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Consumer Willingness to Fly on Advanced Air Mobility (AAM) Electric Vertical Takeoff and Landing (eVTOL) Aircraft

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For any novel means of transportation to thrive, its success hinges on the willingness of prospective customers to adopt the new system. To explore consumer willingness to participate in Advanced Air Mobility (AAM) by flying on electric vertical takeoff and landing (eVTOL) aircraft, an online survey of 975 individuals in the U.S. was conducted using an existing Willingness to Fly (WTF) scale designed specifically for assessing the acceptance of new aviation technologies and services. Most respondents expressed interest in flying on an eVTOL but planned to wait a few months after service starts before participating in AAM. Overall, the most frequent responses were "agree" and "strongly agree" with being WTF in eVTOLs. The survey offered four different eVTOL flight scenarios, with respondent WTF decreasing as weather or conditions deteriorated. Images of specific eVTOL models were used to assess WTF on each aircraft type. The vehicle with the most unique type of powerplants resulted in the lowest reported WTF. The study also analyzed the WTF of flying on eVTOLs across various demographic attributes. Results showed significant differences between genders, with males having a higher average WTF score. There was a weak negative correlation between WTF and age. Married respondents had the highest WTF, followed by single persons. WTF varied significantly across types of employment, income, and educational attainment. The highest WTF scores were found in the $50,000-74,999 range, with urban respondents having higher WTF than those in suburban and rural locations. Safety and cost were the top two concerns among all levels of WTF. The combination of employment status and marital status was found to be most correlated to WTF. By comprehending the inclination of consumers to travel in eVTOL aircraft, policymakers, manufacturers, and stakeholders can garner valuable insights into market demand, consumer preferences, sustainable transportation, and environmental considerations. Identifying characteristics that support or inhibit customer acceptability can assist in overcoming resistance to adoption and lead to more effective implementation of eVTOLs. Public outreach and education may be warranted to promote familiarity and passion among potential users, increasing interest and involvement. Recommendations for future research include repeating the study with an international sample and exploring willingness to pay for AAM services.

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Large urban areas often have significant levels of traffic congestion, primarily due to the constraints highway networks impose on effective transportation management. As a result, high-density metropolitan areas typically have an increased propensity to embrace novel technological advancements to mitigate transit limitations, such as autonomous vehicles. One component of urban mobility that remains largely underused is low-altitude airspace, which is just now being accessed by uncrewed aircraft systems (UAS) for deliveries, law enforcement, photography, and other observational missions. The utilization of low-altitude airspace for the transport of passengers has predominantly come in the form of helicopter traffic; however, this mode of transport has traditionally been financially out of reach by most citizens.

The need for an affordable and effective solution to transport congestion has long vexed cities and their citizens. Advanced Air Mobility (AAM) has been introduced in pursuit of a more feasible substitute for traditional forms of transportation. AAM "operations moving people and cargo in metropolitan and urban areas" (Federal Aviation Administration, 2023, p. 1) is referred to as Urban Air Mobility (UAM). Both AAM and UAM are anticipated to rely on electric vertical takeoff and landing (eVTOL) aircraft. As with any new mode of transportation, it can only be successful if potential users are willing to utilize the new system.

The potential applications of eVTOLs are varied, encompassing the transportation of individuals and goods throughout urban and suburban regions, sightseeing, search and rescue, and emergency medical services. However, a significant obstacle lies in fostering customers' willingness to use these aircraft. This willingness has been shown to be dependent upon several factors, from confidence and trust in the operator to the aircraft, technology, air traffic control, and even the system as a whole (Winter et al., 2020). Previous studies on consumer willingness to adopt a new service or technology have shown that various socio-demographic characteristics and individual opinions towards the apparent advantages and detriments associated with the proposed change affected public willingness to utilize the new device or service (Ferrão et al., 2022; Koumoustidi et al., 2022).

While several studies have been conducted on passenger willingness to fly in autonomous aircraft, there is currently a lack of such data on the touchstone aircraft type proposed to be harnessed in AAM and UAM. Understanding consumers' willingness to fly in eVTOL aircraft holds paramount significance for multiple reasons. Primarily, it can enlighten policymakers, professionals within the aviation industry, and other stakeholders about the potential market demand and consumer preferences within this emerging sector. Additionally, it can provide crucial insights into how eVTOLs can contribute to sustainable transportation and address pressing environmental concerns. Furthermore, by identifying the factors that facilitate or hinder consumer acceptance, this research can help surmount obstacles and steer the successful implementation of eVTOLs.

By delving into safety considerations, environmental impact, technological advancements, economic factors, psychological and emotional aspects, as well as cultural and demographic variables, this study unfurled essential insights into the drivers and impediments affecting consumer acceptance of eVTOLs. This research aimed to contribute to a theoretical understanding of consumer attitudes and inform practical strategies for the successful adoption and integration of eVTOLs within the air transportation industry (Agustinho & Bento, 2022). This study addressed this shortcoming in exigent literature by ascertaining the preferences and characteristics of individuals presented with hypothetical opportunities to utilize eVTOLs as a means of transportation (Koumoustidi et al., 2022).

Literature Review

Consumer adoption of new technologies, services, and devices has been thoroughly explored in academic and market research, yielding recurring themes across studies. Factors common among previous studies include specific cultural and demographic attributes, economic factors, psychological and emotional influences on acceptance, and other features directly shaping consumer willingness to try emergent innovations, such as flying on new aircraft types.

Cultural and Demographic Factors

Numerous failures in the business world have demonstrated the importance of a comprehensive understanding of consumer disposition to accept new products and services. Numerous business case examples illustrate this point:

- New Coke: In 1985, Coca-Cola famously attempted to replace its classic formula with a supposedly "improved" version called New Coke. However, the company grossly underestimated the public's attachment to the original recipe, leading to widespread backlash and a swift reversal of the decision. This debacle serves as a stark reminder of the importance of understanding consumer preferences and not alienating loyal customers (Schindler, 1992).
- Google Glass: Despite being hailed as a revolutionary wearable technology, Google Glass failed to gain widespread adoption due to privacy concerns, social awkwardness surrounding its use, and a lack of compelling applications. This case highlights the need to consider not only a product's technical merits but also its real-world implications and how it aligns with consumer needs and desires (Zuraikat, 2020).
- Quibi: Launched in 2020 with much fanfare, Quibi offered short-form mobile video content specifically designed for on-the-go viewing. However, the platform struggled to attract subscribers and ultimately shut down after failing to gain traction. This failure can be attributed to several factors, including misreading market trends, underestimating competition, and not providing enough value to justify the subscription cost (Alexander, 2020).

These are just a few examples of how businesses have stumbled due to a lack of understanding of consumer disposition. By conducting thorough market research, employing empathy and user-centric design principles, and closely monitoring consumer feedback, businesses can significantly increase their chances of success in launching new products and services (James, 2014). Research has highlighted the influence cultural and demographic factors have on consumer acceptance of new aircraft technologies, such as eVTOLs (Garrow et al., 2021; Winter et al., 2020). Thus, the importance of identifying the relevant factors related to consumer disposition to try AAM cannot be underestimated.

Cross-cultural Differences in Consumer Attitudes Towards New Aircraft

Previous studies have revealed that consumer attitudes towards new aircraft technologies vary across cultural contexts. Culture profoundly impacts how individuals perceive and evaluate these technologies, including individual values, beliefs, and norms. Therefore, it is essential to consider cross-cultural differences to address consumer acceptance effectively (Yavas & Tez, 2023).

For example, individualistic cultures prioritizing personal freedom and independence may exhibit higher acceptance of eVTOLs. These technologies offer convenience and flexibility in transportation, aligning with the values of such cultures. On the other hand, collectivistic cultures that emphasize community harmony and conformity may be more hesitant to embrace new aircraft technologies. Concerns about safety or disrupting established norms can make them more cautious (Shaikh & Karjaluoto, 2015).

An analysis of studies comparing consumer attitudes across different cultural contexts has confirmed that cultural values, societal norms, and individual preferences collectively influence the acceptance of new aircraft technologies. For instance, societies that highly value sustainability and environmental preservation may exhibit greater acceptance of eco-friendly transportation options like eVTOLs (Garrow et al., 2021).

Demographic Factors and Passenger Acceptance

In addition to culture, demographic variables, such as age, gender, and income, also significantly impact consumer attitudes toward new aircraft technologies. These factors shape individuals' preferences, priorities, and expectations regarding air travel and can significantly affect their willingness to embrace innovative transportation options like eVTOL aircraft.

Evaluation of the influence of demographic factors on passenger willingness to fly has revealed fascinating insights. Younger generations, for example, tend to exhibit higher acceptance of new aircraft technologies due to their affinity for innovation and eagerness to explore new experiences. Gender also plays a role, with studies suggesting that men tend to be more open to new technologies and exhibit higher acceptance levels compared to women (Winter et al., 2020).

Ahmed et al. (2020) found that respondents from single-person households were more willing to hire autonomous flying taxis, while older individuals and those from households with more than two working individuals were less inclined and were not willing to pay more than the current ride-hailing rate. Household vehicle ownership status also affected the willingness to use flying taxis and shared flying car services, with persons owning one or zero vehicles being more willing to use such services than those owning more significant numbers of vehicles. Respondents favoring advanced vehicle safety features were more likely to hire human-operated over autonomous flying taxis. Female respondents were also more likely to hire human-operated flying taxis (Ahmed et al., 2020).

Economic Factors Affecting Consumer Willingness to Fly

Economic factors, such as affordability and accessibility, play a significant role in promoting consumer acceptance and willingness to fly on new aircraft. Previous research has shown that cost considerations, including ticket prices, influence passenger decision-making. Exigent research has consistently shown that it is crucial to analyze the impact of affordability and accessibility on passenger perceptions and willingness to adopt new modes of transportation, such as eVTOLs (Choi & Hampton, 2020).

Research by Garrow et al. (2021) indicated that despite concerns about ease of access to take-off/landing facilities and possible interactions among flying cars in the air, respondents were still willing to hire human-operated flying taxis. However, respondents who were very concerned about interactions among air taxis when airborne were hesitant about adopting the new transport system. Additionally, respondents who were very concerned about inflight accidents, personal information privacy, and legal issues stemming from the future use of flying vehicles were less willing to fly on them. Respondents who expected lower travel times and more in-vehicle non-driving activities available to the rider were more motivated to hire human-operated flying taxis (Garrow et al., 2021).

Other studies revealed that potential users who expect more reliable travel times and less traffic congestion were willing to use such services and to pay slightly more than current ride-hailing service rates. Perceptions regarding the efficacy of safety and security measures also affected the willingness to hire flying taxi services. Respondents who were skeptical about the effectiveness of establishing flight rules oversight and no-fly zones near sensitive areas were unwilling to hire eVTOL taxis. Additionally, respondents who drove regularly were more apt to use air taxi services and pay anywhere from 10% to 20% more than current rise-hailing fares. Findings have highlighted the importance of considering these factors in individuals' decision-making when considering flying taxi services (Biehle, 2022).

Additional research has shown a mixed willingness to use flying taxi services. The area where respondents live played an important role in their willingness to hire and pay for flying taxi services. Respondents living in rural areas were not willing to hire flying taxi services, as they are less prone to traffic congestion and parking restrictions. However, respondents living in and near city centers were more likely to pay significantly higher per-mile fees, possibly reflecting their expectations for lower and more reliable travel times in congestion-prone urban areas (Kim et al., 2021).

Educational attainment and household income level have also been found to be related to willingness to hire and pay for flying taxi services. Respondents from mid-income households were generally unwilling to hire flying taxis, while those from high-income households were more welcoming. Moreover, consumers' income levels can affect their acceptance, as individuals with higher disposable income may perceive new aircraft technologies as luxurious and, therefore, more attractive (Biehle, 2022; Garrow et al., 2021; Koumoustidi et al., 2022; Postorino & Sarné, 2020; Winter et al., 2020).

Psychological and Emotional Factors Influencing Passenger Acceptance

Both trust and confidence have been shown to be principal stimuli in passenger acceptance of eVTOLs. These factors have a profound impact on perceptions and attitudes towards new aircraft. According to a study by Garrow et al. (2021), trust was a crucial determinant of passenger perceptions of safety and risk in innovative transportation technologies. The research suggested that higher trust in advanced aircraft technologies was positively associated with an increased willingness to fly (Garrow et al., 2021).

Supporting this finding, Riza et al. (2024) highlighted the importance of trust in the reliability and performance of the aircraft as a significant influencer of passenger confidence. This confidence, in turn, significantly affected their decision-making process. Passengers who have trust in the safety and reliability of eVTOL were more inclined to have a positive attitude towards flying in these cutting-edge vehicles (Riza et al., 2024).

Studies examining trust and confidence in novel aircraft technologies, such as eVTOLs, provided a nuanced understanding of how these factors impact passenger acceptance. Winter et al. (2020) argued that establishing trust through transparent communication from aviation authorities, manufacturers, and regulators regarding the safety and reliability of electric aircraft nurtures passenger confidence and dispels many apprehensions about flying in new aircraft (Winter et al., 2020).

The impact of previous flying experiences cannot be ignored when considering passenger attitudes towards new aircraft. Han et al. (2019) contended that past flying experiences shaped passenger perceptions and attitudes toward new transportation options. Positive experiences, such as punctuality, smooth conditions, and comfortable flights, fostered more favorable attitudes toward flying in novel aircraft (Altamirano et al., 2023; Han et al., 2019; Zaps & Chankov, 2022). Behme and Planing (2020) found that passengers with prior experience flying on new aircraft types exhibited higher acceptance and willingness to fly in eVTOLs than those without prior experience. Addressing passenger comfort and minimizing in-flight discomfort is essential for enhancing passenger acceptance and satisfaction, particularly in new and innovative aircraft types such as eVTOLs (Sharafkhani et al., 2021). These findings reiterate the significant influence of past flying experiences on consumer willingness to embrace innovative aircraft technologies (Behme & Planing, 2020; Riza et al., 2024).

Studies have also highlighted the significant impact of travel mood perception on passengers' mental health and emotional well-being during intercity travels. The emotional state of passengers during travel can significantly influence their overall experience and satisfaction, underscoring the importance of understanding and addressing emotional well-being in new types of air travel (Li et al., 2022).

Research has also indicated that most respondents are concerned about the safety and security of air taxis and flying cars. They are fearful about the cost of purchasing a flying car, the safety consequences of equipment failure, the potential for accidents, the cost of maintenance, the environmental impact, and the potential for in-vehicle activities. They also have concerns about the safety benefits of air taxis and flying cars, such as fewer crashes, less severe crashes, and lower travel time. They also have concerns about the privacy and legal liability of flying car owners (Ahmed et al., 2020).

Other Factors and Theories Related to Willingness to Fly

Airlines and manufacturers face the essential task of promoting passenger acceptance of eVTOLs by comprehending the factors that influence consumer acceptance. By aligning marketing efforts and communication strategies with these identified factors, companies can effectively address consumer concerns and highlight the advantages offered by these new aircraft. Additionally, manufacturers can utilize the insights gained from the study to prioritize technological advancements that positively impact passenger perceptions and acceptance (Rautray et al., 2020; Tom, 2020).

Various established methods have been employed to comprehend the adoption of new technologies and services by customers. These theories offer valuable paradigms and structures for researchers to comprehend consumer perceptions, choices, and technology adoption. These concepts are extensively employed in research conducted in the computer industry, autonomous car sector, and disruptive technology businesses. Notable ideas in this field include the Theory of Planned Behavior (TPB), the Technology Acceptance Model (TAM), the Theory of Reasoned Action (TRA), the Innovation Diffusion Model (IDM), and the Unified Theory of Acceptance and Use of Technology (UTAUT). Over time, these theories have developed to examine intricate facets of acceptability, adoption, and inclination to utilize different technologies. TAM, which incorporates trust as a facilitator of acceptance, emerged as a compelling model for evaluating willingness to use AAM (Winter et al., 2020).

Trust in technology has been shown to be a central theme in customer acceptance and willingness to use it. Factors encouraging and enabling trust can support acceptance and willingness to ride in autonomous vehicles. Trust plays a crucial role in determining people's readiness to use autonomous forms of transit, and this is influenced by factors such as risk perception. Those identified as potential users of autonomous air taxis were more inclined to embrace and utilize the technology if they viewed the service as a personal, direct advantage or benefit. These consumers were most likely affluent individuals residing in densely populated urban areas where commuting can be exasperating, resulting in lost productivity, less time spent with loved ones and friends, or engaging in meaningful personal activities (Shariff et al., 2017; Vance & Malik, 2015; Winter et al., 2015).

The Willingness to Fly (WTF) scale, created by Rice et al. (2020), has been employed in several research investigations to evaluate participants' inclination to travel by air in different situations. Winter et al. (2020) found that the willingness to fly in an eVTOL increases as the action is perceived as applicable in a given situation. This suggests that perceived utility significantly shapes individuals' willingness to fly on eVTOLs (Biehle, 2022). Additionally, previous research showed that consumer willingness to fly in various vehicles has been a subject of recent focus (Anania et al., 2018). These findings underscored the importance of understanding public attitudes and perceptions towards flying in eVTOLs.

Furthermore, empirical studies have assessed consumers' willingness to fly under specific conditions, such as when pilots take certain medications (Rice et al., 2017). These studies revealed that participants base their willingness to fly on their emotions triggered by the knowledge of the pilot's medication intake. This highlights the complex interplay between psychological factors and willingness to fly, emphasizing the need for comprehensive survey scales that capture these nuances. In conclusion, developing and utilizing survey scales, such as the WTF scale, are crucial for understanding individuals' attitudes and perceptions toward flying in eVTOLs. These scales provide valuable insights into the factors influencing willingness to fly, including perceived utility, emotional triggers, and specific situational contexts (Rice et al., 2015).

Factors identified in this literature review collectively shape consumer acceptance. Consequently, the aviation industry must consider these diverse factors and proactively address any barriers or concerns to facilitate the integration of eVTOL into existing air travel systems. The factors influencing consumer willingness to fly contribute valuable insights to the aviation industry's development of effective marketing and design strategies for eVTOL aircraft. A thorough understanding of safety considerations enables the implementation of robust safety features and effective communication of safety measures to alleviate passenger concerns. Similarly, insights on environmental impact can be leveraged to promote the eco-friendly nature of eVTOLs as a selling point to attract environmentally conscious passengers. With awareness of these various issues and factors, stakeholders can prepare adequately for AAM market entry and operations.

Method

This study incorporated a survey of persons living within the U.S. to assess their willingness to fly on human-piloted eVTOLs. Specific details about the sample and the survey instrument are provided in the following sections.

Participants

The study used Amazon's Mechanical Turk (MTurk) platform to recruit participants for compensated assignments. The goal was to achieve 1,000 responses for a sample representative of the U.S. population (Pew Research, 2023). The minimum sample size for all types of statistical tests that were utilized in this study was determined using G*Power software (using $\alpha = 0.05$ and $1 - \beta = 0.80$). The most restrictive minimum sample size required was calculated to be 721, which was exceeded by the number of responses collected.

Materials and Procedure

WTF Scale Development

This study utilized a survey adapted from the WTF scale created by Rice et al. (2020) with permission from the corresponding author. The WTF scale emerged from the need for research on willingness among air travel passengers and pilots to assist in finding solutions to safety, product, and service issues as identified by Rice et al. (2020), European Aviation Safety Agency (2013), Winter et al. (2020), as well as Meister and Gawron (2010). Passenger willingness to fly was found to be influenced by their perceptions of safety, services, and products, which affect their emotions and decisions. Passengers preferred newer aircraft that offer quieter, faster, lower cabin pressures and attractive interior designs. Passenger willingness to fly has foundational parameters important for a safe, sustainable, and successful future airline industry. Subjective scales to be used to measure willingness were deemed necessary for understanding consumer responses to new aviation technologies and services. Studies by Higueras-Castillo et al. (2019), Winter et al. (2020), and Ward et al. (2021) indicated the importance of consumer adoption preferences for electric transportation modalities, including air taxis. It was noted that the study of customer profiles of early adopters is critical to best prepare for product and service launch and adoption (Meister & Gawron, 2010; Rice et al., 2020; Winter et al., 2020).

The WTF scale was developed using the five stages identified by Hinkin (1998). This incremental process began with item generation, then involved nominal paring of the items, Likert-scale paring, factor analysis and reliability testing, and sensitivity testing. The resultant scale was a Likert-type scale using the scores of strongly disagree, disagree, neutral, agree, and strongly disagree (Rice et al., 2020).

Adaptation of the WTF Scale

The primary change to the WTF scale was the reduction of Likert options from five to four, eliminating the “neutral” option. This amendment was implemented based on the recommendations of preceding research. Garland (1991) highlighted mitigating social desirability responses by eliminating the neutral option. Edwards and Smith (2014) noted that when presented with a neutral option, respondents have been shown to favor this option over expressing something else, regardless of their actual opinion. Moreover, Leung (2011) showed that the possible negative impacts of this type of change on Likert scales were negligible.

A panel of aviation and survey methodology experts evaluated the validity of the draft survey. This panel was made up of five faculty members. Two were qualitative research methodologists working at a regionally accredited university doctoral program. These faculty members have each chaired over 100 dissertations, many of which employed survey instruments or required the development of survey instruments. Two other faculty members were aviation subject matter experts working at a regionally accredited aviation-focused university with significant experience working with master’s and doctoral students. The final faculty member was a survey methods expert from a regionally accredited R1 doctoral university. This individual had over 20 years of survey development and design experience. The panel expressed limited comments about the implications of specific language used in certain questions, which were addressed to the satisfaction of the expert panel. The second draft was piloted to a group of 100 respondents who were not included in the results of this study. Feedback from the pilot was used to complete the public-facing, final version of the survey.

Initially, respondents were directed to a welcome page describing the survey. Brief definitions of AAM, UAM, and eVTOLs were provided. Supplemental questions were added to determine participants' familiarity with and sentiment about AAM. Subsequently, a series of questions presented hypothetical situations regarding traveling on eVTOLs. Examples of scenarios include flying on eVTOLs at different times of day and in different weather conditions. Respondents were then asked to respond to the WTF scale questions. These questions address comfort, happiness, safety, fear, and confidence about taking the flight. Next, images of different eVTOLs were presented, and respondents were asked about their willingness to fly on the displayed aircraft. Questions were then presented about respondent concerns that might influence their willingness to fly on eVTOLs. Lastly, demographic questions based on the metrics collected by the U.S. Census Bureau (2022) were included at the end of the survey, as recommended by Dillman et al. (2014).

Design and Purpose

This study aimed to determine public inclination to utilize eVTOLs. The study employed a quantitative, non-experimental methodology utilizing a sample size adequate to provide insight into public WTF eVTOLs in the U.S. The data collection survey was created and published through the Zoho Survey platform. Participants were enlisted using Amazon's Mechanical Turk (MTurk) network, which enlists individuals to complete tasks such as taking surveys in return for financial remuneration. Participation and completion of tasks are optional, and the MTurk platform ensures the preservation of anonymity. MTurk was selected due to its successful use in previous aviation and non-aviation survey research studies (Farrell & Sweeney, 2021; Huff & Tingley, 2015; Rice et al., 2017; Rice et al., 2020; Winter et al., 2020; Zhang & Gearhart, 2020). Results from using MTurk have consistently been shown to be comparable to and, in some cases, superior to traditional survey methods in exigent research (Farrell & Sweeney, 2021; Huff & Tingley, 2015; Rice et al., 2017; Zhang & Gearhart, 2020). The survey was made available via MTurk for approximately three weeks, the time required to reach the desired sample size.

Results

During the data collection period, there were 1,344 visits to the survey, from which 1,073 individuals began the survey. Of those who started the survey, 975 participants completed it, resulting in a response rate of 90.9%, as defined by the American Association for Public Opinion Research (AAPOR) (2023). The revised WTF scale was evaluated for reliability, which yielded a Cronbach's $\alpha = 0.918$.

Familiarity with AAM and eVTOLs

When asked how familiar they were with AAM, 72% of respondents were *familiar* or *very familiar,* with only 14.6% indicating they were *not very familiar*. Respondents answered similarly when asked about familiarity with eVTOLs, with 72.5% *familiar* or *very familiar*. A slightly lower percentage (13%) stated they were *unfamiliar* with eVTOLs. Individuals were asked about their level of interest in flying on an eVTOL. Very few (<10%) noted that they were either *not very excited* or *not excited* about taking a flight in an eVTOL. A fair number of respondents (32%) indicated neutral interest, with 41.5% reporting being *excited* and 18% being *very excited*. Respondents were next asked when they planned to use eVTOLs after they were introduced into service. Most (35.03%) indicated they would wait *a few months* before taking an eVTOL flight, and very few (3.2%) stated they *do not plan to ever fly on* one. The results of this question are shown in Table 1.

Table 1
How do You Plan to Respond When eVTOLs are Introduced into Service?

Question	Responses (%)
I want to be one of the first to fly on one	20.00
I plan to wait a few weeks before flying on one	19.89
I plan to wait a few months before flying on one	35.03
I plan to wait a few years before flying on one	21.81
I do not plan to ever fly on one	3.28

Willingness to Fly: Flight Scenarios

The survey offered four different eVTOL flight scenarios to participants. A four-item Likert scale was provided. The numerical coding for quantitative analysis was strongly disagree (1), disagree (2), agree (3), and strongly agree (4). Among all four scenarios, respondents largely indicated that they agreed at some level that they were willing to fly ($M = 2.99$, $SD = 0.77$). The average responses for each scenario are outlined in Table 2. Statistically significant differences between scenarios are indicated in Table 3. Scores for a flight during poor weather were the lowest of all scenarios ($M = 2.74$, $SD = 0.947$) and were significantly different ($p < 0.0001$) from all other scenarios.

Table 2
Mean WTF Scores for Each Scenario

Scenario	Mean	SD
Flight on clear, sunny day	3.15	0.671
Taxi/ride-hailing/airport shuttle flight	3.08	0.677
Flight at night	2.99	0.785
Flight in poor weather (fog or rain)	2.74	0.947

Note. Scale: strongly disagree (1), disagree (2), agree (3), and strongly agree (4)

Table 3

Differences in Scores among Scenarios

Scenarios	Clear, sunny day	Taxi/ride-hailing/ shuttle	Night	Poor weather
Clear, sunny day	NA	+	+	+
Taxi/ride-hailing/shuttle	∨	NA	+	+
Night	∨	∨	NA	+
Poor weather	∨	∨	∨	NA

Note. NA = not applicable. *Post hoc* results: + row label sig. greater than column label; ∨ row label sig. less than column label

Willingness to Fly on Specific Aircraft Models

Respondents were shown images of specific eVTOL models to assess their willingness to fly on each aircraft. The first image displayed an aircraft with numerous fixed-position motors that face upwards (Figure 1). Only 2.9% indicated they *strongly disagreed* that they would be willing to fly on this model, and 88.3% *agreed* or *strongly agreed* that they would be willing to fly on this model. The next model (Figure 2) showed an aircraft with several motors that could be rotated vertically and horizontally. Again, around 3% said they would not be willing to fly on such an aircraft, and 85.3% *agreed* or *strongly agreed* to fly this type. An electric jet/ducted fan model with a large number of motors that can be moved from vertical to horizontal was shown next (Figure 3). Slightly more individuals (5.1%) said they would not fly on this model, while 79.2% *agreed* or *strongly agreed* that they would fly on this type. A simpler aircraft with four rotatable motors was displayed (Figure 4). Among responses, 4.1% *strongly disagreed* with flying on the type, and 83.6% *agreed* or *strongly agreed* that they would be willing to take a flight in the model. The last model (Figure 5) showed a gyrocopter-like model. In this case, 2.8% stated they *strongly disagreed* that they would fly on this model, and 88.7% *agreed* or *strongly agreed* that they would fly on the craft. A cross-comparison of differences among WTF scores for individual eVTOLs calculated by a Z-score test for two proportions is provided in Table 4.

Table 4

Cross-comparison of WTF among eVTOL models

Figure #	1	2	3	4	5
1		NS	< 0.001	= 0.067	NS
2	NS		= 0.013	NS	= 0.042
3	< 0.001	= 0.013		= 0.023	< 0.001
4	NS	NS	= 0.023		= 0.003
5	NS	= 0.042	< 0.001	= 0.003	

Note. NS = not significant

Figure 1
eVTOL Model 1

Note. Strongly agree (18.5%), Agree (69.8%), Disagree (8.8%), Strongly disagree (2.9%)

Figure 2
eVTOL Model 2

Note. Strongly agree (28.2%), Agree (57.1%), Disagree (11.6%), Strongly disagree (3.1%)

Figure 3
eVTOL Model 3

Note. Strongly agree (25.3%), Agree (53.9%), Disagree (15.7%), Strongly disagree (5.1%)

Figure 4
eVTOL Model 4

Note. Strongly agree (28.7%), Agree (54.9%), Disagree (12.3%), Strongly disagree (4.1%)

Figure 5
eVTOL Model 5

Note. Strongly agree (30.4%), Agree (58.3%), Disagree (8.5%), Strongly disagree (2.8%)

Concerns that may influence WTF eVTOLs

Respondents were asked to select as many concerns about flying eVTOLs as they wished from a provided list. There was also an option to select “other, " resulting in a prompt for them to specify their additional concern(s). The percentages of respondents who selected each type of concern are shown in Table 5 (note: percentages do not add up to 100% due to the ability to select more than one option). Of the respondents that marked “other,” there was a range of expressed discomforts: other air traffic, weather, environmental impact compared to traditional transportation, assembly, capability to remain aloft following motor failure, the skill of the pilot, parachutes, safety regulations, fear of flying, and thoroughness of flight testing. Individuals were then asked to select their primary concern. For almost half of respondents (49.7%), safety was the primary concern of respondents, followed by cost, accessibility, onboard technology, noise, and being powered by batteries. Less than 1% of respondents indicated that they had no primary concern. One person listed “other,” flight in poor weather and at night, as their primary concern.

Demographic Analysis

The demographic attributes of the sample were analyzed to provide descriptive statistics, visual representations of data, and additional statistical analysis in limited cases—this portion of the study aimed to balance detailed findings with ease in understandability and interpretation. Moreover, superfluous analysis was avoided if deemed inconsequential to the goals of this study (e.g., the significance of differences in numbers of males versus females).

Table 5
Percentages of Concern Type Selected by Respondents

Types of Concerns	Response (%)
Safety	63.7
Cost	42.4
Accessibility	34.4
Onboard technology	31.7
Being powered by batteries	20.6
Noise	19.5
None	1.7
Other (Please specify)	1.7

General Demographic Attributes

The sample comprised 46.4% males, 51.1% females, 1.4% others, and 1.1% persons who preferred not to answer. The majority of respondents were white. Also, most (82.5%) were not Hispanic, Latino, or of Spanish origin. The distribution of reported ethnicities is shown in Table 6. Among respondents, 79% were married, 15.9% were single, 4% were divorced or separated, and the remaining 1.1% preferred not to answer. The average number of persons living in the household was 2.17 (SD = 1.31).

The top five levels of highest educational attainment were a bachelor's degree (42.2%), some college (17.4%), high school or equivalent (12.5%), associate's degree (12%), and master's degree (6.1%). Most of the sample reported to be employed full-time (75.9%). Self-employed individuals made up 10.9% of the sample, followed by employed part-time (6.1%), out of work and looking for work (2.2%), being a homemaker (1.6%), and retired (1.1%). The remainder of the sample was evenly spread among those out of work and not looking for work, students, those unable to work, and those reporting "other." The largest cluster (39.1%) of respondents fell within an income range of $50,000-74,999. The distribution of reported incomes is shown in Figure 6. The average age of participants was 36.5 (SD = 11.4). When asked about the location of their place of residence, 53% stated they lived in an urban environment, 23.6% reported living in a rural area, and 23.4% lived in a suburban area.

WTF versus respondent attributes

A more in-depth examination of the data compared the average WTF scores with various respondent attributes. The WTF was highest among those most familiar with AAM and eVTOLs. Also, the WTF was highest among those excited or very excited about flying on eVTOLs. The top WTF scores occurred among those reporting that they would be among the first to fly on an eVTOL, followed by those planning to fly on one a few months after introduction. The lowest WTF scores were among those wanting to wait the longest to fly an eVTOL or planned to never fly on one.

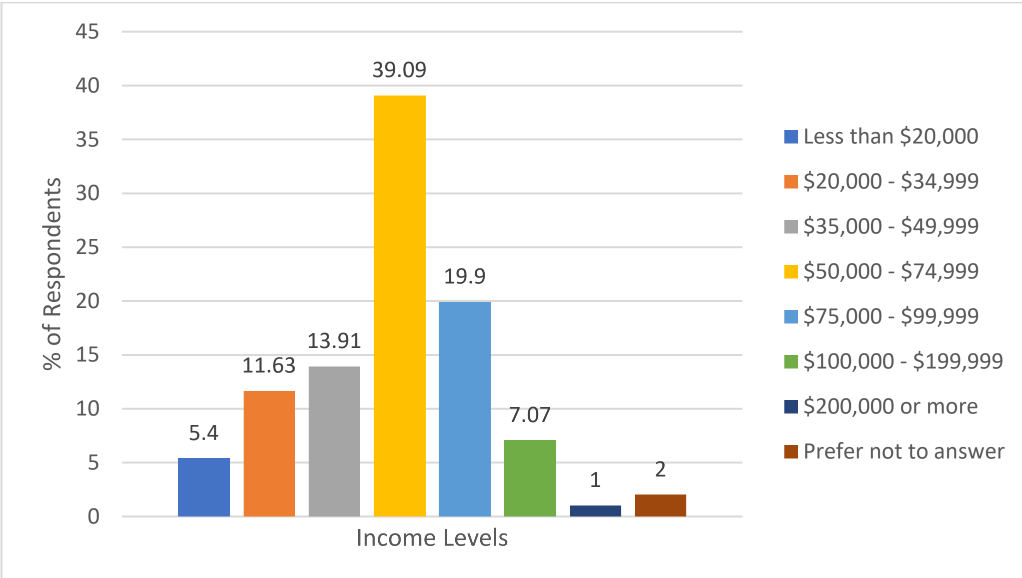
WTF values were next compared across genders. A Mann-Whitney *U* test was conducted, which indicated significant differences between genders, with males having a higher average WTF score ($U = 94245.5$, $p < 0.001$, $d_{Cohen} = 0.28$). A Spearman correlation was utilized to determine if there was a relationship between WTF and age. Data indicated that there was a weak, negative correlation between WTF and age ($r_s[398] = -0.198$, $p < 0.001$).

Table 6
Ethnicities of Respondents

Types of Concerns	Response (%)
White	90.3
American Indian or Alaska Native	6.2
Asian	4.8
Black or African-American	4.4
Race and Ethnicity Unknown	1.7
Native Hawaiian or Other Pacific Islander	1.4
Other	0.8

Note. The total may add up to more than 100% because respondents could select multiple options.

Figure 6
Distribution of Income for Respondents



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Across all races and ethnicities, the most frequent responses were *agree* and *strongly agree* with being WTF in eVTOLs. A Chi-square test of independence was conducted using the categories of white versus all others (note: this consolidation was completed due to low frequencies among non-white groups). Differences were detected among the WTF scores and race categories (χ^2 [1, N = 863] = 15.587, $\phi = 0.14$, $p = 0.001$). Through further analysis, the primary difference between these groups was that non-whites tended to *agree* rather than *strongly agree*, while the opposite was true for whites (χ^2 [1, N = 807] = 7.485, $\phi = 0.09$, $p = 0.006$).

Married respondents ($M = 3.01$) indicated the highest WTF, followed by single persons ($M = 2.89$), divorced or separated persons ($M = 2.29$), and "other" groups ($M = 2.05$). A Kruskal-

Wallis test evaluated differences in WTF based on marital status. The only pair identified as significantly different by the Steel-Dwass-Critchlow-Fligner procedure was married vs. separated or divorced ($Wij = 3.666, p = 0.047$). Three-person households scored highest on WTF (M = 3.079), followed by four-person households ($M = 3.069$). Persons living alone had the lowest WTF ($M = 2.76$). A Kruskal-Wallis test evaluated differences in WTF based on household size. The significance of differences in household size calculated via the Steel-Dwass-Critchlow-Fligner procedure is shown in Table 7.

Table 7
*WTF among Household Sizes (*p *values)*

# in house	1	2	3	4	5	6
1		NS	<0.0001	0.003	NS	NS
2	NS		<0.0001	<0.0001	NS	NS
3	<0.0001	<0.0001		NS	0.018	NS
4	0.003	<0.0001	NS		NS	NS
5	NS	NS	0.018	NS		NS
6	NS	NS	NS	NS	NS	

Note. NS = not significant

Additional associations with WTF were also assessed. A Kruskal-Wallis test indicated that WTF varied significantly across types of employment ($H(2, n = 1050) = 19.554, p < 0.001$). An assessment of differences between pairs using the Steel-Dwass-Critchlow-Fligner procedure showed that those who were unemployed reported significantly lower WTF than both those employed full-time ($Wij = -5.98, p < 0.001$) and part-time ($Wij = -4.28, p = 0.007$). However, there was no difference in WTF between full-time and part-time workers.

The highest WTF score among income groups occurred in the $50,000-74,999 range ($M = 3.08$). Slightly lower and analogous WTF scores were reported for the following groups: $20,000-34,999 ($M = 2.95$), $35,000-49,999 ($M = 2.98$), and $75,000-99,999 ($M = 2.96$). A Kruskal-Wallis test was conducted to compare WTF among income groups. There were no significant differences among groupings of income levels except between those making less than $20,000 and those making $50,000-74,999 ($Wij = 4.419, p = 0.03$).

WTF versus educational attainment was also assessed with a Kruskal-Wallis test. There were no significant differences among groupings of education levels. In descending order, the education levels with the five highest WTF were: trade/technical/vocational ($M = 3.271$), some college-no degree ($M = 3.079$), high school/GED ($M = 3.042$), up to 8th grade ($M = 3.033$), and bachelor's ($M = 2.972$). An assessment of differences between pairs using the Steel-Dwass-Critchlow-Fligner procedure was conducted to assess *p* values despite the lack of significant differences. The lowest *p* values were associated with professional versus high school ($Wij = -3.932, p = 0.188$) and professional versus some college ($Wij = -3.839, p = 0.219$).

A Kruskal-Wallis test indicated that WTF varied significantly across the living environment locations ($H(2, n = 648) = 44.956, p < 0.0001$). The WTF among urban respondents was significantly higher than persons living in suburban ($Wij = 9.272. p < 0.001$) and rural locations

(*Wij* = 3.953, $p = 0.014$). Persons living in rural areas had higher WTF than suburban areas (*Wij* = 5.589, $p < 0.001$).

Among all levels of WTF, respondents were most concerned with eVTOL safety with cost being the next highest concern. A summary of WTF vs. concerns about flying on eVTOLs is shown in Table 8. When respondents were asked to choose their number one concern, safety and cost were the top two responses among all WTF scores.

Table 8

Concerns of Respondents as Percentages versus WTF (raw numbers in parentheses)

	Safety	Noise	Cost	Onboard technology	Accessibility	Being powered by batteries	None
Strongly disagree	84.21% (16)	26.32% (5)	42.11% (8)	36.84% (7)	21.05% (4)	36.84% (7)	0.00% (0)
Disagree	63.46% (33)	13.46% (7)	34.62% (18)	23.08% (12)	26.92% (14)	28.85% (15)	0.00% (0)
Agree	61.78% (341)	18.12% (100)	41.30% (228)	30.43% (168)	35.51% (196)	19.02% (105)	0.72% (4)
Strongly agree	72.77% (139)	24.61% (47)	48.69% (93)	38.22% (73)	34.55% (66)	21.99% (42)	5.24% (10)

Lastly, an assessment of factors that most influenced WTF was conducted via a robust ANOVA employing the best fit with an adjusted R^2 criterion model. It was determined that the model was significantly influenced by the explanatory variables ($F[15, 815] = 12.614$, $p < 0.001$, partial $\eta^2 = 0.189$). The highest impact resulted from the variables "employment status" and "marital status," resulting in an $R^2 = 0.188$, meaning these variables explained 19% of the variability in WTF scores. Other status types that were found to be most influential were full-time employment ($r = 0.245$) and being married or in a domestic partnership ($r = 0.280$). Additional notable relationships (calculated via Locally Weighted Regression and Smoothing Scatterplots [LOWESS]) included the number of persons in a household ($r = 0.156$), urban environment ($r = 0.173$), suburban environment ($r = -0.175$), and being divorced ($r = -0.223$) or single ($r = -0.164$). The relationship between income and WTF is shown in Figure 7.

Discussion

The results of the survey provided a comprehensive cross-section of individual attributes in relation to WTF. Due to the demographic similarities indicated by the sample in this study with those that reported being familiar with technological advances in Winter et al. (2020) and similar research, it was unsurprising that most respondents were acquainted with AAM and eVTOLs. Similarly, most indicated some level of excitement about flying on an eVTOL, as with both Kim et al. (2021) and Riza et al. (2024), respondents who were more familiar with AAM and eVTOLs tended to report a higher WTF.

The distribution of WTF among the different flight scenarios followed what would be expected based on previous findings. Because of concerns about safety and the trust in new technologies typical of persons with similar attributes as in the MTurk sample, WTF was highest for a flight on a clear, sunny day and decreased to the lowest score for flight poor weather (Garrow et al., 2021; Shaikh & Karjaluoto, 2015; Winter et al., 2020). Following the same logic, the significant differences among WTF scores for the specified flight conditions were to be reasonably anticipated.

Figure 7
Correlations between Income Ranges and WTF Scores

The WTF for specific eVTOL models provided insights into how users may respond to the appearance of aircraft and the types of available propulsion. The highest agreement to fly was denoted for the eVTOL in Figure 5, followed closely by Figures 1 and 2. The only model significantly different from all other models was that in Figure 3. This was perhaps the case as the eVTOL in Figure 3 was the only model that enlisted a remarkably unique propulsion type, and such unfamiliarity could negatively influence user trust. Correspondingly, the vehicle with the highest WTF most resembled existing aircraft, specifically helicopters. This follows what would be expected per Han et al. (2019) and Riza et al. (2024) among individuals with previous experience and familiarity with air travel and specific aircraft.

The concerns respondents had about flying on eVTOLs aligned with those noted in exigent research. Worry about safety has consistently been a primary factor in the acceptance of novel technologies and forms of air transportation; therefore, it was not unexpected that it was ranked first by respondents (Garrow et al., 2021; Riza et al., 2024; Shaikh & Karjaluoto, 2015; Winter et al., 2020). Ranked second was cost, which was also found to be a key factor in other studies as well (Choi & Hampton, 2020).

Evaluation of WTF scores as they related to demographic attributes found similar associations in other studies. Men had higher WTF both in the current as well as in previous studies. Winter et al. (2020) noted that men accepted innovation and new experiences more readily. It has also been shown that age is predictably a factor in willingness to fly on new aircraft types or those enlisting novel technologies. As was found by Winter et al. (2020), there was a negative correlation between respondent age and WTF, i.e., WTF decreased as age increased and vice-versa.

WTF was highest among married persons, perhaps due in part to the value placed on time spent with family, as noted in Shariff et al. (2017) as well as Vance and Malik (2015). Even in light of this, the second highest WTF was among single persons, and the difference between single and married respondents was insignificant. It could be surmised that younger persons tend to be single, at least more so than older persons, thus providing a sort of logical explanation for the arrangement of WTF scores.

There were some dissimilarities between the current findings and certain previous studies. For example, respondents in this study had the highest WTF in the $35,000-49,999 income group, with nearly the same level of WTF across a spectrum from $20,000-99,999. This is somewhat contrary to studies that stated individuals from mid-income households would be less interested in air taxi services (Biehle, 2022; Garrow et al., 2021; Koumoustidi et al., 2022; Postorino & Sarné, 2020). One could argue, however, that the income range reported in this study aligns with younger persons who are more likely to embrace AAM.

Opposite to Kim et al. (2021), respondents in the current study residing in rural areas reported higher WTF than persons in suburban areas, yet urban respondents in both this study and that of Kim et al. (2021) had the highest WTF. Another inconsistency was regarding education. Previous studies have purported that WTF increases with greater educational attainment, in contrast to current findings. The current findings did not show any significant differences across attainment levels, and the rank order of WTF per education level did not follow the pattern reported in other studies (Biehle, 2022; Garrow et al., 2021; Koumoustidi et al., 2022; Postorino & Sarné, 2020).

Amalgamating the findings of this study produces some insights into the most likely customers for AAM and eVTOLs. The first in line to fly will be those familiar with AAM and eVTOLs and those most excited to do so. AAM stakeholders could boost familiarity and excitement through public outreach and education to increase interest and WTF. This tactic may be most important for operators using aircraft that look markedly different from existing VTOLs, including drones. This education and outreach should focus on safety, thus allaying the primary concern among prospective users. Since the cost was the second most significant concern, stakeholders should focus on the benefits of using AAM, such as time savings, to offset possible pushback against ticket prices. Other concerns can also be addressed through information campaigns. For example, a demonstration flight or video showing the low noise profiles of typical eVTOLs could be an influential tactic to mitigate public fear and worry.

Data collected in this study also provided a demographic profile of potential AAM consumers. Attributes linked to the highest WTF show that persons who are white, male, and aged between 22 and 44 (M = 36.5, Mdn = 35, Mode = 35) are the most likely candidates for early adoption of AAM. Furthermore, responses with the highest WTF came from those who were married, lived in three-person households, were employed full-time, lived within an urban area, had a middle-class income (as defined by the Pew Research Center [Cohn & Passel, 2022]), and had a bachelor's degree or lower level of education.

Limitations

The sample was found to have demographic discrepancies compared to the U.S. population, although this has been consistently acknowledged in prior research using MTurk samples. The participants in this study were predominantly young, married, white males residing in urban areas. Incomes ranged from working class to middle class. It is plausible to speculate that the participant attributes would resemble those of early adopters as they demonstrate technical savvy by participating in the MTurk service. It is also appropriate to acknowledge that the findings of this survey may not fully reflect the viewpoints of all individuals in the U.S.

Delimitations

The researcher chose the MTurk platform to enlist participants based on the extensive body of literature that has utilized MTurk to collect samples and the studies that have demonstrated the effectiveness and reliability of such samples. The researcher expanded the statistical analysis of the data beyond the initially planned scope to provide the most comprehensive analysis of the findings. The study was restricted to individuals residing in the U.S., as the goal of the study was to provide information to U.S. researchers and other stakeholders.

Conclusion

As urban areas continue to be overwhelmed by ground transit network constraints, cities, and their citizens have become increasingly willing to embrace alternative forms of transportation. Airspace just above cities has largely been underused in urban mobility, with helicopter traffic being the most common mode of transport. AAM and UAM have been presented as alternatives, but fostering customer willingness to use these aircraft can be a significant challenge. Factors such as confidence, trust, aircraft, technology, air traffic control, and the system as a whole can affect public willingness to use these aircraft.

By understanding consumer willingness to fly in eVTOL aircraft, policymakers, aviation industry professionals, and stakeholders are provided insights into market demand, consumer preferences, sustainable transportation, and environmental concerns. Identifying factors that facilitate or hinder consumer acceptance can help overcome obstacles and guide the successful implementation of eVTOLs.

This study successfully reached its goal of providing insight into the WTF on eVTOLs among persons in the U.S. The results contribute to a theoretical understanding of consumer attitudes and inform practical strategies for successfully adopting and integrating eVTOLs within the air transportation industry. The survey findings outline consumer WTF on eVTOLs in various situations, and specific eVTOLs were presented to respondents to see if aircraft aesthetics and propulsion types may influence the adoption of AAM. A demographic profile of persons most willing to fly on eVTOLs was developed, providing invaluable information to AAM researchers and stakeholders. AAM stakeholders have the potential to enhance familiarity and enthusiasm by engaging in public outreach and education, hence augmenting interest and engagement.

Recommendations

Based on the findings of this research, several recommendations for future study surfaced. The first recommendation would be to broaden the scope. This could be accomplished by sample expansion or through the use of a temporal dimension. Replicating the study with a more extensive and more diverse sample encompassing multiple countries is crucial. This could enhance generalizability and provide insights into cultural variations in eVTOL acceptance. Repeating the study after eVTOL certification and initial service operation is valuable. Assessing "live" experiences will capture the influence of real-world scenarios and address potential discrepancies between hypothetical and actual perceptions. The second recommendation would be to enhance data collection via enhanced user profiling and more comprehensive questions on eVTOL-specific factors. Incorporating more questions about respondent attributes like demographics, travel habits, and technology attitudes will allow for a deeper understanding of potential user segments and their specific concerns. Further study into desired services, vehicle features, and safety anxieties related to specific eVTOL designs could pinpoint key acceptance drivers and barriers. The third recommendation is to explore the influence of cost on WTF, which is essential. Understanding price sensitivity will inform pricing strategies and assess affordability for different user segments.

Note: The copy of the survey can be retrieved from this link: https://drive.google.com/file/d/1zCZ-8sQJK-oNw7hiWltxr5m9GRH390Vm/view?usp=sharing

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