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What drives users to accept flying cars for urban air mobility? Findings from an empirical study

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ABSTRACT

The rapid progression of technology has enabled the transformation of flying cars from a theoretical concept to a practical reality, aimed at alleviating urban traffic congestion and meeting the demand for efficient transportation. Key challenges currently revolve around legal frameworks, technological advancements, and financial resources. Additionally, societal concerns, particularly regarding user acceptance of flying cars, play a crucial role in their development. Therefore, investigating user acceptance behavior and identifying influencing factors for flying cars is essential for informing policy decisions, adjusting market strategies, assessing commercial feasibility, and ensuring successful integration into urban landscapes.

This study offers a synthesis, evaluation, and critique of relevant literature on technology acceptance models, user acceptance in the transportation sector, trust, and perceived risk. User behavioral intention is established as the primary criterion for assessing acceptance, with six core latent variables identified: performance expectancy, effort expectancy, social influence, hedonic motivation, trust, and perceived risk. Theoretical hypotheses are formulated based on these variables, leading to the creation of a theoretical model, followed by questionnaire design. A structural equation model is developed using sample data to validate research hypotheses and explore moderating effects, including the impact of demographic characteristics.

The research outcomes reveal that various factors influence user behavioral intention towards flying cars, with perceived risk emerging as the most significant factor. Trust not only directly affects user intention but also indirectly influences it through other variables. Moreover, age is identified as a significant moderating factor in this context.

The study draws several key conclusions: safety is a primary concern for users, emphasizing the need to enhance safety features of flying cars; trust plays a dual role, warranting further investigation into strategies for building user trust; catering to users over 30 requires emphasizing simplicity and safety, while younger users are more influenced by peers, necessitating tailored promotional strategies by companies.

This paper expands the utility of the UTAUT2 model, offering valuable insights for future research on flying cars and proposing policy recommendations for the commercial advancement of flying cars based on the research findings.

1. Introduction

The rapid urbanization process has led to increasing transportation challenges in cities, such as traffic congestion, environmental pollution, and accidents. Traditional ground transportation systems are struggling to meet the growing travel demands of urban populations. Recent technological advancements in unmanned aerial vehicles (UAVs), including drones and electric vertical take-off and landing (eVTOL) aircraft, have been developed to address these challenges by operating in three-dimensional space. These innovations offer new possibilities for the advancement of multi-dimensional transportation systems in the future. Despite the perception that multi-dimensional transportation is a distant concept, progress in this area is advancing at a faster pace than anticipated by many. Various countries and regions have started strategic planning and promotional efforts to enhance multi-dimensional transportation systems.

Numerous international express companies have been conducting experimental trials using drones for package delivery services. For

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instance, Amazon Prime Air has tested its drone delivery service in the United States, while United Parcel Service (UPS) utilized drones for delivering COVID-19 vaccines during the pandemic. Similarly, DHL, a German air freight company, has launched a commercial drone package delivery service. In China, Meituan, a prominent e-commerce platform, introduced a drone-based food delivery service in Shenzhen in 2022.

High-tech firms, automotive, and aviation sectors are developing business strategies incorporating eVTOL aircraft for urban commuting, introducing the concept of urban air mobility (UAM). The National Aeronautics and Space Administration (NASA) is actively involved in promoting UAM advancement by providing technical support. The European Union Aviation Safety Agency (EASA) is engaged in pilot projects to commercialize UAM within 3–5 years. Japan plans to introduce an air taxi service during the 2025 Osaka World Expo, marking a significant milestone in flying car commercialization. South Korea also aims to implement urban air transportation services by 2025. EHang, a global UAM technology firm, has introduced the EH216-S unmanned passenger aircraft, which has received airworthiness certification and conducted the world's first commercial flight demonstration in Guangzhou and Hefei.

China has initiated policy efforts to develop a comprehensive three-dimensional transportation network, as outlined in the "National Comprehensive Three-Dimensional Transportation Network Planning Outline" released in February 2021. The country also released the "14th Five-Year Plan for the Development of a Modern Comprehensive Transportation System" in January 2022, focusing on reforming air traffic control systems and airspace management. Additionally, the "Medium and Long-term Development Plan for Scientific and Technological Innovation in the Transportation Sector (2021–2035)" was jointly released by the Ministry of Transport and the Ministry of Science and Technology to advance research and development in flying cars.

In conclusion, urban air mobility is on the horizon, but research in this field lags behind other transportation sectors. Flying cars are seen as a key mode of transportation in urban air mobility applications, with challenges related to technology, regulations, and funding. Addressing social issues, such as safety, privacy, and noise concerns, is crucial for user acceptance and the successful adoption of flying cars. User attitudes play a significant role in driving the development and commercialization of flying cars. Therefore, comprehensive research on user acceptance is essential for promoting and developing flying cars in the market.

The paper's structure includes a theoretical framework, a conceptual model, research methodology, findings, suggestions for future research, and theoretical and practical implications. The conclusion summarizes the key insights and findings of the study.

2. Literature review

2.1. Development of UTAUT model

The Unified Theory of Acceptance and Use of Technology (UTAUT) is a theoretical framework developed to explain the factors that influence individuals' or organizations' intentions to adopt new technologies. Venkatesh et al. (2003) combined eight established theories to address this issue. The model includes performance expectancy, effort expectancy, social influence, and facilitating conditions, which are influenced by variables such as gender, age, experience, and the voluntary nature of technology use. Venkatesh et al. (2012) further refined the model to create the UTAUT2, depicted in Fig. 1. Additional constructs like hedonic motivation, price value, and habit were integrated to improve the model's explanatory power. The core components of the UTAUT2 model align with those of the original UTAUT model, with the exception of the removal of the voluntariness of use element.

2.2. UTAUT2 model in the transportation research

Various versions of the UTAUT2 model have been utilized in transportation research to explore how society perceives emerging technologies like electric vehicles (Zhou et al., 2021) and autonomous driving systems (Palatinus et al., 2022; Lukovics et al., 2023). In recent times, there has been a rise in different types of shared and autonomous transportation options. These include shared bicycles (Smith et al., 2023), shared e-scooters (Kopplin et al., 2021), shared automated vehicles (Nordhoff et al., 2020; Dichabeng et al., 2021; Zheng and Gao, 2021; Curtale et al., 2022), autonomous delivery services (Kapser et al., 2020), and autonomous public transport systems (Korkmaz et al., 2022).

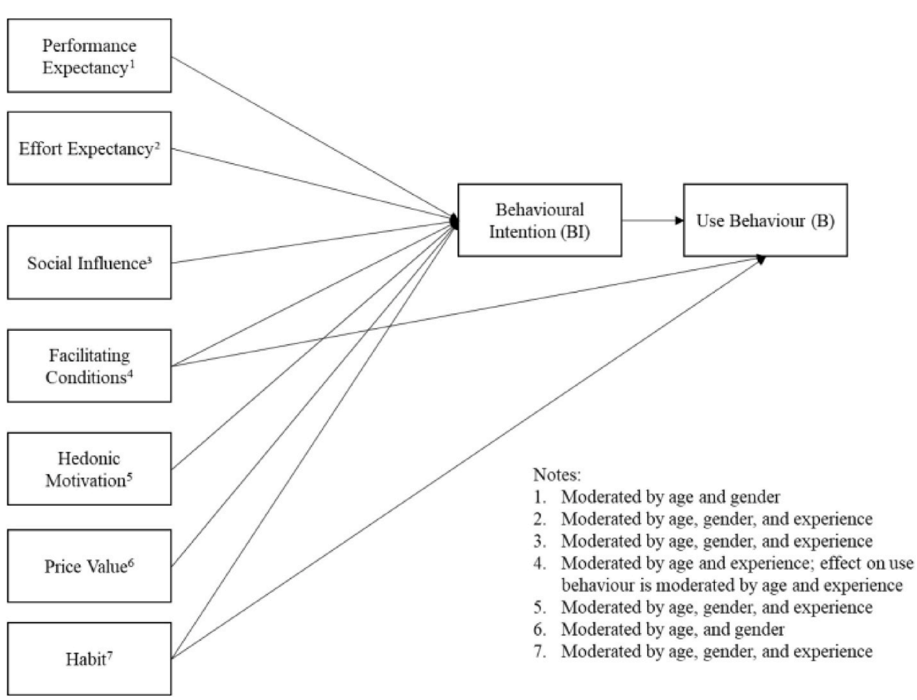

Fig. 1. The original UTAUT2 model.

Lukovics et al. (2023) combined the UTAUT2 model with psychological metrics to improve the explanatory power regarding the adoption of autonomous vehicles in future scenarios. The UTAUT2 model is widely applied in transportation studies due to its ability to comprehensively examine and clarify public acceptance of new technologies. Many studies have included additional variables to enhance their findings.

2.3. Current research about flying cars

Flying cars, a novel form of transportation that merges ground and air travel, have garnered increasing attention as a futuristic mode of transit. Since their inception in the 20th century, this technology has undergone significant advancements. Pan and Alouini (2021) delved into the historical progression and development of flying cars, highlighting their potential to mitigate traffic congestion and enhance transportation efficiency within urban environments. The authors stress the importance of systematically and commercially utilizing low-altitude airspace for transportation purposes.

In a study by Ahmed et al. (2021), the researchers investigated the public's interest in utilizing and financially supporting flying taxis and shared flying car services. The research identified various factors that shape consumer attitudes and preferences in this domain. The propensity of individuals to engage with and financially support flying car services is influenced by their socio-demographic characteristics and their perceptions of the advantages and drawbacks associated with this mode of transport.

Pan and Alouini (2021) explored the key challenges and strategies for the potential integration of aerial vehicles. The study addresses critical issues such as safety, training, environmental impacts, infrastructure requirements, logistics, cybersecurity, and human factors. Furthermore, the paper offers an initial quantitative analysis of public perceptions and expectations regarding flying cars.

Despite the current lack of quantitative studies on user acceptance of flying cars, this research aims to bridge this gap in the existing literature, offering valuable insights and setting the stage for future investigations in this emerging field.

2.4. UTAUT2 model for flying cars

The UTAUT2 model is a comprehensive theoretical framework that explains the adoption of technology in various contexts. This model combines elements from eight established frameworks and has been extensively validated to understand user intentions in the transportation sector. It is currently recognized as the most effective theory in explaining technology acceptance. The concept of flying cars, seen as a futuristic mode of transportation, is an example of a new technological innovation relevant to technology adoption. A review of national and international research in literature review revealed that the UTAUT2 model has wide applicability and strong generalizability. Therefore, this study chooses to utilize the UTAUT2 model for its investigation.

3. Methodology

The Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) is a robust model that integrates eight traditional theories in the technology acceptance domain. It has been extensively validated for its ability to explain user behavioral intentions in the transportation sector, positioning it as a leading theory in technology acceptance studies. The emergence of flying cars as a futuristic transportation mode introduces a novel technological innovation that aligns with the principles of technology acceptance. Through a comprehensive literature review, it is evident that the UTAUT2 model has a wide range of applications and demonstrates significant generalizability. Consequently, this research study adopts the UTAUT2 model as the theoretical framework (see Fig. 2) for its investigation.

3.1. Original UTAUT2 constructs

In light of the nascent stage of development in the field of flying cars, characterized by ongoing technological advancements and evolving legal frameworks, the existing infrastructure may not be sufficiently equipped to support the widespread integration of flying cars. Moreover, a considerable amount of time is anticipated before flying cars can be operationalized for commercial purposes. Therefore, it is deemed essential at this juncture to exclude three latent variables - namely facilitating conditions, habit, and price value - from the UTAUT2 model. For flying cars, facilitating conditions largely depend on government support in terms of policy preferences and regulatory management, that is, government involvement. However, this study approaches the issue from the user's perspective, and other researches also confirmed that from this viewpoint, the impact of government involvement on behavioral intention is not significant or has not been considered (Samadzad et al., 2023; Bala et al., 2023; Karami et al., 2024). This decision is predicated on the notion that these variables are presently not pertinent or applicable within the context of the ongoing developmental phase of flying cars. As technological progress advances and the market for aerial

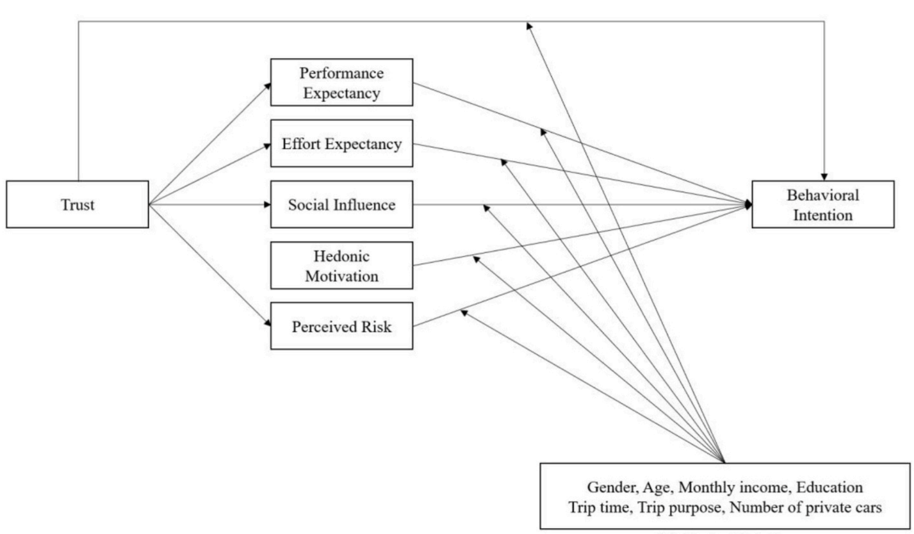

Fig. 2. Research model.

vehicles matures, these factors can be reintegrated into the model to enhance understanding and predict user acceptance and adoption trends. In the interim, focusing on the remaining variables will provide a more precise and contextually relevant framework for assessing the potential adoption of this emerging transportation technology.

Koh and Yuen (2023) have identified that performance expectancy, effort expectancy, social influence, and hedonic motivation exert varying degrees of influence on users' behavioral intentions towards ride-hailing services involving autonomous vehicles and self-driving cars. The positive impact of performance expectancy, effort expectancy, and social influence on behavioral intention has been corroborated in studies across diverse domains such as mobile visual search, digital yuan acceptance, mobile language learning, and autonomous vehicles (Ljubi and Groznik, 2023). Kapser and Abdelrahman (2020) have validated that performance expectancy, social influence, and hedonic motivation significantly influence behavioral intention towards autonomous cargo vehicles. Zhou et al. (2021) and Curtale et al. (2021) have identified performance expectancy, effort expectancy, and hedonic motivation as crucial latent variables affecting user behavioral intention, using electric vehicles and shared autonomous electric vehicle services as case studies, respectively. Rejali et al. (2024) have found that social influence and hedonic motivation substantially impact behavioral intention regarding autonomous modular vehicles. Korkmaz et al. (2022) conducted a study on public transportation systems, revealing that performance expectancy and social influence significantly influence users' behavioral intentions. In conclusion, it is evident that performance expectancy, effort expectancy, social influence, and hedonic motivation play pivotal roles in shaping users' behavioral intentions across a spectrum of research disciplines.

Therefore, the hypotheses are suggested as follows:

H1. Performance expectancy affects behavioral intention positively.

H2. Effort expectancy affects behavioral intention positively.

H3. Social influence affects behavioral intention positively.

H4. Hedonic motivation affects behavioral intention positively.

3.2. Added constructs

The European Union Aviation Safety Agency (EASA) conducted a study in 2021 to evaluate public acceptance of urban air mobility (EASA, 2021). The study employed various flying cars as case studies to investigate the factors influencing user acceptance. The results indicated that the primary factor affecting users' readiness to embrace flying cars is the safety risks associated with them, a conclusion consistent with the findings of Ahmed et al. (2020). Pan and Alouini (2021) identified key safety concerns related to flying cars in their research, including passenger safety concerns in adverse weather conditions, performance risks such as collision avoidance, obstacle evasion, and search and rescue operations, as well as environmental risks like noise pollution. Several studies have explored the impact of trust and perceived risk as essential latent variables on user acceptance within the realm of autonomous transportation modes, such as autonomous buses (Cai et al., 2023), autonomous cars (Xu et al., 2018; Kenesei et al., 2022), in-vehicle technologies for autonomous cars (Adnan et al., 2018), electric scooter sharing technology (Samadzad et al., 2023), and autonomous delivery vehicles (Kapser et al., 2021). AI Haddad et al. (2020) summarized the current challenges faced by aerial vehicles, emphasizing trust and perceived risk as critical factors. These studies have also confirmed the inverse relationship between trust and perceived risk. Therefore, this study introduces two additional latent variables: trust, denoting an individual's confidence in the reliability of flying cars, and perceived risk, representing the level of risk perceived by individuals when using flying cars for transportation.

Therefore, the hypotheses are suggested as follows:

H5a. Trust affects performance expectancy positively.

H5b. Trust affects effort expectancy positively.

H5c. Trust affects social influence positively.

H5d. Trust affects perceived risk negatively.

H5e. Trust affects behavioral intention positively.

H6. Perceived risk affects behavioral intention negatively.

3.3. Moderator constructs

In the research conducted by Venkatesh and colleagues (2003; 2012), the focus was on exploring the influence of age and gender as moderating factors on the latent variables in the model. The results demonstrated the significance of these moderating effects within the context of information systems. Curtale et al. (2021) and van't Veer et al. (2023) investigated the moderating effects of socio-demographic characteristics and travel-related attributes on the latent variables in the model. They utilized examples of electric vehicle sharing services and travel behavior to illustrate their findings. The study confirmed that gender, age, monthly income, education level, travel duration, travel purpose, and the number of private vehicles all play roles as moderating variables, to some extent, in the relationships between the predictor variables of the model (such as performance expectancy, effort expectancy, etc.) and behavioral intention. Some studies have also considered the moderating effect of regional differences on behavioral intentions. For example, Kapousizis et al. (2024) examined the influence of population density and city size on the behavioral intention towards e-bikes. The results indicated that the moderating effect was not significant.

Therefore, the hypotheses are suggested as follows:

H7. Gender moderates the relationships between antecedent variables and behavioral intention.

H8. Age moderates the relationships between antecedent variables and behavioral intention.

H9. Monthly income moderates the relationships between antecedent variables and behavioral intention.

H10. Education moderates the relationships between antecedent variables and behavioral intention.

H11. Travel time moderates the relationships between antecedent variables and behavioral intention.

H12. Travel purpose moderates the relationships between antecedent variables and behavioral intention.

H13. The number of private cars moderates the relationships between antecedent variables and behavioral intention.

4. Questionnaire design

4.1. Questionnaire structure

Data collection for this research involves administering questionnaire surveys, where the quality of the questionnaires significantly impacts the accuracy of the research outcomes. To ensure the reliability of the survey instruments, a comprehensive review and synthesis of relevant literature in the fields of technology acceptance and flying cars are conducted. Subsequently, the questionnaire is developed, taking into account the distinctive features of flying cars. Emphasis is placed on ensuring the clarity of the questionnaire by carefully crafting the wording of each measurement item to be straightforward yet precise, avoiding ambiguity, abstract concepts, or technical jargon. Additionally, the length of the questionnaire is managed thoughtfully to prevent respondent fatigue. The questionnaire utilized in this study is structured into five main sections.

The first section introduces the survey under the title “Survey on the Perception and Acceptance of Flying Cars for Urban Air Transportation.” The introductory part provides the author’s details and clarifies that the questionnaire is intended for academic purposes, assuring respondents of the confidentiality of their personal information.

The third section assesses participants’ familiarity with airborne vehicles. Respondents indicating familiarity proceed to the subsequent section, while those indicating unfamiliarity are provided with an overview of flying cars to establish a foundational understanding and avoid misconceptions.

The fourth section, central to the questionnaire, investigates participants’ behavioral intentions regarding the adoption of flying cars. Each latent variable within the model is measured by three items, resulting in a total of 21 questionnaire items.

The fifth section collects demographic information from participants, including gender, age, education level, occupation, city of residence, monthly disposable income, travel habits, private vehicle ownership, and preferences for the application of flying cars in various scenarios.

The questionnaire design in this study is informed by relevant literature and a prior survey on flying cars. The scale used is based on established measurement tools with national and global applicability. Following a pilot study, the final version of the questionnaire was developed. A 7-point Likert scale is employed for scoring, with higher scores indicating stronger agreement. The model comprises seven latent variables, as outlined in Table 1.

4.2. Pilot study

During pilot testing, a preliminary questionnaire is distributed on a limited scale to gather data and identify and rectify any illogical measurement components. This process aims to ensure the rationality and reliability of the final questionnaire. In this study, a questionnaire was created using the Questionnaire Star platform, and 100 questionnaires were collected. After careful screening, seven questionnaires were excluded due to inconsistencies or unusually short completion times, resulting in a 93% questionnaire recovery rate. Subsequently, the research analyzed the reliability and validity of the data obtained from the pilot survey.

Reliability refers to the internal consistency of measurement items related to latent variables in the questionnaire, assessing the stability and dependability of the scale. Cronbach’s alpha coefficient is commonly used in academia to evaluate questionnaire reliability, with a value above 0.7 generally considered acceptable. A coefficient closer to 1 indicates higher reliability. The study conducted a reliability analysis during the pilot testing phase, with results presented in Table 2 showing that all latent variables had Cronbach’s alpha coefficients exceeding 0.7, indicating a high level of reliability in the pilot questionnaire.

The concept of validity pertains to the degree of agreement between the underlying variables observed in the measurement model and the empirical data collected, indicating the effectiveness of the questionnaire. Evaluating validity typically involves scrutinizing content validity, convergent validity, and discriminant validity. Regarding content validity, the initial survey instrument employed in this study was developed by adapting existing national and international survey tools. Modifications were made to tailor the questionnaire to the specific context of aerial vehicles, and it was refined iteratively based on feedback from various stakeholders. As a result, the content validity of the preliminary survey questionnaire is considered adequate.

Convergent validity is commonly assessed through factor loadings (FL), composite reliability (CR), and average variance extracted (AVE), as outlined in Table 3. Given the structured format of the questionnaire in this study, factor loadings were determined using confirmatory factor analysis (CFA); however, exploratory factor analysis (EFA) would be required if the structure were less clear. The analysis indicates that all factor loadings are above 0.7, composite reliability values exceed 0.7, and average variance extracted values are higher than 0.5. Consequently, the convergent validity of the preliminary survey questionnaire is considered satisfactory.

In the context of discriminant validity, it is commonly accepted that a scale demonstrates adequate discriminant validity when the square root of the Average Variance Extracted (AVE) is greater than the absolute value of the inter-factor correlation coefficients. The relevant details are outlined in Table 4, revealing that the square roots of the Average

Table 1
Constructs, their items, and sources.

Construct	Items	Sources adapted from
Performance Expectancy (PE)	PE1: Using flying cars will save travel time.	[Venkatesh et al. (2012); Curtale et al., 2021; Renske et al., 2023]
	PE2: Using flying cars will save travel costs.	
	PE3: Using flying cars will be more convenient compared to traditional transport.	
Effort Expectancy (EE)	EE1: Learning how to use flying cars will be easy for me.	[Venkatesh et al. (2012)]
	EE2: I find the flying car easy to use.	
	EE3: It is easy for me to become skillful at using flying cars.	
Social Influence (SI)	SI1: People who are important to me think that I should use flying cars.	[Venkatesh et al. (2012)]
	SI2: People who influence my behavior think that I should use flying cars.	
	SI3: Opinions from social media will influence my usage of flying cars.	
Hedonic Motivation (HM)	HM1: Using the flying car is fun.	[Venkatesh et al. (2012)]
	HM2: Using the flying car is enjoyable.	
	HM3: Using the flying car is very entertaining.	
Trust (TR)	TR1: I believe that the flying car will be greener than traditional public transport.	(Curtale et al., 2021; Korkmaz et al., 2022)
	TR2: I believe that the flying car will help to ease traffic congestion.	
	TR3: I believe that the flying car will help to reduce emissions.	
Perceived Risk (PR)	PR1: I am concerned about the safety of the flying car.	(Kapser et al., 2020; EASA, 2021; Renske et al., 2023)
	PR2: I am concerned about the noise of the flying car.	
	PR3: I am concerned about the privacy of the flying car.	
Behavioral Intention (BI)	BI1: I intend to try to use flying cars when available in the future.	[Venkatesh et al. (2012)]
	BI2: I will always try to use flying cars in my daily life.	
	BI3: I will encourage my friends and colleagues to use flying cars.	

Table 2
The reliability of the questionnaire.

Constructs	The number of items	Cronbach’s alpha
Performance Expectancy	3	0.923
Effort Expectancy	3	0.933
Social Influence	3	0.943
Hedonic Motivation	3	0.911
Trust	3	0.935
Perceived Risk	3	0.937
Behavioral Intention	3	0.904

Table 3
The convergent validity of the questionnaire.

Constructs	Items	FL	CR	AVE
Performance Expectancy	PE1	0.892	0.798	0.922
	PE2	0.899		
	PE3	0.890		
Effort Expectancy	EE1	0.901	0.826	0.934
	EE2	0.892		
	EE3	0.931		
Social Influence	SI1	0.911	0.846	0.943
	SI2	0.903		
	SI3	0.944		
Hedonic Motivation	HM1	0.870	0.772	0.910
	HM2	0.906		
	HM3	0.859		
Trust	TR1	0.959	0.828	0.935
	TR2	0.868		
	TR3	0.898		
Perceived Risk	PR1	0.970	0.831	0.936
	PR2	0.871		
	PR3	0.891		
Behavioral Intention	BI1	0.833	0.761	0.905
	BI2	0.902		
	BI3	0.878		

Variance Extracted (AVE) consistently surpass the absolute values of the inter-factor correlation coefficients. As a result, the discriminant validity of the pre-survey questionnaire is deemed to be satisfactory.

Upon examination of the pre-survey questionnaire, it was found that all measurement items in the questionnaire met the required criteria. Therefore, it has been established that the pre-survey questionnaire can be utilized as the official questionnaire without any modifications, demonstrating strong reliability and validity.

4.3. Formal questionnaire distribution and collection

The study collected data through an online survey that aimed to capitalize on the broad reach and accessibility of online platforms to ensure a diverse participant pool. Additionally, the survey was shared through personal connections such as friends, family, and social media to enhance its reach and expand the number of participants. Participants were not restricted in providing personal information such as age, occupation, income, education level, or city of residence. This approach was chosen to accurately represent the current awareness and attitudes towards flying cars among respondents. The survey was conducted during the summer break of 2023, resulting in 934 questionnaires being collected, with 211 invalid responses being excluded due to inconsistencies, contradictions, or unusually short completion times. A total of 723 valid responses were obtained, indicating an effective response rate of 77.4%. Moreover, with a confidence level of 95%, a margin of error of 5%, and population proportion set at 50%, the minimum sample size is 385 and our sample size is sufficient.

5. Results and discussion

5.1. Descriptive analysis

From Table 5 we can learn: The sample is composed of 48.271% males and 51.729% females, with a slight difference of less than 5%. This equitable gender distribution within the survey respondents indicates an absence of sample bias. The data reveals that the primary age group of users falls between 18 and 40 years old, with other age categories collectively representing only 11.894% of the sample, suggesting a skew towards a younger demographic. In terms of educational achievement, individuals with a high school education or above make up 96.403% of the sample, while those with less than a high school education constitute 3.597%, indicating a high level of education among the majority of survey participants. Users with a monthly income of 10,000 yuan or less account for 62.794% of the sample, indicating a moderate income range among respondents. A significant portion of users, 69.986%, spend more than 15 min on travel, possibly due to extended distances and traffic congestion, especially in urban areas. The majority of users have consistent travel purposes such as work, school, or shopping, collectively representing 88.520% of the total. In terms of private car ownership, 88.243% of respondents have at least one private car in their household, aligning with the per capita car ownership rate in China. Concerning the potential use of flying cars, around 70% of respondents support their deployment in emergency rescue operations or logistics transportation, indicating a common perception of flying cars and drones among the majority of individuals.

5.2. Reliability analysis

The concept of reliability concerns the internal consistency of measurement items associated with latent variables in a questionnaire, serving as an indicator of the scale's reliability level. In this study, the reliability of the questionnaire was evaluated using Cronbach's alpha coefficient, despite the absence of a universally agreed-upon standard. Scholars commonly consider a coefficient above 0.9 as indicative of excellent questionnaire reliability. A coefficient falling between 0.8 and 0.9 suggests good reliability, while a range of 0.7–0.8 indicates acceptable reliability. Questionnaires with coefficients between 0.6 and 0.7 are moderately reliable, and those between 0.5 and 0.6 are deemed to have suboptimal reliability. Questionnaires with reliability coefficients below 0.5 are typically recommended for redesign. The reliability analysis results of the formal questionnaire are detailed in Table 6, demonstrating that all latent variables possess Cronbach's alpha coefficients surpassing 0.7.

5.3. Validity analysis

The concept of validity concerns the degree of agreement between the latent variables in the measurement model and the empirical data collected, indicating the effectiveness of the questionnaire. Validity assessment typically includes evaluating content validity, convergent validity, and discriminant validity. In this study, the formal questionnaire was developed by adapting established questionnaires from

Table 4
The discriminant validity of the questionnaire.

	PE	EE	SI	HM	TR	PR	BI
PE	**0.893**						
EE	0.343	**0.909**					
SI	0.370	0.422	**0.920**				
HM	0.440	0.394	0.376	**0.879**			
TR	0.456	0.384	0.495	0.463	**0.910**		
PR	−0.324	−0.386	−0.511	−0.504	−0.476	**0.912**	
BI	0.581	0.526	0.501	0.621	0.515	−0.562	**0.872**

Note: The bolded part represents the square root of AVE.

Table 5
Socio-demographic and transport-related characteristics.

Variable	Category	Percentage (%)
Gender	Male	48.271
	Female	51.729
Age	<18 years	1.521
	18∼25 years	22.822
	26∼30 years	31.812
	31∼40 years	33.472
	41∼50 years	7.469
	51∼60 years	2.766
	>60 years	0.138
Monthly Income	>¥3000	10.650
	¥3001∼¥5000	14.523
	¥5001∼¥10000	37.621
	¥10001∼¥15000	22.960
	¥15001∼¥20000	8.299
	>¥20000	5.947
Education	Primary School's degree	1.107
	Middle School's degree	2.490
	High School's degree	11.895
	Bachelor's degree	75.380
	Postgraduate's degree	9.129
Trip Time[a]	0∼10 min	6.362
	11∼15 min	23.651
	16∼30 min	39.142
	>30 min	30.844
Trip Purpose[a]	Work	62.102
	School	11.48
	Shopping	14.938
	Travel	6.501
	Commercial	2.351
	Other	2.628
Number of private cars	0	11.757
	1	64.315
	2	16.459
	>2	7.469
Flying cars' usage	Emergency Use	50.069
	Drone Delivery Use	18.949
	Passenger Transport Use	30.982

[a] Note: Trip time refers to the duration of commuting trips and trip purpose refers to the main reason for daily travel, such as work, school, travel.

Table 6
The reliability of the formal questionnaire.

Constructs	The number of items	Cronbach's alpha
Performance Expectancy	3	0.907
Effort Expectancy	3	0.910
Social Influence	3	0.934
Hedonic Motivation	3	0.909
Trust	3	0.930
Perceived Risk	3	0.907
Behavioral Intention	3	0.920

domestic and international literature to suit the specific context of flying cars. Feedback from the supervisor and peers was used to refine the questionnaire, which was then tested in a small pilot survey to ensure its appropriateness. As a result, the formal questionnaire exhibits adequate content validity.

Convergent validity is commonly assessed using factor loadings, composite reliability, and average variance extracted, as outlined in Table 7. In this research, factor loadings were determined through confirmatory factor analysis due to the structured nature of the questionnaire; however, exploratory factor analysis would have been employed if the structure was unclear. The analysis indicates that all factor loadings are above 0.7, composite reliability values exceed 0.7, and average variance extracted values are higher than 0.5. Consequently, the formal questionnaire demonstrates satisfactory convergent validity.

In the context of discriminant validity, it is commonly accepted that a scale demonstrates adequate discriminant validity when the square root

Table 7
The convergent validity of the formal questionnaire.

Constructs	Items	FL	CR	AVE
Performance Expectancy	PE1	0.862	0.765	0.907
	PE2	0.869		
	PE3	0.893		
Effort Expectancy	EE1	0.867	0.772	0.911
	EE2	0.881		
	EE3	0.888		
Social Influence	SI1	0.902	0.824	0.934
	SI2	0.908		
	SI3	0.913		
Hedonic Motivation	HM1	0.887	0.770	0.909
	HM2	0.870		
	HM3	0.874		
Trust	TR1	0.901	0.815	0.930
	TR2	0.902		
	TR3	0.906		
Perceived Risk	PR1	0.878	0.764	0.907
	PR2	0.882		
	PR3	0.863		
Behavioral Intention	BI1	0.890	0.794	0.920
	BI2	0.897		
	BI3	0.886		

of the Average Variance Extracted (AVE) is greater than the absolute value of the correlation coefficients between factors. The detailed metrics are outlined in Table 8, indicating that the square roots of the Average Variance Extracted consistently surpass the absolute values of the factor correlation coefficients. As a result, the formal questionnaire exhibits strong discriminant validity.

The evaluation of the reliability and validity of the structured questionnaire demonstrated that all measurement components within the survey tool adhered to the predefined criteria. Additionally, the questionnaire displayed robust reliability and validity, enabling the researchers to proceed with structural equation modeling (SEM) path analysis and investigate potential moderation effects.

5.4. SEM analysis

Based on the data presented in Table 9, it can be deduced that hypotheses H1 to H4 are corroborated. Among the hypotheses analyzed, social influence and hedonic motivation demonstrate a significant impact on users' behavioral intention, with path coefficients of 0.210 and 0.213, respectively. The newly introduced variables H5e and H6, along with their respective hypotheses, have been successfully tested for significance and have garnered support. Perceived risk is shown to have a notable effect on users' behavioral intention, with a path coefficient of −0.253. Hypotheses H5a to H5d, which explore the influence of trust on other variables, have also been subjected to statistical significance testing and have been validated. Moreover, the path coefficients associated with these hypotheses surpass those of alternative hypotheses, indicating that trust plays a crucial role as a variable in the investigation of flying car acceptance.

This research employs a range of model fit measures, such as the chi-square to degrees of freedom ratio ($\chi 2/df$), goodness-of-fit index (GFI), root mean square error of approximation (RMSEA), comparative fit index (CFI), normed fit index (NFI), and non-normed fit index (NNFI). The findings presented in Table 10 indicate that all indices, with the exception of the root mean square residual, align with the stipulated criteria, indicating a favorable fit of the model.

From Table 9 and Fig. 3 we can learn:

The impact of various factors on users' behavioral intentions in adopting new technologies, such as flying cars, is a critical area of study.

One key factor is performance expectancy, which influences users' likelihood of adopting a new technology based on perceived benefits compared to existing alternatives. Users evaluate the benefits of a technology in terms of travel convenience, knowledge expansion, and

Table 8
The discriminant validity of the formal questionnaire.

	PE	EE	SI	HM	TR	PR	BI
PE	**0.875**						
EE	0.317	**0.879**					
SI	0.316	0.302	**0.908**				
HM	0.344	0.335	0.292	**0.877**			
TR	0.309	0.377	0.278	0.333	**0.903**		
PR	−0.340	−0.356	−0.283	−0.312	−0.346	**0.874**	
BI	0.472	0.471	0.452	0.481	0.485	−0.504	**0.891**

Note: The bolded part represents the square root of AVE.

Table 9
Summary of hypothesis testing.

Hypothesis	Proposed Path and Effect	β	p-value	Result
H1	PE→BI (+)	0.196	<0.001	Supported
H2	EE→BI (+)	0.172	<0.001	Supported
H3	SI→BI (+)	0.210	<0.001	Supported
H4	HM→BI (+)	0.213	<0.001	Supported
H5a	TR→PE (+)	0.364	<0.001	Supported
H5b	TR→EE (+)	0.436	<0.001	Supported
H5c	TR→SI (+)	0.326	<0.001	Supported
H5d	TR→PR (−)	−0.404	<0.001	Supported
H5e	TR→BI (+)	0.187	<0.001	Supported
H6	PR→BI (−)	−0.253	<0.001	Supported

Note: "→" denotes the path; "+" means a positive impact and "−" means a positive and negative impact.

personal image enhancement, weighing them against associated drawbacks like financial costs and time commitments. Factors like visibility, trialability, and social recognition also influence users' performance expectations.

Effort expectancy, another significant factor, relates to users' subjective assessment of the effort required to use a technology. Users are more likely to adopt a technology if they perceive the benefits to outweigh the effort needed. Social influence, on the other hand, plays a role in users' behavioral intentions by fostering acceptance of new technologies through community interactions and word-of-mouth recommendations. Hedonic motivation, which focuses on the pleasure and entertainment aspects of a technology, can positively influence users' intentions to adopt a technology that offers unique and enjoyable experiences. Trust is a fundamental element that impacts users' perceptions of a technology's performance, effort, social influence, and hedonic motivation, while also reducing perceived risks associated with adopting new technologies.

Trust is crucial in establishing confidence in the safety, reliability, and professionalism of companies offering innovative technologies like flying cars. However, perceived risks related to safety, infrastructure development, environmental impact, and noise pollution can hinder users' willingness to adopt flying cars. Enhancing trust and addressing these risks are essential for promoting the widespread adoption of flying cars and other emerging technologies.

5.5. Moderating effect analysis

The concept of moderating effects suggests that the relationship between two variables is dependent on the value of a third moderating variable. The evaluation and exploration of moderating effects are influenced by the measurement levels of both the independent and moderating variables. When both the moderating and independent variables are categorical, an analysis of variance is typically conducted. A statistically significant interaction effect indicates that the moderating variable has played a role in moderating the relationship. The significance of the main effects may not align with the hypothesis of the moderating effect. Consequently, a simple effects analysis can be carried out to gain a more detailed understanding of the specific function of the moderating variable. In cases where the moderating variable is continuous, hierarchical regression methods can be used for testing, regardless of the type of independent variable. This involves initially examining the primary effect sizes of the independent and moderating variables on the dependent variable, followed by incorporating the product term "independent variable × moderating variable" into the regression equation. A statistically significant coefficient for this term indicates a significant moderating effect. When the moderating variable is categorical and the

Table 10
Measurement metrics.

Fit index	χ^2/df	GFI	RMSEA	RMR	CFI	NFI	NNFI
Recommended	<3	>0.9	<0.1	<0.05	>0.9	>0.9	>0.9
Real	2.482	0.964	0.045	0.662	0.978	0.964	0.974

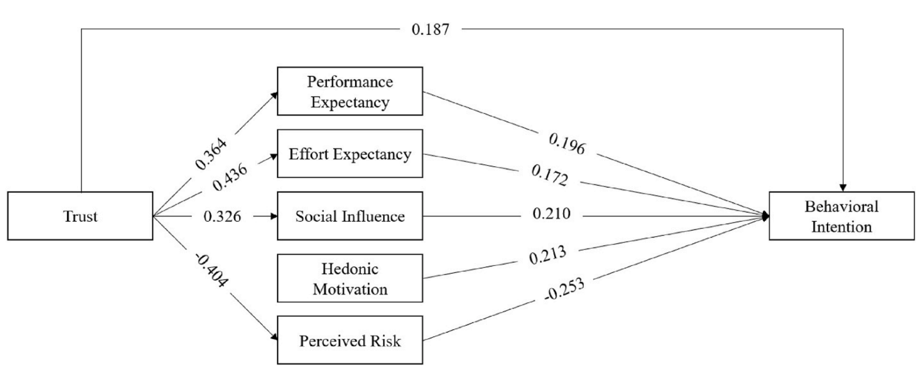

Fig. 3. Diagrammatic results of research model.

independent variable is continuous, a multi-group structural equation analysis is recommended. It is advisable to first test for differences in standardized path coefficients within the structural equation. If these variances show statistical significance, the moderating effect can be considered significant.

In the present study, gender, age, monthly income, education level, travel time, travel purpose, and the number of private cars were identified as moderating variables, all of which are categorical. The independent variables in the model are latent variables conceptualized as continuous. Therefore, this study employs multi-group structural equation analysis to investigate the moderating effects.

5.5.1. Moderating effect of gender

According to the results presented in Table 11, it is clear that gender does not serve as a moderating element in any of the pathways, indicating that gender does not contribute to the fluctuations in users' behavioral intentions.

5.5.2. Moderating effect of age

Based on the findings presented in Table 5, the age brackets of 26–30 and 31–40 years old are notably prevalent within the sample population. Therefore, this study divides age into two distinct categories: individuals aged 30 years and younger (group 1) and those above 30 years of age (group 2), with the aim of examining the potential moderating influence of age. As depicted in Table 12, it is observed that, except for performance expectancy, the influence of various factors on behavioral intention could potentially be influenced by age.

5.5.3. Moderating effect of monthly income

Based on the data provided in Table 5, the study observes that a significant proportion of users report monthly incomes falling within the ranges of 5001–10,000 yuan and 10,001–15,000 yuan. Consequently, the research categorizes monthly income into two groups: those earning 10,000 yuan or less (group 1) and those earning above 10,000 yuan (group 2) to explore the potential moderating effect of income on the model. Analysis depicted in Table 13 indicates that monthly income does not exert a moderating influence on any of the pathways examined.

5.5.4. Moderating effect of education

According to the information provided in Table 5, it is apparent that a significant proportion of users hold a bachelor's degree. To ensure equitable representation within the study group, the research has segmented educational achievement into two distinct groups: individuals with a high school education or lower (group 1) and those with education beyond high school (group 2). This classification is crucial for examining the potential moderating effects of educational attainment. As illustrated in Table 14, the data indicates that educational level does not have a moderating impact on any of the pathways under investigation.

5.5.5. Moderating effect of trip time

Based on the findings presented in Table 5, a significant portion of users typically spend between 16 and 30 min on their daily commute. Consequently, this study categorizes travel time into two distinct groups: those with a commute duration of 15 min or less (group 1) and those exceeding 15 min (group 2), in order to examine the potential moderating influence of travel time on the model. As depicted in Table 15, the results indicate that travel time does not have a moderating impact on any of the pathways analyzed.

5.5.6. Moderating effect of trip purpose

Based on the findings presented in Table 5, it is observed that travel behaviors related to work, school, and shopping demonstrate a greater level of regularity in comparison to other forms of travel, which are typically more irregular. Consequently, this study classifies travel intentions into two primary categories: fixed routes (group 1) and non-fixed routes (group 2) in order to explore the potential influence of travel purpose on the model. However, as indicated in Table 16, the

Table 11
Result of the moderating effect of gender.

Path	β		Difference
	Male	Female	
PE→BI	0.132***	0.211***	0.079
EE→BI	0.177***	0.132***	0.045
SI→BI	0.219***	0.159***	0.060
HM→BI	0.245***	0.147***	0.098
TR→BI	0.156***	0.220***	0.064
PR→BI	−0.228***	−0.233***	0.005

Note: *** = p<1%, ** = p<5%, * = p<10%.

Table 12
Result of the moderating effect of age.

Path	β		Difference
	Group 1	Group 2	
PE→BI	0.234***	0.108**	0.126
EE→BI	0.155***	0.249***	0.094***
SI→BI	0.208***	0.166***	0.042***
HM→BI	0.157***	0.238***	0.081***
TR→BI	0.235***	0.164***	0.071**
PR→BI	−0.261***	−0.317***	0.056***

Note: *** = p<1%, ** = p<5%, * = p<10%.

Table 13
Result of the moderating effect of hourly income.

Path	β		Difference
	Group 1	Group 2	
PE→BI	0.204***	0.139***	0.065
EE→BI	0.154***	0.131**	0.023
SI→BI	0.174***	0.232***	0.058
HM→BI	0.211***	0.160***	0.051
TR→BI	0.180***	0.203***	0.023
PR→BI	−0.217***	−0256***	0.039

Note: *** = p<1%, ** = p<5%, * = p<10%.

Table 14
Result of the moderating effect of hourly income.

Path	β		Difference
	Group 1	Group 2	
PE→BI	0.019	0.207***	0.188
EE→BI	0.305***	0.122***	0.183
SI→BI	0.261***	0.189***	0.072
HM→BI	0.082	0.216***	0.134
TR→BI	0.057	0.210***	0.153
PR→BI	−0.362***	−0.215***	0.147

Note: *** = p<1%, ** = p<5%, * = p<10%.

Table 15
Result of the moderating effect of trip time.

Path	β		Difference
	Group 1	Group 2	
PE→BI	0.199***	0.159***	0.040
EE→BI	0.109*	0.177***	0.068
SI→BI	0.182***	0.200***	0.018
HM→BI	0.157**	0.206***	0.049
TR→BI	0.146**	0.209***	0.063
PR→BI	−0.316***	−0.196***	0.120

Note: *** = p<1%, ** = p<5%, * = p<10%.

analysis reveals that travel purpose does not have a moderating impact on any of the pathways examined.

5.5.7. Moderating effect of the number of private cars

According to the information provided in Table 5, it is clear that most users own only one private car. Therefore, this study categorizes the number of private cars into two separate groups: individuals with one car or less (group 1) and those with more than one car (group 2). As shown in Table 17, private cars do not have a moderating impact on any of the relationships.

In brief, age is the primary moderating factor of significance, as delineated in Table 18. The outcomes suggest that age plays a significant role in shaping the interrelations among the variables examined, while demographic aspects such as gender, educational attainment, and possession of private vehicles do not demonstrate substantial moderating impacts. This highlights the importance of age as a pivotal moderator that should be considered when investigating the determinants of users' behavioral intentions within this specific framework.

Based on the standardized path coefficients presented in Table 12 and Fig. 4, a comprehensive analysis is conducted to investigate the impact of age on the relationship between latent variables and behavioral intention. The examination reveals that age plays a significant role in moderating the association between effort expectancy and behavioral intention, particularly among users aged 30 and above. Older individuals place greater importance on operational convenience when evaluating flying cars, and a complex operational process may deter them from making a purchase. In contrast, younger users exhibit higher adaptability to new technologies, leading to reduced hesitancy towards operational challenges. To enhance purchase conversion rates among potential customers aged 30 and above, manufacturers should prioritize simplifying operational procedures and ensuring user-friendly operations of flying cars.

Furthermore, the influence of social influence on behavioral intention is also influenced by age, with a more pronounced effect observed among users aged 30 and below. Younger demographics are more susceptible to peer influence and social media, leading to a tendency to adopt the use of flying cars due to social trends. In contrast, older individuals rely more on personal judgment and experiences when deciding on the feasibility of using flying cars. Manufacturers targeting younger consumers should focus on community and group marketing strategies to cultivate trends for the adoption of flying cars among this demographic.

The relationship between hedonic motivation and behavioral intention is similarly affected by age, with a more significant moderating effect observed among users aged over 30 years. Individuals in this age group with stable financial standing and higher disposable income are more inclined towards seeking pleasure, translating into tangible purchasing actions. To stimulate purchasing interest among this demographic, businesses should emphasize the innovative and enjoyable aspects of flying cars in their marketing strategies.

Moreover, age moderates the relationship between trust and behavioral intention, with a more pronounced impact observed among individuals aged 30 and below. Younger consumers show greater openness to new technologies but also exhibit a cautious approach when adopting them. Establishing trust is crucial for flying car manufacturers targeting younger consumers, as it influences their willingness to use the products. Companies can build trust by providing exceptional product quality, transparent communication, and high-quality customer service.

Lastly, the relationship between perceived risk and behavioral intention is also moderated by age, with a stronger effect observed among users aged over 30 years. Older individuals tend to exercise caution and carefully evaluate potential risks due to their social responsibilities and family burdens. In contrast, younger individuals are more open to risk-taking behaviors. To increase the willingness of users aged 30 and above to adopt flying cars, companies should focus on mitigating perceived risks by enhancing safety protocols and providing comprehensive after-sales support. Companies should tailor their marketing strategies to address the varying risk perceptions among users of different age groups.

Table 16
Result of the moderating effect of trip purpose.

Path	β		Difference
	Group 1	Group 2	
PE→BI	0.177***	0.184*	0.007
EE→BI	0.139***	0.293***	0.154
SI→BI	0.172***	0.268***	0.096
HM→BI	0.194***	0.186*	0.008
TR→BI	0.207***	0.060	0.147
PR→BI	−0.247***	−0.096	0.151

Note: *** = p<1%, ** = p<5%, * = p<10%.

Table 17
Result of the moderating effect of the number of private cars.

Path	β		Difference
	Group 1	Group 2	
PE→BI	0.195***	0.118	0.077
EE→BI	0.137***	0.228***	0.091
SI→BI	0.170***	0.254***	0.084
HM→BI	0.210***	0.100	0.110
TR→BI	0.185***	0.189***	0.004
PR→BI	−0.231***	−0.239***	0.008

Note: *** = p<1%, ** = p<5%, * = p<10%.

Table 18
Results of the hypothesis testing for moderating effect.

hypothesis	Effect relationship	Result
H7	Gender moderates the relationships between antecedent variables and behavioral intention	Rejected
H8	Age moderates the relationships between antecedent variables and behavioral intention	Supported
H9	Hourly income moderates the relationships between antecedent variables and behavioral intention	Rejected
H10	Education moderates the relationships between antecedent variables and behavioral intention	Rejected
H11	Trip time moderates the relationships between antecedent variables and behavioral intention	Rejected
H12	Trip purpose moderates the relationships between antecedent variables and behavioral intention	Rejected
H13	The number of private cars moderates the relationships between antecedent variables and behavioral intention	Rejected

6. Conclusion and remark

6.1. Research conclusion

The rapid growth of urban populations and development has led to increasing transportation challenges in cities. Flying cars are being considered as a potential solution to provide efficient and convenient personal rapid transit in urban areas. However, the adoption of flying cars faces various social and technical obstacles such as airspace management, safety regulations, and environmental concerns. While the technical feasibility of flying cars is becoming more apparent, user acceptance is influenced by multiple factors. Therefore, utilizing an expanded UTAUT2 model to examine the determinants affecting the adoption of flying cars can offer valuable insights for research, development, marketing, and policy-making strategies.

This study conducts an overview and evaluation of existing research on technology acceptance models, user acceptance in transportation, trust, and perceived risk through a literature analysis approach. The

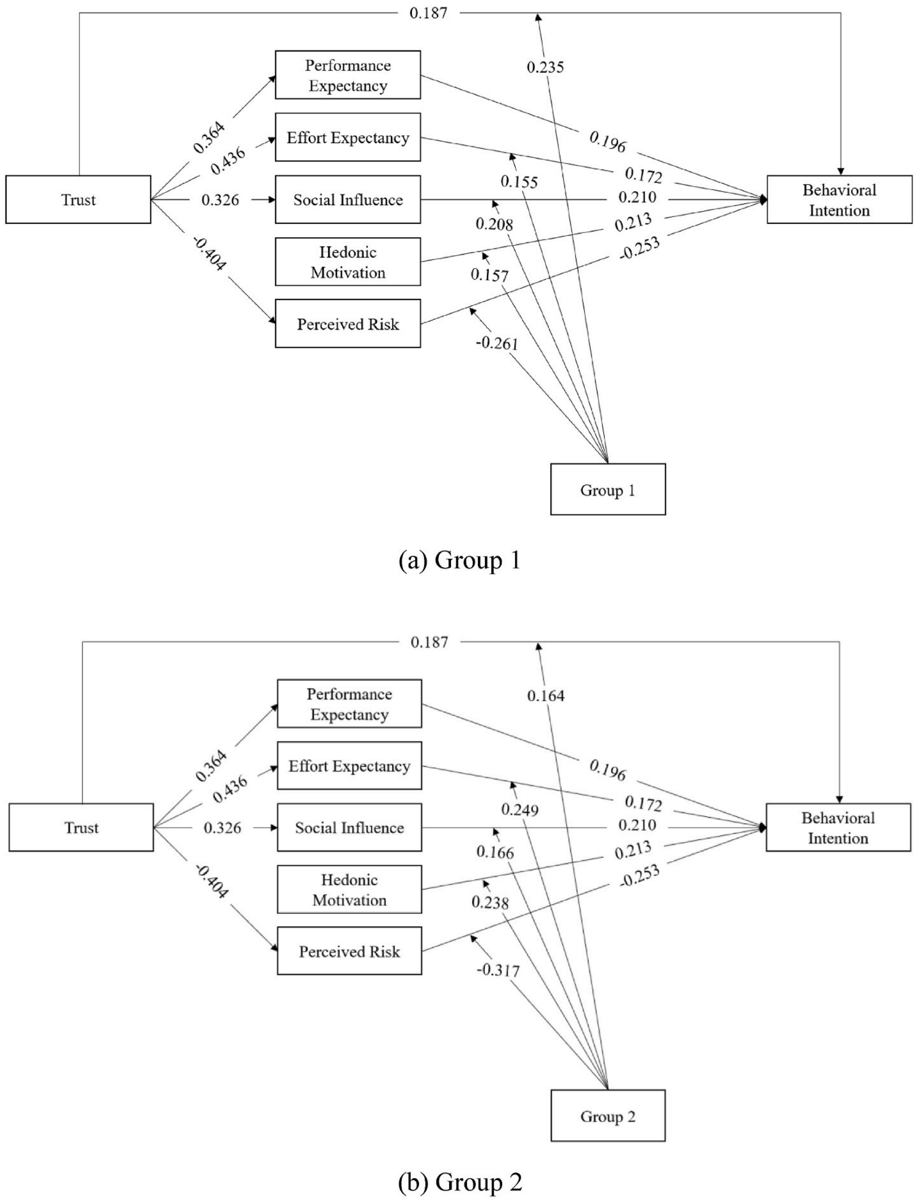

Fig. 4. Moderating effect for age.

study focuses on behavioral intention as the criterion for user acceptance and identifies six primary latent variables: performance expectancy, effort expectancy, social influence, hedonic motivation, trust, and perceived risk. Theoretical hypotheses are formulated based on these variables, leading to the development of a theoretical model and a questionnaire design. A structural equation model is then developed using sample data to validate the research hypotheses. Additionally, a moderating effect analysis is conducted to explore potential variations in influence relationships across different groups within the model.

The primary findings of the study indicate that factors such as performance expectancy, effort expectancy, social influence, hedonic motivation, trust, and perceived risk significantly influence users' behavioral intentions towards adopting flying cars. Perceived risk emerges as the most influential factor, highlighting users' concerns about potential risks associated with flying car adoption. Trust plays a crucial role in shaping users' behavioral intentions directly and indirectly through various mechanisms. Age is identified as a key moderating factor in the associations between user variables and behavioral intentions towards flying cars, with different age groups showing varying sensitivities to factors like ease of use, hedonic motivation, and perceived risk. Manufacturers are advised to tailor their product attributes and marketing strategies to meet the evolving demands of users across different age demographics.

6.2. Policy and managerial recommendations

6.2.1. Enhancing adoption through user-centric policies

To increase the likelihood of flying car adoption, policies and strategies should focus on enhancing perceived benefits, particularly the convenience of flying cars. Given that convenience (0.893) is more valued by users than saving travel time (0.862) or reducing travel costs (0.869), policymakers and manufacturers should emphasize features that make flying cars more convenient, such as vertical take-off and landing capabilities. These capabilities can significantly enhance convenience by avoiding traffic congestion and providing flexibility in urban environments. Additionally, integrating flying cars with existing transportation infrastructure and promoting their benefits through public awareness campaigns can further shift user perceptions in favor of adoption.

Effort expectations positively influence user intention to adopt flying cars (0.172***). To address concerns about the ease of learning and operating flying cars, manufacturers should design user-friendly interfaces and controls. Comprehensive training programs, supported by either government or private sector incentives, can help potential users become comfortable with flying car operations. Establishing robust support and maintenance services can also assist users during the early stages of adoption, reducing the perceived effort required to use flying cars and enhancing overall user confidence.

Social influence (0.210***) plays a critical role in shaping user intentions. Policies should capitalize on this by fostering community-based programs that involve demonstrations and pilot projects within neighborhoods. Positive experiences shared among community members can enhance the social acceptability of flying cars. Additionally, collaboration with influencers and leveraging social media platforms to spread positive messages can build credibility. Public endorsements from trusted figures can further increase legitimacy and trust among potential users, encouraging wider adoption.

6.2.2. Building trust and reducing perceived risks

Trust is vital for the adoption of flying cars, influencing performance expectations, effort expectations, social influence, and reducing perceived risk. Ensuring transparent communication about the safety, reliability, and environmental benefits of flying cars is essential. Policymakers should develop and enforce stringent safety and operational standards, with certification and regular audits to build public confidence. Collaborating with well-established and trusted brands in the transportation and technology sectors can also leverage their reputation to enhance trust in flying cars.

Perceived risk negatively impacts user intention (−0.253***), making it crucial to mitigate these concerns effectively. Investing in and promoting noise reduction technologies can address one of the primary concerns of potential users. Emphasizing the safety features and protocols of flying cars through data and case studies can reassure users about the technology's safety. Additionally, clear and transparent data policies that protect user privacy can alleviate concerns about data security, further reducing perceived risks associated with flying car adoption.

6.2.3. Addressing age-related differences

Age significantly moderates the relationships between various factors and user intention. For users over 30, simplified operation and interfaces can reduce effort expectations, making flying cars more appealing. Marketing efforts for younger users (under 30) should focus on social media and community influence, as this demographic is more susceptible to these factors. Highlighting the enjoyment and trustworthiness of flying cars can also convert hedonic motivation into actual adoption, particularly for older users who seek enjoyable experiences and have higher trust requirements.

By implementing these comprehensive policy and management strategies, stakeholders can effectively address the concerns and motivations of different user groups. These targeted approaches can create a conducive environment for the adoption of flying cars, ultimately enhancing their acceptance and integration into mainstream transportation options.

6.3. Theoretical and practical contributions

This research significantly advances the UTAUT2 model by integrating a new dimension that captures the complexities and unique attributes of flying cars. This integration is essential for accurately reflecting the specific challenges and opportunities presented by UAM technologies. The study aligns with Wandelt et al. (2023), who highlight the multifaceted challenges in unmanned aerial vehicle operations across logistics, mobility, and monitoring, emphasizing the need for robust theoretical frameworks to address these complexities.

Furthermore, the study's empirical approach provides a solid foundation for future research in UAM, echoing the sentiments of Sun et al. (2021), who underscore the importance of operational considerations and research challenges in on-demand air mobility. By addressing these considerations, the research offers a nuanced understanding of user behavior and technology adoption in the context of flying cars.

From a practical standpoint, this study offers actionable insights for the advancement, regulation, and promotion of aerial vehicles. It provides evidence-based recommendations for policymakers and industry stakeholders to foster a conducive environment for the adoption of flying cars. For example, Babetto et al. (2023) discuss the technical, legal, and social aspects of UAM adoption in Europe, highlighting the importance of regulatory frameworks and public acceptance. This research complements their findings by offering strategies to mitigate perceived risks and enhance user experiences.

Moreover, the study's focus on performance expectations aligns with Jin et al. (2024), who address the optimization challenges in urban air mobility systems, particularly in vertiport location planning and travel mode choice behavior. By improving the reliability and efficiency of flying car operations, stakeholders can better meet user expectations and drive adoption. Additionally, Wang et al. (2024) explore policy challenges for the coordinated delivery of trucks and drones, underscoring the need for integrated and flexible regulatory approaches in the UAM sector. This research reinforces the necessity of cohesive policies that support the seamless integration of flying cars into existing transportation infrastructures.

In conclusion, this research makes significant theoretical and practical contributions to the understanding and adoption of flying cars within the UAM context. By expanding the UTAUT2 model and providing targeted recommendations, it offers a comprehensive framework for addressing the unique challenges and opportunities associated with this innovative technology. The insights gained from this study are invaluable for advancing UAM research, informing policy decisions, and guiding industry practices towards a sustainable and efficient urban air mobility future.

6.4. Limitations and future work

The investigation may not fully capture the dynamic and multifaceted nature of technology acceptance and usage. A longitudinal or experimental study could provide more profound insights into causal relationships and changes in consumer perceptions and behaviors over an extended timeframe.

The research is conducted within the specific context of urban air mobility, potentially limiting the generalizability and applicability of the findings to other contexts and technologies. A comparative analysis or meta-analysis could explore the similarities and differences in the acceptance of flying cars across various countries, cultures, and consumer demographics.

The study utilizes the UTAUT2 model as a theoretical framework, which may not comprehensively account for all relevant factors and interactions influencing the acceptance and adoption of flying cars. A more comprehensive or context-specific model could incorporate additional variables, such as environmental concerns, personal innovativeness, compatibility, among others.

The study relies on self-reported consumer perceptions and intentions, which may not necessarily align with the actual behaviors and outcomes associated with the use of flying cars. A study focusing on behaviors or outcomes could evaluate metrics like usage frequency, duration, satisfaction, loyalty, among others, among flying car consumers.

CRediT authorship contribution statement

Jiangling Wu: Writing – review & editing, Validation, Methodology, Formal analysis, Conceptualization, Investigation. **Qiang He:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Conceptualization. **Amit Kumar Singh:** Writing – review & editing. **Linjie Tian:** Writing – review & editing, Supervision.

Data availability

Data will be made available on request.

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