecting the adoption and use of electric scooter sharing systems from the end user's perspective? Transp. Policy 136, 70–82. https://doi.org/10.1016/j.tranpol.2023.03.006.
Sener, I.N., Zmud, J., 2019. Chipping away at uncertainty: Intent to use self-driving vehicles and the role of ride-hailing. Transp. Plan. Technol. 42 (7), 645–661.
Shaheen, S., Cohen, A., Farrar, E., 2018. The Potential Societal Barriers of Urban Air Mobility (UAM). https://doi.org/10.7922/G28C9TFR.
Singleton, P.A., 2019. Validating the Satisfaction with Travel Scale as a measure of hedonic subjective well-being for commuting in a US city. Transp. Res. F 60, 399–414. https://doi.org/10.1016/j.trf.2018.10.029.
Sivasubramaniyam, R.D., Charlton, S.G., Sargisson, R.J., 2020. Mode choice and mode commitment in commuters. Travel Behav. Soc. 19, 20–32. https://doi.org/10.1016/j.tbs.2019.10.007.
Smith, O.B., 2013. Peak of the day or the daily grind: commuting and subjective well-being. Portland State University. Ph.D. dissertation.
Smith, O., 2017. Commute well-being differences by mode: evidence from Portland, Oregon, USA. J. Transport and Health. 4, 246–254.
Song, F., Hess, S., Dekker, T., 2019. Fancy sharing an air taxi? Uncovering the impact of variety seeking on the demand for new shared mobility services. In: Song, F., 2019. Understanding mode choice behaviour when new modes come into play. PhD Thesis, University of Leeds. https://etheses.whiterose.ac.uk/26467/1/PhD%20thesis_Corrected_Fangqing%20Song.pdf.
Straubinger, A., Rothfeld, R., Shamiyeh, M., Büchter, K.D., Kaiser, J., Plötner, K.O., 2020. An overview of current research and developments in urban air mobility–Setting the scene for UAM introduction. J. Air Transp. Manag. 87, 101852 https://doi.org/10.1016/j.jairtraman.2020.101852.
Tabachnick, B.G., Fidell, L.S., 2001. Using Multivariate Statistics. Allyn and Bacon, Boston.
Ton, D., Zomer, L.B., Schneider, F., Hoogendoorn-Lanser, S., Duives, D., Cats, O., Hoogendoorn, S., 2020. Latent classes of daily mobility patterns: the relationship with attitudes towards modes. Transportation 47, 1843–1866. https://doi.org/10.1007/s11116-019-09975-9.
Vahedi, J., Shams, Z., Mehdizadeh, M., 2021. Direct and indirect effects of background variables on active commuting: mediating roles of satisfaction and attitudes. J. Transp. Health 21, 101054. https://doi.org/10.1016/j.jth.2021.101054.
Vascik, P.D., Hansman, R.J., 2017. Constraint identification in on-demand mobility for aviation through an exploratory case study of Los Angeles. In: In: 17th AIAA Aviation Technology, Integration, and Operations Conference. https://doi.org/10.2514/6.2017-3083.
Winter, S.R., Rice, S., Lamb, T.L., 2020. A prediction model of Consumer's willingness to fly in autonomous air taxis. J. Air Transp. Manag. 89, 101926 https://doi.org/10.1016/j.jairtraman.2020.101926.
Yap, M.D., Correia, G.H.D.A., van Arem, B., 2016. Preferences of travellers for using automated vehicles as last mile public transport of multimodal train trips. Transp. Res. A Policy Pract. 94, 1–16. https://doi.org/10.1016/j.tra.2016.09.003.
Ye, R., Titheridge, H., 2019. The determinants of commuting satisfaction in low-income population: a case study of Xi'an, China. Travel Behav. Soc. 16, 272–283. https://doi.org/10.1016/j.tbs.2019.01.005.
Yedavalli, P., Mooberry, J., 2019. An assessment of public perception of urban air mobility (UAM). Defining Future Skies, Airbus UTM, pp. 2046738072–-1580045281.