Air Travelers' Preferences for Multimodal Urban Air Mobility (UAM) as an Airport Shuttle: A Stated Preference Study

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Abstract

Urban Air Mobility (UAM) presents a promising solution to alleviate traffic congestion and reduce travel time. However, UAM trips inherently require take-off and landing at dedicated vertiports, making them multimodal by nature—a factor often overlooked in the existing literature. This study investigates passengers' preferences for multimodal UAM transport compared to ground transport, with a specific focus on how access modes to vertiports influence traveller attitudes in an airport access scenario. To examine these preferences, a two-stage stated preference (SP) experiment was designed, and a nested logit model was applied to analyse travellers' intentions to choose UAM-integrated multimodal transport options for airport access. The findings aim to provide researchers, policymakers, and practitioners with a deeper understanding of public adoption of UAM services. Additionally, the results are expected to inform the development of UAM networks and their integration with ground transport systems.

Keywords: Urban Air Mobility, multimodal passenger transport, airport shuttle, stated-preference survey

1 Introduction

As ground transport systems approach capacity limits, cities worldwide face growing traffic congestion. According to INRIX (2025) which analysed congestion levels in 946 urban areas globally, 55% experienced increased traffic delays compared to 2023. With workers returning to offices, this trend is expected to worsen. In contrast to well-developed ground transport systems, low-altitude airspace remains underutilised. Recent advancements in vertical take-off and landing (VTOL), battery technologies, and automation have enabled the development of Urban Air Mobility (UAM). Utilising electric vertical take-off and landing (eVTOL) aircraft, UAM offers a promising solution to urban congestion by providing significantly faster travel speeds (can be 150-200 mph, see Holden & Goel (2016)) and bypassing ground traffic altogether.

Due to its unique characteristics—such as low-altitude operation, fast travel speeds, and higher costs—researchers have extensively examined potential users' attitudes toward UAM. Examples include Boddupalli et al. (2024), Coppola et al. (2024), Karimi et al. (2024) and Riza et al. (2024), which conducted surveys to explore travellers' expectations, concerns, and willingness to use UAM compared to traditional modes (cars, public transit, and taxis) across scenarios such as commuting, intercity travel, and airport access. These studies found that, compared to existing ground transport modes (especially car), respondents' willingness to use UAM is mixed, with some found negative (Boddupalli et al., 2024; Fu et al., 2019; Jang et al., 2025) and others found positive (Cho & Kim, 2022; Coppola et al., 2024; Samadzad et al., 2024). As UAM services are significantly more expensive than other options, high cost has been identified as a major barrier to adoption (Cohen et al., 2021; Long et al., 2023; Straubinger et al., 2020). Like many novel services and technologies, UAM primarily attracts young, well-educated, and employed individuals (Brunelli et al., 2023; Fu et al., 2019; Song et al., 2024). Due to the high cost of UAM services, studies have found that UAM adoption is generally higher among individuals with higher incomes (Chae et al., 2024; Coppola et al., 2024; Karimi et al., 2024).

Unlike private cars or taxis, UAM operations rely on designated vertiports. In UAM's early stages, the vertiport network is likely to be sparse due to safety and noise concerns that require these facilities to be located away from residential areas (Preis & Vazquez, 2022). As a result, vertiports may not always be within walking distance, necessitating first/last-mile ground transport modes such as buses, shared bikes, or taxis. Consequently, UAM trips are inherently multimodal. The convenience or inconvenience of these access/egress modes can significantly influence travellers' willingness to adopt UAM. Despite advancements in UAM research, the impact of access/egress modes remains underexplored in the existing literature.

To address this gap, this study employs a two-stage stated preference (SP) survey to examine the role of ground transport access modes in UAM adoption. The airport access scenario serves as the study context, given the suitability of UAM for long-distance, premium-priced trips and the higher income levels of air travellers relative to the general population. In this survey, respondents first choose an access mode and then select their primary travel mode to the airport. A nested logit model is used to assess how access modes influence respondents' choices.

The remainder of this paper is structured as follows: Section 2 reviews the relevant literature. Section 3 outlines the survey design and data collection methods. Section 4 details the modelling framework and presents anticipated results. Finally, Section 5 discusses the conclusions and implications.

2 Literature review

The number of studies on Urban Air Mobility (UAM) has surged over the past five years. In 2018, fewer than 80 publications existed, but this number nearly doubled to around 160 by 2020 (Abbasi et al., 2024). UAM research spans a wide range of topics, including aircraft configurations, vertiport design and location, public acceptance, demand estimation, and fleet operational planning (Garrow et al., 2021; Rajendran & Srinivas, 2020; Sun et al., 2021). Among these, public acceptance and demand estimation have garnered significant attention, as UAM, being a novel and capital-intensive transport mode distinct from ground transport, requires widespread public support.

Current research on public acceptance and demand for UAM can be broadly categorised into two groups. The first focuses on psychological factors, using technology acceptance models to analyse how attributes like perceived safety and perceived benefits affect adoption intentions (Janotta & Hogreve, 2024; Karami et al., 2024; Vongvit et al., 2024). Among these factors, perceived safety is widely recognised as positively correlated with UAM adoption. The second group examines the impact of trip attributes (e.g., travel time, cost), personal characteristics (e.g., socioeconomic factors), and travel habits (e.g., commonly used modes, air travel frequency). These studies frequently employ SP surveys and discrete choice models, consistently identifying travel time and cost as key determinants. Notably, they emphasise that reducing costs is essential for UAM to transition beyond a niche market (Asmer et al., 2024; Rimjha et al., 2021; Wu & Zhang, 2021).

Vertiport accessibility is another major factor influencing UAM's success (Asmer et al., 2024; Rimjha et al., 2021). Many studies use "access/egress time" as a proxy for accessibility, with assumptions ranging from 5 to 20 minutes (Boddupalli et al., 2024; Coppola et al., 2024; Fu et al., 2019; Karimi et al., 2024). A few studies further specify access modes: for example, Song et al. (2024) assumes an average access time of 9 minutes by car or walking, Hwang & Hong (2023) assumes 4–14 minutes by walking, and Rothfeld (2022) assumes 5–10 minutes on foot. However, vertiport location optimisation studies present a contrasting picture. For instance, Rimjha et al. (2021) propose 50 to 200 vertiports across 17 counties in Northern California, equating to only 9×10^{-4} to 0.004 vertiports/km^2. Similarly, Rajendran & Zack (2019) assumed that only those who could save at least 40% in travel time by using UAM would switch to this mode. Using New York trip data, recommend only 21 vertiports for New York City (0.017 vertiports/km^2). Asmer et al. (2024), referencing to Mayakonda et al. (2020)'s assumption on vertiport density (0.002-0.007 vertiports/km^2), assumed that vertiport density would range from 0.001 to 0.002 vertiports/km^2 in 2030 and 0.01-0.02 vertiports/km^2 in 2050. This translates to access/egress distances of 9-12 km in 2030 and 3-5 km in 2050.

The mismatch between vertiport density assumptions and accessibility modelling highlights the unrealistic nature of assuming all vertiports are reachable by walking. UAM trips should be treated as air-ground multimodal journeys, where the convenience of the access/egress stage significantly impacts adoption decisions. While the effect of accessibility on travel demand has been well studied for both ground transport (shared mobility and public transport) (Albrecht et al., 2025; Berg Wincent et al., 2023; Chowdhury et al., 2016; van Soest et al., 2020) and air travel (Choo et al., 2013; Gupta et al., 2008; Hess & Polak, 2006), the integration of UAM with ground transport has received less attention. Given UAM's unique access requirements and respondents' unfamiliarity with the mode (which may increase perceived risk), the influence of the access/egress stages on adoption and travellers' perceptions of its multimodal nature remains underexplored.

3 Data

Since UAM is still a new concept and few travellers have experienced this service, we use a SP experiment to collect data on respondents' travel mode choices. Given that UAM is more suitable for longer intracity trips, we focus on airport access as the scenario.

The hypothetical trips to the airport are shown in Figure 1. For car and taxi (including ridehailing), the trips are point-to-point, involving just one leg. For UAM and tube trips, since the distances to vertiports or tube stations may exceed walking distance, respondents can use a taxi or bus to reach the station. We assume the airport is directly connected to the UAM or tube system, so the egress distance is set to zero. Thus, both UAM and tube trips are divided into two stages: the access stage and the main stage.

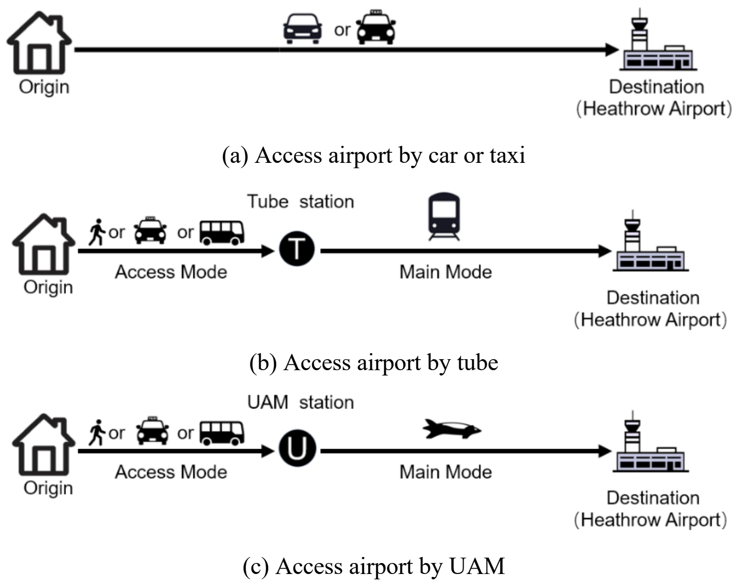


Figure 1 Journey to the airport by various modes

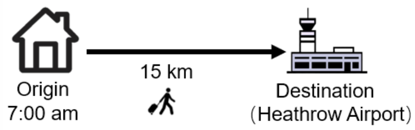
The overall experiment consists of three parts: (1) Blocking questions to determine if respondents have air travel experience. Those without such experience are screened out. If respondents are not screened out, they are asked whether they have used air travel for business purposes and whether the car option applies. These two questions serve to tailor the survey to respondents' real travel experiences (as show in Table 1); (2) Eight stated mode choice scenarios, which form the core of the survey; and (3) Questions on socio-demographic details, travel habits, and attitudes toward UAM.

Table 1 The relationship between travel experience and blocks

Block No.	Used air travel for business purposes	Have a car that drives regularly	Block feature	
			Business travel choice scenario	Car option in the choice scenario
Block 1	Yes	Yes	Yes	Yes
Block 2	Yes	No	Yes	No
Block 3	No	Yes	No	Yes
Block 4	No	No	No	No

The choice scenarios are divided into two stages. First, respondents are asked to imagine a trip to the airport and consider whether they would use a tube or UAM, taking into account walking time, in-vehicle time, waiting time, and travel costs for the access modes. Based on these factors, they must decide whether to stick with walking or opt for a bus or taxi as the access mode. In the second stage, respondents choose their travel mode for the main journey, based on the two access modes they selected for the tube or UAM in the first stage. If respondents feel that the selected access modes are unsuitable for the second stage, they can always return to adjust their choices. The choice scenarios for both stages are presented in Figure 2 and Figure 3.

Background:
Imagine it's **7 am**, and you are preparing to leave for a **non-business** trip.
You will travel **alone** and **carry luggage**.
Your goal is to arrive at **Heathrow Airport** by **9 am**, and it is about **15 km** away.



Step 1: Choose the Access Mode for the Tube and UAM

If you want to take the **tube** (with an in-vehicle travel time of about **40 minutes**) to the airport, which access mode would you choose given the following times and costs for walking, taxi and bus access?

Tube (Access Mode)	Walking	Taxi	Bus
Walking time	15 mins	--	4 mins
In-vehicle time	--	10 mins	10 mins
Waiting time	--	10 mins	5 mins
Access cost	**--**	**£5.00**	**£2.00**
Select	Walking	Taxi	Bus

If you want to take the **UAM** (with an in-vehicle travel time of about **15 minutes**) to the airport, which access mode would you choose given the following times and costs for walking, taxi and bus access?

UAM (Access Mode)	Walking	Taxi	Bus
Walking time	20 mins	--	4 mins
In-vehicle time	--	5 mins	5 mins
Waiting time	--	5 mins	10 mins
Access cost	**--**	**£7.00**	**£1.00**
Select	Walking	Taxi	Bus

Note: Access cost represents the fare for taking a taxi or bus instead of walking during the access stage.

Figure 2 Choice scenario of the access Stage (Stage 1)

Step 2: Select Your Preferred Transport Mode to the Airport

Given the following available options, which mode of transport would you choose to travel to the airport?
Note that the access modes for Tube and UAM are based on your previous selections, which are:
Tube Access Mode: **Walking**
UAM Access Mode: **Taxi**
As a reminder, you are leaving for the airport at **7 am** and need to be there by **9 am** (**15 km** distance).
You will travel **alone** for **non-business** trip and **carry luggage.**

Main mode	Car	Taxi	Tube (walking)	UAM (taxi)
Access time	2 mins	Not applicable	15 mins	5 mins
In-vehicle time	30 mins	50 mins	40 mins	15 mins
Waiting time	Not applicable	5 mins	2 mins	15 mins
Total cost[1]	£24.00	£20.00	£5.00	£37.00
Sharing space with strangers[2]	No strangers	Sharing space with 1 stranger	80% of passengers have a seat	Sharing space with 2 strangers
Advance luggage check-in[3]	No	No	Yes	Yes

Note 1: For **Car**, this includes fuel costs, parking fees, and access charges; For **Taxi**, **Tube** and **UAM**, it shows only your travel cost, not your companions'.
Note 2: For **Taxi and UAM**, this indicates how many strangers will share the main mode with you and your companion. For **Tube**, it reflects how crowded the carriage is, assuming empty seats are filled first.
Note 3: 'Yes' means you can advance check in your luggage at the Tube or UAM station before reaching the airport.

Figure 3 Choice scenario of the main Stage (Stage 2)

The SP choice experiments were designed using the D-efficient approach (Rose & Bliemer, 2013, 2009). The attributes describing the travel options are presented in Table 2 and were based on the average values of real trips from central London (e.g., Bank, South Kensington, Chelsea) to Heathrow airport. The priors were sourced from the literature (Brunelli et al., 2023; Song et al., 2024) and subsequently adjusted using data from the pilot survey.

The survey went through three rounds of piloting. In the first round, the survey was tested within the research group (n=5), leading to the removal of the bike option as respondents noted that air travellers usually carry luggage, which is impractical for cycling. Additionally, information on first-class/economy class was moved to the personal information section, as participants felt the choice tasks contained too much information. In the second round, the pilot was expanded to include 11 faculty members and students in the department. Following this, two revisions were made: we replaced the survey's introduction with two videos, as the original was deemed too long, and we reduced the number of scenarios each respondent needed to answer from 12 to 6 to shorten the survey. In the third round, the survey was piloted with an air travel research group at the Indian Institute of Science. Based on their feedback, we introduced the "advance check-in" option for UAM, allowing passengers to check in their luggage at the vertiport, where it will be directly transported to their destination airport. The survey will be piloted again in January 2025 with helicopter users in London and will be distributed after this round of testing.

Table 3 Attributes and attribute levels of the access stage

Attribute	Alternatives		
	Walk	Taxi	Bus
Access time by walking (min)	10 | 15 | 20	N/A	2 | 4
Access time by vehicle (min)	N/A	5 | 10	5 | 10
Waiting time (min)	N/A	2 | 5 | 10	2 | 5 | 10
Access cost (GBP)	N/A	5 | 7 | 10	1 | 1.5 | 2

Table 4 Attributes and attribute levels of the main stage

Attribute	Alternative			
	Car	Taxi	Tube	UAM
Travel cost (GBP)	12 | 18 | 24	40 | 45 | 50	5 | 7 | 9	15 | 20 | 30
In-vehicle travel time (min)	30 | 45 | 60	30 | 40 | 50	35 | 40 | 45	10 | 12 | 15
Waiting time (min)	N/A	2 | 5 | 10	2 | 5 | 10	2 | 5 | 10
Sharing space with strangers	N/A	0 | 1 | 2 | 3	N/A	0 | 1 | 2 | 3
Advance check-in	Yes | No	Yes | No	Yes | No	Yes | No
Crowding level[1]	N/A	N/A	50% of passengers have a seat | 80% of passengers have a seat | 80% of the seats occupied	N/A

Note 1: We assume that passengers will be seated if there is an empty seat.

Our current target population consists of air travellers residing in London, with a target sample size of 300. The survey quota will be set according to the age and income distributions specified in the Civil Aviation Authority (2019) guidelines. The ultimate goal of this study is to collect data from a developing city (e.g., Bangalore or Shanghai) and compare it with the results from London. After completing data collection in London, we will adapt the survey for the developing city and distribute it there.

4 Modelling approach

Similar to Hess & Polak (2006) and Wen et al. (2012), We use a nested logit model to analyse the intention of travellers choosing UAM-involved multimodal transport options to the airport.

For car and taxi, there is no access stage. Therefore, their utility functions are:

$$U_{car} = ASC_{car} + \beta_{IVTT} \cdot IVTT + \beta_{Cost} \cdot Cost + \epsilon \quad (1)$$

$$U_{taxi} = ASC_{taxi} + \beta_{WT} \cdot WT + \beta_{IVTT} \cdot IVTT + \beta_{Cost} \cdot Cost + \epsilon \quad (2)$$

where ASC is the alternative specific constant, $Cost$ is the travel cost, $IVTT$ represents the in-vehicle travel time, WT is the waiting time, β's are coefficients associated with the attributes, and ϵ is the unobservable part of the utility function.

For tube and UAM, both include an access stage and a main stage. The utility for access stage is:

$$U_{access} = ASC + \beta_{AT} \cdot AT + \beta_{WT} \cdot WT^{a} + \beta_{Cost} \cdot Cost^{a} + \epsilon \quad (3)$$

where AT represents the travel time of the access mode (e.g., walking time for walking, in-vehicle travel time for taxi or bus); WT^{a} is the waiting time for the access mode, and $Cost^{a}$ is the access mode cost.

The utilities for the main stage of the tube and UAM are as follows:

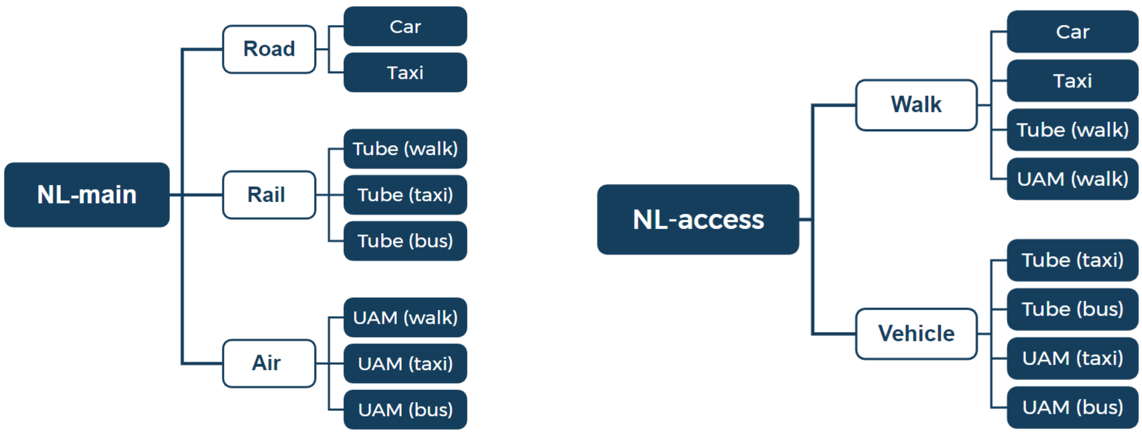
$$U_{tube,main} = ASC + \beta_{WT} \cdot WT^{m} + \beta_{IVTT} \cdot IVTT^{m} + \beta_{Cost} \cdot Cost^{m} + \beta_{CR} \cdot CR + \epsilon \quad (4)$$

$$U_{UAM,main} = ASC + \beta_{WT} \cdot WT^{m} + \beta_{IVTT} \cdot IVTT^{m} + \beta_{Cost} \cdot Cost^{m} + \beta_{SS} \cdot SS + \beta_{AC} \cdot AC + \epsilon \quad (5)$$

where WT^{m} is the waiting time for the main mode, $IVTT^{m}$ is the in-vehicle travel time for the main mode, $Cost^{m}$ is the main mode cost, CR is the crowding level for the tube, SS indicates whether the traveller needs to share space with strangers in the UAM vehicle, and AC denotes the availability of advance check-in at the vertiport.

The utility for respondents selecting the multimodal UAM or tube trip is the sum of the access and main stage utilities.

Two nested structures are considered for this study: NL-main and NL-access. In the NL-main model, we categorise the alternatives based on the main stage travel mode and divide the alternatives into three nests (Figure 4 (a)). In the NL-access model, alternatives are categorised by access mode (whether walking or vehicle-based), and are grouped into two nests (Figure 4 (b)). Both structures will be tested once the data is collected.



(a) NL-main

(b) NL-access

Figure 4 Structure of the nested logit models

5 Expected results

Using the model described above, we expect the following findings:

- The optimal nest structure for capturing two-stage choice behaviour.
- The extent to which the access mode influences respondents' intention to adopt UAM for future airport access.
- Passengers' willingness to share space with strangers during a UAM trip.
- The impact of UAM advance check-in on respondents' willingness to pay for UAM services.
- The complex effects of past air travel experience, attitudes toward new technology, and views on air travel on the propensity to adopt UAM.

Upon completing the data collection and analysis of the London dataset, we plan to extend this study to a city in a developing country (e.g., Shanghai or Bangalore). We will then compare the findings between the two cities, highlighting both similarities and differences. This research aims to deepen understanding of public attitudes toward UAM as a regular travel mode across diverse urban contexts and provide insights for the future development of UAM networks and their integration with ground transport systems.

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