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If You Fly It, Will Commuters Come? Predicting Demand for eVTOL Urban Air Trips

Robert B. Binder[1], Laurie A. Garrow[2]
Georgia Institute of Technology, Atlanta, GA, 30332, United States

Brian J. German[3]
Georgia Institute of Technology, Atlanta, GA, 30332, United States

Patricia L. Mokhtarian[4]
Georgia Institute of Technology, Atlanta, GA, 30332, United States

Matthew J. Daskilewicz[5]
Georgia Institute of Technology, Atlanta, GA, 30332, United States

and

Thomas H. Douthat[6]
Georgia Institute of Technology, Atlanta, GA, 30332, United States

In this paper, we present details of a survey we will use to estimate commuters' willingness to pay for electric vertical take-off and landing (eVTOL) flights in urban areas in the United States. The survey started execution in April 2018 and will continue execution through approximately June 2018. We will collect responses from approximately 2,500 high-income workers who reside and work in the Atlanta, Boston, Dallas-Ft. Worth, San Francisco Bay Area, or Los Angeles combined statistical areas (CSAs). The survey targets individuals with average one-way commutes of 45 minutes or more.

I. Introduction

Improvements in battery technologies are spurring the development of a new class of electric propulsion aircraft. As described in Garrow, German, and Ilbeigi, "on-demand mobility (ODM) has been interpreted in an aviation context as an air service between origin-destination pairs located at dispersed locations – not necessarily airports – that operates in an unscheduled 'on-demand') paradigm; when called by a user, typically via a smartphone app, an aircraft is dispatched to the nearest departure origin. There is now widespread belief that ODM missions could be served by smaller electric propulsion aircraft with vertical take-off-and-landing (VTOL) capabilities that operate from heliports or similar infrastructure" [1].

But just because we can build electric-VTOL (or eVTOL) aircraft for urban air-taxi service, will passengers come? Clearly, the success of any urban air-taxi service depends not only on the engineering accomplishments, but also on passenger demand. Multiple researchers have conducted workshops and/or focus groups to better understand the demand potential of these new aircraft [1, 2]. For example, Airbus conducted focus groups in New York City, Frankfurt, and Shanghai and identified eight potential market segments [2]. The top three potential market segments based on the respondents from the United States (U.S.) included airport transfers, end-to-end city transfers, and daily commuting [2]. Garrow, German, and Ilbeigi conducted four focus groups in Atlanta [1]. Similar to the Airbus study,

[1] Former Graduate Research Assistant, School of City and Regional Planning and Founder, Oxus Design LLC
[2] Professor, School of Civil and Environmental Engineering
[3] Associate Professor, Daniel Guggenheim School of Aerospace Engineering, Associate Fellow to AIAA
[4] Susan G. and Christopher D. Pappas Professor, School of Civil and Environmental Engineering
[5] Research Engineer, Daniel Guggenheim School of Aerospace Engineering
[6] Research Engineer, School of Civil and Environmental Engineering

they found that individuals were interested in using an air taxi service, particularly for time-sensitive business trips [1]. For example, participants noted the ability to park their automobiles near a vertiport, the stations served by eVTOL vehicles, and take an air taxi to the airport (thereby avoiding parking fees at the airport, as well as the uncertainty of roadway congestion en route). Participants also noted the ability to take an air taxi from their destination airport to a vertiport close to their hotel and/or work location site. Using an air taxi service for commuting was also popular, particularly among those participants who wanted to live in rural areas [1].

Predicting demand for urban air-taxi service is challenging, given the novelty of this mode of transportation. This limits the potential of using historic revealed preference data, particularly for the daily commuting use case as the past market conditions are quite distinct from a future eVTOL market. In these types of situations, it is common to use stated-preference surveys to identify demand for a new product. In this paper, we describe a survey we designed to better understand U.S. consumers' willingness to pay for using eVTOL aircraft for regular commuting. At the time this paper was submitted, the survey was being executed, thus here we focus on describing the logic behind the survey design, including our sampling plan and survey instrument.

II. Sampling Plan

We are using a commercial opinion panel to survey commuters in five metropolitan areas in the U.S. Specifically, we included individuals who had a home and work zip code within the Census-defined Combined Statistical Areas (CSAs) for Atlanta, Boston, Dallas/Ft. Worth, the San Francisco Bay Area, and Los Angeles, shown in Figure 1. (See [3-11 for the TIGER/line® road, county, and CSA shapefiles we used to generate Figures 1-6). Our goal is to survey 2,500 individuals with personal before-tax annual incomes of at least $150,000 and average one-way commute times of at least 45 minutes. As of the time of submitting this paper, we had obtained 1,231 responses and the commercial opinion panel was unsure they would be able to fulfill our quota without significantly increasing the survey costs (we paid $23,500[7] for the survey). If needed, we will relax the one-way commute time restriction but tighten the income requirement (on the assumption that the shorter the commute, the greater the value of time should be in order for such premium services to be attractive), targeting individuals with personal before-tax annual incomes of $200K or more. Our motivations for selecting the five CSAs are described below.

Figure 1. Survey Cities

Atlanta is a land-locked city in the Southeast that has no geographic features that help prevent outward growth expansion in the region. The sprawling region provides a spoke interstate system to different areas of the region and has many large employment centers along the Interstate 285 perimeter that surrounds Atlanta. The automobile-dominant mode share of the region, combined with the lack of natural boundaries that limit outward expansion and the spoke interstate feature, set the region apart from the other survey cities.

Figure 2. Atlanta CSA

[7] This amount does not include overhead charged on research grants.

Figure 3. Boston CSA

Boston is a city on the East Coast that is part of the Northeast Corridor. The Boston CSA has geographic features and transportation alternatives that influence commute patterns. The Boston CSA borders the Atlantic Ocean and includes parts of Connecticut, New Hampshire, Massachusetts, and Rhode Island. The City of Providence, Rhode Island lies within the Boston CSA. The Boston Harbor, Cape Cod Bay, and Charles River are all geographic features that affect commute patterns and commute times. The transit mode share is higher in the Boston region than for any other CSAs in our survey.

Figure 4. Dallas-Ft. Worth CSA

Dallas-Ft. Worth is similar to Atlanta in that it lacks geographic features that limit sprawl and influence development patterns. Distinct from Atlanta, the interstate network was constructed in a grid-pattern between Dallas and Ft. Worth with many large business-attracting areas between the cities near the City of Arlington and along the perimeter of the cities. Dallas is one of two cities in the U.S. that Uber selected for testing eVTOL flights [12].

Figure 5. Los Angeles CSA

Los Angeles is the second city in the U.S. that Uber selected for testing eVTOL flights [12], and is one of two West Coast cities included in our study. The region is infamous for long commute times and for having one of the most congested interstate systems in the nation [13]. Los Angeles has geographic features that act as barriers to development in particular areas of the region, e.g., the CSA borders the Pacific Ocean and has terrain features (such as mountains) that impact where development occurs and where the transportation network can be located. Los Angeles is unique among the other cities in that from the 1970s until 2014, it had regulations requiring buildings above a certain height to have a heliport on their roof to assist in evacuations [14]. This sets Los Angeles apart from other cities in that it already has an existing infrastructure in a downtown area that could potentially be converted to vertiports.

Finally, the San Francisco CSA was chosen because of its unique geographic features and reputation as an incubator of new technologies [15]. The Bay Area has three major cities (Oakland, San Francisco, and San Jose) within the San Francisco CSA. The San Francisco Bay only has four existing bridge crossings from the East Bay to areas in San Francisco and the cities of Silicon Valley. This physical barrier makes for challenging commutes and could be an ideal pattern for future eVTOL air-taxi service. There are also key geographic features in the terrain that impact the location of existing transportation connections along the interstates, highways, and transit.

Figure 6. San Francisco CSA

III. Survey Instrument

The survey instrument contained nine parts. It included approximately 80 questions in all, but some questions were not shown to all respondents, e.g., respondents were only asked if they made a transfer on their commute to work if they indicated that they typically commute to work using a transit mode. Appendix 1 provides complete details of the survey instrument and associated programming logic described in this section.

A. Institutional Review Board Consent

The first section contains the required Institutional Review Board (IRB) statement, provides compensation information, and asks respondents whether they agree to participate in the study. We stated that as a participant, "You will be asked to complete a survey that asks you about your attitudes and current travel patterns." We did not explicitly refer to an air taxi service in the introduction, to minimize biasing recruitment (people may have been less inclined to respond if they had no interest in the service) and results (those who did respond may have been more likely to answer favorably toward questions involving air travel service if they knew that was our primary interest in conducting the survey).

B. Screening Questions

The second section contains screening questions. Only those individuals who were full-time workers, traveled to a work location outside the home at least two days per week, and had an annual personal (versus household) income of $150K were eligible to participate in the study. Individuals employed by an airline were excluded. We used the home and work zip codes to ensure that the respondent lived and worked within one of the five CSAs included in the study.

At the beginning of the data collection process, we required that participants had a typical one-way commute time of at least 45 minutes. At the time of submitting this paper, we had collected approximately 1,650 responses and met our target of 500 responses for both San Francisco and Los Angeles. To meet our ultimate goal of 2,500 responses, we may need to relax this screening criterion for Atlanta, Boston, and Dallas-Ft. Worth and include individuals who have typical one-way commute times less than 45 minutes.

C. Opinions about Travel

The third section of the survey asked participants about their views on a variety of issues directly or indirectly related to travel. We will use the questions in this section (as well as those collected later in the survey) to conduct factor and cluster analyses, which will provide insights into the types of consumers for which air taxi service is most attractive. (See Mokhtarian, Ory and Cao [16] for an example of a study that uses these methodologies to identify consumer segments.)

To conduct a factor analysis, we need to identify constructs that we hypothesize will influence demand for air taxi services. We include eight constructs in this section, shown in Table 1. Sixteen questions were asked, to obtain measurements associated with these constructs. For each question, respondents reported how much they agree or disagree with the statement using a Likert-type scale with five categories: strongly disagree, disagree, neutral, agree, and strongly agree.

In factor analysis, it is common to ask at least two questions associated with each construct, and preferable to vary the directionality of the questions to be (collectively) both "positively" and "negatively" associated with a given construct. Stated another way, the wording of the two questions associated with the construct is designed so that an individual who selected "agree" or "strongly agree" on one question would tend to select "disagree" or "strongly disagree" on the other question. The questions were ordered differently in the survey than in Table 1, to minimize the consistency bias associated with having the items pertaining to the same construct adjacent to each other, to counteract respondents' tendencies to fall into an automatic response pattern (e.g. a predictable alternation of positively and negatively oriented questions), and to reduce any unintended carryover effects from one question to the next.

Finally, we included a "trap question" in this section, in which we asked participants to select "disagree" to confirm they were reading the questions. We terminated the survey for those who did not select the correct response, given it is more likely these individuals were not paying attention to the survey questions (and would potentially bias survey results if they completed the entire survey).

Table 1. Constructs and Survey Questions Related to Opinions about Travel

Survey Question	Construct	Direction
I am fine with not owning a car, as long as I can use/rent one any time I need it	Car-oriented	-
I need a car while I am at work	Car-oriented	+
I prefer to walk rather than drive whenever practical	Mode preference	+/-
I would prefer to take transit rather than drive whenever practical	Mode preference	+/-
I would take transit more often if I had a guaranteed ride home when I had to leave work late	Mode preference	+/-
My trips to and from work are generally pleasant	Commute benefit	+
My trips to and from work are stressful	Commute benefit	-
I would tend to feel sick if I tried to read while on a plane	Motion sickness	+
I rarely consider the impact of the environment in my daily choices	Pro-environment	-
I limit my driving to help improve air quality	Pro-environment	+
Traveling by car is safer overall than taking transit	Driving/car safety	+
Using a ride-sharing service, such as Lyft or Uber, is safer overall than driving	Driving/car safety	-
Using a ride-sharing service, such as Lyft or Uber, is more convenient overall than driving	Ridesharing convenience	+
If I were to use a ride-sharing service, such as Lyft or Uber, I would have to wait too long to be picked up	Ridesharing convenience	-
I would usually rather have someone else who is trustworthy do the driving	Control	-
Being in a car makes me nervous if someone else is driving	Control	+

D. Current Commute

The fourth section of the survey asked questions about the individual's current commute including:

- The typical travel mode taken to work
- The typical departure times at which the individual left home for work and left work for home
- Whether the individual typically made stops on the way to and/or from work and if so, the purpose of these stops
- Whether the individual had taken a ride-sharing service and if so, how the individual typically used these services
- Congestion levels near the individual's home and work locations during the two commuting periods
- For those individuals who typically took transit to work, how long it took them to go from home to transit, from transit to work, and whether they made a transfer.

Based on insights gained from focus groups, we found that individuals who owned battery-operated automobiles were warier of battery-operated aircraft [1, 17]; thus, we included questions about whether the individual owned or leased a battery-powered vehicle and if so, whether it was used in a high-occupancy lane to reduce commute time.

E. Introduction to Air Taxi Service

The fifth part of the survey introduced the concept of eVTOL aircraft for air taxi service and showed participants four images based on designs reported in the press (see [18-21] for these images, which are not included in this paper due to copyright restrictions). We used a bullet-pointed list to describe the aircraft and included information about the design, operation, and safety features based on questions participants in our prior focus groups asked [1, 17]. The description included the following:

- Are battery powered
- Carry two to four passengers

- Travel within a city at cruise speeds of 150 mph
- Could be used for getting to and from work faster
- Have efficient security checks with no lines
- Take off and land vertically like a helicopter
- Take off and land at locations in a city such as tops of buildings and parking decks
- Have a ride quality and cabin noise level similar to large aircraft
- Are much quieter than helicopters, both for the community and for the occupants of the aircraft
- Travel at about the altitude where traffic helicopters fly
- Are flown by certified pilots
- Do not fly in hazardous weather conditions (such as thunderstorms)
- Meet stringent safety requirements mandated by the U.S. Federal Aviation Administration

Based on this initial description, we asked individuals how appealing the design was to them and how likely they would be to use it. We then presented respondents with potential features of the eVTOL aircraft and asked them if they would be more or less likely to use it with these characteristics. The tested features included fuel/battery combinations, a parachute for the aircraft, and multiple propellers for redundancy. Also, given that pilots of small aircraft need to pay attention to the total weight they are carrying, we asked if respondents would be more or less likely to take an eVTOL aircraft if they had to be weighed on a scale or if they had to verbally state their weight to an agent. We further asked whether their decision to take an eVTOL aircraft for commuting would be influenced by the availability of the air taxi service (which would not be able to operate in bad weather) and the availability of a ride guarantee in the event the eVTOL could not operate. Finally, we asked whether this air taxi service would influence any mid- to long-term decisions, such as where to live or how many vehicles to own or lease.

F. Trade-off Questions

The sixth part of the survey contained eight questions as shown in Figures 7 to 9 (these images, and others included in the survey, are reprinted here from the Creative Commons Attribution license [22-25]). Each question presented two hypothetical options for commuting and asked which one the respondent would choose. The first option had features similar to the respondent's current trip and the second was a trip on a new eVTOL aircraft.

In designing these trade-off questions, there are several decisions the researcher needs to make: how many options should be included in each question? What attributes should be included with each option? For each attribute, what range of values (referred to as levels) should we include? And, how many trade-off questions should we ask respondents?

Given the length of our survey, we decided to keep these trade-off questions as “simple” as possible. For this reason, we only included two commute mode options to choose from in each question: the respondent’s current typical mode (auto, transit, or ride-share), and eVTOL. We customized the trade-off questions to be representative of the individual's current typical commute.

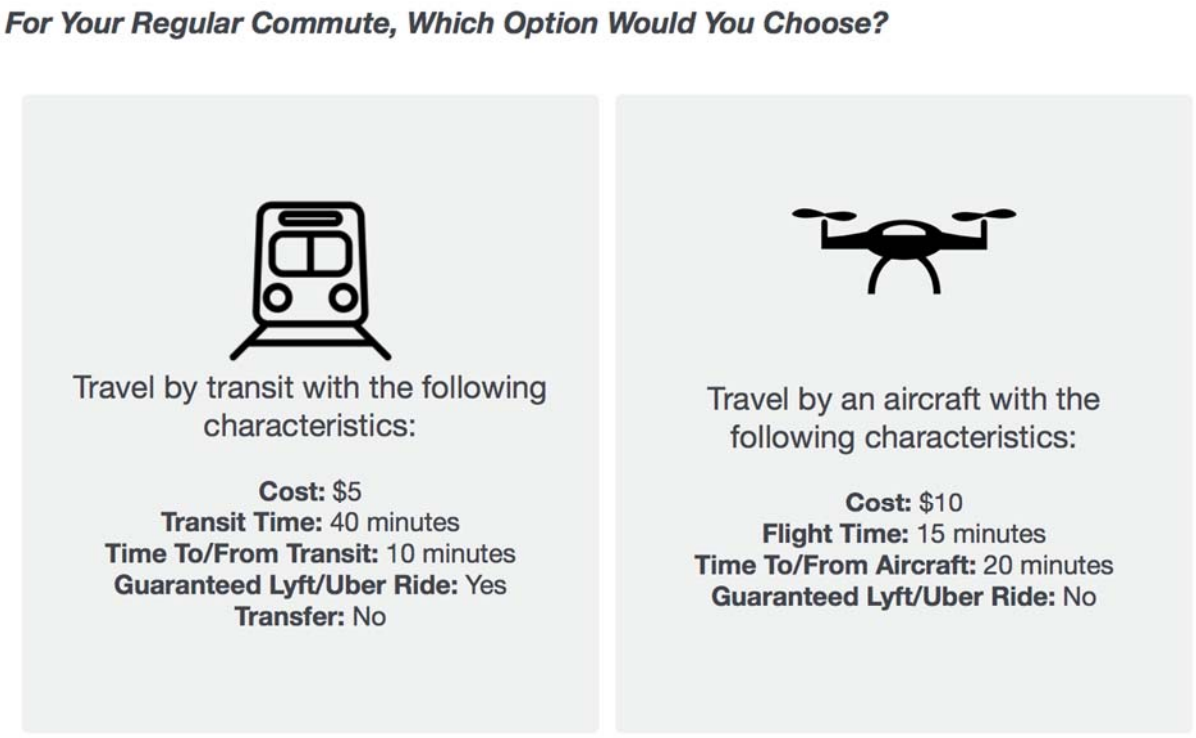

Figure 7. Transit versus eVTOL

Figure 8. Auto versus eVTOL

Figure 9. Rideshare versus eVTOL

We included multiple factors in our model. Given our primary objective is to estimate commuters' willingness to pay, we wanted to ensure: (1) travel times for the non-eVTOL modes were comparable to those currently experienced by the respondent; (2) travel times and costs for the eVTOL flights spanned the range of values researchers anticipate will be needed for profitability; and, (3) the costs for the non-eVTOL modes are typically lower than those for the eVTOL mode and are bounded by the cost of a transit fare across the study areas. To achieve these goals, we customized time and cost for each of the modes based on distance bands. In particular, we used the reported home and work zip codes to place the individual into one of four distance categories (using the centroids of the zip codes and a straight-line distance calculation): 0-24 miles, 25-39 miles, 40-54 miles and 55 or more miles. We set the minimum travel time at 30 minutes and the maximum travel time at two hours for the non-eVTOL modes. Given a recent paper by Joby Aviation that reported target design speeds of 100 – 400 knots (corresponding to about 115 to 460 miles per hour (mph)), we used a conservative design speed of approximately 175 knots (corresponding to 200 mph) for estimating eVTOL flight times [26]. Table 2 summarizes the travel times used in the survey. Note we used the same travel times for the transit and rideshare modes.

Table 2. Travel Times Used in Survey

Distance	Level 1				Level 2				Level 3				Level 4			
(miles)	AIR	CAR	TR	RS	AIR	CAR	TR	RS	AIR	CAR	TR	RS	AIR	CAR	TR	RS
0 – 24	0:10	0:30	0:30	0:30	0:15	0:40	0:40	0:40	0:20	0:50	0:50	0:50	0:25	1:00	1:00	1:00
25 – 39	0:10	0:30	0:30	0:30	0:15	0:45	0:45	0:45	0:20	1:00	1:00	1:00	0:25	1:15	1:15	1:15
40 – 54	0:15	1:00	1:00	1:00	0:25	1:15	1:15	1:15	0:35	1:30	1:30	1:30	0:45	1:45	1:45	1:45
55+	0:20	1:00	1:00	1:00	0:30	1:30	1:30	1:30	0:45	1:45	1:45	1:45	0:50	2:00	2:00	2:00

Note: AIR=eVTOL, TR=transit, and RS=rideshare

Deciding on the range of cost values to be tested was the most challenging part of the survey design. Costs – as well as travel times – vary by multiple factors. For example, the costs of a transit ride for the T in Boston or MARTA in Atlanta are $3.00 and $2.50, respectively, and do not vary with distance. In reality, the cost of travel by auto varies within the study areas. According to Gas Buddy, on May 1, 2018 the national gas price average was $2.82 per gallon; within our study areas it was $2.66 in Dallas, $2.76 in Atlanta, $2.83 in Boston, $3.66 in Los Angeles, and $3.72 in San Francisco [27]. The fuel efficiency of the individual's auto will also impact commuting costs. To accommodate

the large variation in costs, we set the costs associated with a one-way commute within a lower bound equal to that of a transit pass in Atlanta ($2.50) and an upper bound of $20.

We set the range of prices of the eVTOL ride based on estimates reported in conferences. Most recently, Uber shared that they were targeting eVTOL prices of $5.73 per passenger mile at launch, $1.84 per passenger mile in the near term, and $0.44 per passenger mile in the long term [28]. To put this in context the average operating cost of helicopters is $8.93 per passenger mile and the average cost per mile of auto ownership in 2017 was $0.592 [28, 29]. We recognize that the costs we used in the survey are higher than those used in other studies (e.g., see [30]) and that it is unrealistic to expect a large number of individuals to pay $90 per day for a round-trip commute (of more than 55 miles one-way). However, given that our goal is to determine if there is a viable market for launching air taxi service before the long-term costs per passenger mile are realized, we set the prices in a range we believe would be realistic in the mid-term and targeted our sampling plan to higher-income individuals with long commutes – i.e. those with both the motivation and the means to pay a premium for a shorter commute. Table 3 summarizes the costs used in the survey. Note we used the same costs for the transit and rideshare modes.

Table 3. Costs (in USD) Used in Survey

Distance	Level 1				Level 2				Level 3				Level 4			
(miles)	AIR	CAR	TR	RS	AIR	CAR	TR	RS	AIR	CAR	TR	RS	AIR	CAR	TR	RS
0 – 24	5	2.50	2.50	2.50	5	2.50	2.50	2.50	10	5	5	5	10	5	5	5
25 – 39	5	2.50	2.50	2.50	10	3	3	3	15	4	4	4	20	5	5	5
40 – 54	10	4	4	4	20	6	6	6	30	8	8	8	40	10	10	10
55+	20	5	5	5	25	10	10	10	35	15	15	15	45	20	20	20

Note: AIR=eVTOL, TR=transit, and RS=rideshare

In addition to travel time and cost, we included access/egress times, wait times, guaranteed ride availability, and transfers. Table 4 summarizes these factors and how they relate to the underlying survey design, i.e., the "other travel time component" is referred to as "time to/from eVTOL," "time to/from transit," and "wait time" for the eVTOL, transit, and rideshare modes, respectively. We assumed that the auto alternative did not include access and egress times.

Given the number of attributes in our trade-off questions, combined with the number of levels that we wanted to test, we would have had to ask each individual respondent 32 trade-off questions, which clearly is not realistic. In these cases, it is common to create blocks of questions so that each respondent sees no more than eight tradeoff questions. Respondents are then randomly assigned to one block (which contains eight questions). We created a total of 128 trade-off questions, representing a total of 4 distance ranges × 4 blocks × 8 questions per block. Tables 2-4 summarize the attributes and levels used in the survey. Appendix 2 shows which levels correspond to each of the 128 trade-off questions. Because we did not vary time or cost across the non-eVTOL modes, we used the same 128 trade-off questions for each non-eVTOL mode. That is, the factors and levels we used for the eVTOL vs. auto, eVTOL versus transit, and eVTOL versus rideshare are identical; we only changed the image shown, the labeling of the "other" travel time components, and which attributes were shown (based on which attributes were relevant to the non-eVTOL mode).

Table 4. Other Attributes and Their Levels Used in the Survey

Additional Features	Level 1				Level 2			
	AIR	CAR	TR	RS	AIR	CAR	TR	RS
Other travel time component labeled as		N/A				N/A		
Time to/from eVTOL	10 min				20 min			
Time to/from transit			10 min				20 min	
Wait time				10 min				20 min
Ride guarantee	No	N/A	No	N/A	Yes	N/A	Yes	N/A
Transfer	N/A	N/A	No	N/A	N/A	N/A	Yes	N/A

Note: AIR=eVTOL, TR=transit, and RS=rideshare

Finally, as part of this section we kept track of the number of times the respondent selected the eVTOL option and asked if there was anything that would have changed the respondent's mind or any circumstances under which the respondent would have selected an eVTOL option more often.

G. Current Air Travel

The seventh part of the survey asked respondents approximately how many annual air trips they made and then asked them how many annual work trips and how many annual personal trips they took out of each airport in their city. Atlanta included only Hartsfield-Jackson Atlanta International Airport (ATL). Boston included both Boston Logan International Airport (BOS) and Providence T.F. Green Airport (PVD). Dallas included both Dallas/Fort Worth International Airport (DFW) and Dallas Love Field (DAL). San Francisco included four airports: the San Francisco International Airport (SFO), the Metropolitan Oakland International Airport (OAK), the Norman Y. Mineta San Jose International Airport (SJF), and the Sacramento International Airport (SMF). Los Angeles included six airports: the Los Angeles International Airport (LAX), Ontario International Airport (ONT), John Wayne Airport (SNA), San Bernardino International Airport (SBD), Burbank Bob Hope Airport (BUR) and Long Beach Airport (LGB). We then asked six questions related to the respondent's attitudes towards flying and the new aircraft design (e.g., I would be afraid to travel in one of these eVTOL aircraft).

H. Personality and Lifestyle Questions

The eighth part of the survey asked questions focused on personality and lifestyle characteristics, similar to those described in Section C. We included seven constructs, shown in Table 5, that we hypothesize will help predict individuals' willingness to take an air taxi service (or willingness to fly in one of these aircraft). We only included one question associated with each of the subjective well-being and trust constructs. This section also included a trap question. We did not terminate the survey if the respondent answered the trap question incorrectly, but will use it to identify potential respondent fatigue. As in Part C and for the same reasons, the questions were ordered differently in the survey than in Table 5.

Table 5. Constructs and Survey Questions Related to Personality and Lifestyle

Survey Question	Construct	Direction
At this stage in my life, having fun is more important to me than working hard	Leisure-oriented lifestyle	+
I'm too busy to do many of the things I'd like to do	Leisure-oriented lifestyle	-
I like the idea of living somewhere with large yards and lots of space between homes	Pro-high density	-
I like the idea of living in a neighborhood where I can walk to shops	Pro-high density	+
My phone is so important to me, it's almost a part of my body	Technology dependence	+
I often introduce new trends to my friends or family	Technology/early adopter	+
I like to wait a while rather than being first to buy new products	Technology/early adopter	-
I'm worried that technology invades my privacy too much	Technology	-
I am generally satisfied with my life	Subjective well being	+
People are generally trustworthy	Trust	+

I. Additional Socio-economic Information

We conclude the survey by asking for socio-demographic and socio-economic information that was not already obtained for screening or customizing survey questions. These questions included gender, education level, number of adults, number of children under 18 living in the household, occupation, and household (versus individual) income.

J. Additional Considerations

Our focus in this survey is on high-income individuals who have long one-way commutes to work in five major U.S. metropolitan areas. However, we will want to generalize our results to other metro areas and to provide some insights into how our survey population relates to the general U.S. population. To do this, we included questions that are part of the American Community Survey [31]. We will be able to compare how the distributions of responses to these questions vary between the two surveys and, where appropriate, weight our survey results to match the general population of full-time workers with high incomes and longer commutes. The pertinent questions drawn from the ACS survey are noted in Appendix 1.

IV. Next Steps/Conclusion

This paper described the sampling plan and survey instrument we will use to forecast commuting demand for eVTOL flights. The inclusion of perceptual and attitudinal constructs and socio-demographic characteristics will enable us to understand how individuals' perceptions and attitudes influence demand for commuting air taxi service and how these perceptions and attitudes are correlated with socio-demographic characteristics. Our inclusion of nine questions that directly tie to ACS should enable us to extrapolate our results from the five sampled CSAs to other areas.

Appendices

Appendix 1 contains the survey instrument and Appendix 2 contains the values of time and cost we used in the trade-off questions.

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Appendix 1: Survey Instrument

PART A: IRB CONSENT FORM

The Institutional Review Board (IRB) consent form is shown to participant and they can agree/disagree to participate in the study.

[Programming note: If individual does not agree to participate in survey, then terminate]

PART B: SCREENING QUESTIONS

1. Are you an airline employee?
   - ○ Yes
   - ○ No

[Programming note: If individual selects yes, then terminate]

2. How many days per week do you typically go to a workplace outside your home?
   - ○ None
   - ○ One
   - ○ Two
   - ○ Three
   - ○ Four
   - ○ Five
   - ○ Six
   - ○ Seven

[Programming note: If individual selects none or one then terminate]

3. What is your five-digit home zip code?

   [ ]

[Programming note: If home zip code does not belong to the study area, then terminate]

4. What is your five-digit work zip code? If you have multiple work locations, please enter the zip code of the primary location.

   [ ]

[Programming note: If work zip code does not belong to the study area, then terminate; both home and work zip code have to be in the same city]

5. During the *PAST 12 MONTHS*, in the **WEEKS WORKED**, how many hours did you usually work each *WEEK at each location?*

At your main place of work	
At home	
Elsewhere	

[Question 5 is on ACS]

6. How many minutes did it usually take you to get from home to work last week (or the most recent week you worked)?

Minutes

[Programming note: If less than 45 minutes, then terminate]

[Question 6 is on ACS]

7. How many minutes did it usually take you to get from work to home last week (or the most recent week you worked)?

Minutes

8. What was your total income during the *PAST 12 MONTHS*? (This is the income you personally earned before taxes and deductions. Do not report your household income.)

- ☐ Under $10,000
- ☐ $10,000 - $19,999
- ☐ $20,000 - $29,999
- ☐ $30,000 - $39,999
- ☐ $40,000 - $49,999
- ☐ $50,000 - $74,999
- ☐ $75,000 - $99,999
- ☐ $100,000 - $149,999
- ☐ $150,000 - $199,999
- ☐ $120,000 - $249,999
- ☐ $250,000 - $299,999
- ☐ $300,000 - $349,999
- ☐ $350,000 - $399,999
- ☐ $400,000 - $449,999
- ☐ $450,000 - $499,999
- ☐ $500,000 or more

[Programming note: If less than 150K, then terminate]

[Question 8 is on ACS]

9. During the *PAST 12 MONTHS (52 weeks)*, did you work 50 or more weeks? Count paid time off as work.

- ☐ Yes
- ☐ No

[Programming note: If no then terminate]

[Question 9 is on ACS]

PART C: YOUR OPINIONS ABOUT TRAVEL

In this section, we ask about your views on a variety of issues directly or indirectly related to travel. For each of the following statements, please check the response that best expresses your opinion.

10. My trips to and from work are generally pleasant

- ☐ Strongly disagree
- ☐ Disagree
- ☐ Neutral
- ☐ Agree
- ☐ Strongly agree

11. Using a ride-sharing service, such as Lyft or Uber, is more convenient overall than driving

- ☐ Strongly disagree
- ☐ Disagree
- ☐ Neutral
- ☐ Agree
- ☐ Strongly agree

12. I need a car while I am at work

- ☐ Strongly disagree
- ☐ Disagree
- ☐ Neutral
- ☐ Agree
- ☐ Strongly agree

13. I would usually rather have someone else who is trustworthy do the driving

- ○ Strongly disagree
- ○ Disagree
- ○ Neutral
- ○ Agree
- ○ Strongly agree

14. I rarely consider the impact on the environment in my daily choices

- ○ Strongly disagree
- ○ Disagree
- ○ Neutral
- ○ Agree
- ○ Strongly agree

15. I like traveling by airplane

- ○ Strongly disagree
- ○ Disagree
- ○ Neutral
- ○ Agree
- ○ Strongly agree

16. I would prefer to take transit rather than drive whenever practical

- ○ Strongly disagree
- ○ Disagree
- ○ Neutral
- ○ Agree
- ○ Strongly agree

17. If I were to use a ride-share service, such as Lyft or Uber, I would have to wait too long to be picked up

- ○ Strongly disagree
- ○ Disagree
- ○ Neutral
- ○ Agree
- ○ Strongly agree

18. I prefer to walk rather than drive whenever practical

- ○ Strongly disagree
- ○ Disagree
- ○ Neutral
- ○ Agree
- ○ Strongly agree

19. Traveling by car is safer overall than taking transit

- ○ Strongly disagree
- ○ Disagree
- ○ Neutral
- ○ Agree
- ○ Strongly agree

20. I would take transit more often if I had a guaranteed ride home when I had to leave work late

- ○ Strongly disagree
- ○ Disagree
- ○ Neutral
- ○ Agree
- ○ Strongly agree

21. Traveling by air makes me nervous

- ○ Strongly disagree
- ○ Disagree
- ○ Neutral
- ○ Agree
- ○ Strongly agree

22. I limit my driving to help improve air quality

- ○ Strongly disagree
- ○ Disagree
- ○ Neutral
- ○ Agree
- ○ Strongly agree

23. Being in a car makes me nervous if someone else is driving

- ○ Strongly disagree
- ○ Disagree
- ○ Neutral
- ○ Agree
- ○ Strongly agree

24. I would tend to feel sick if I tried to read while in a plane

- ○ Strongly disagree
- ○ Disagree
- ○ Neutral
- ○ Agree
- ○ Strongly agree

25. My trips to and from work are stressful

- ○ Strongly disagree
- ○ Disagree
- ○ Neutral
- ○ Agree
- ○ Strongly agree

26. I am fine with not owning a car, as long as I can use/rent one any time I need it

- ○ Strongly disagree
- ○ Disagree
- ○ Neutral
- ○ Agree
- ○ Strongly agree

27. Using a ride-sharing service, such as Lyft or Uber, is safer overall than driving

- ○ Strongly disagree
- ○ Disagree
- ○ Neutral
- ○ Agree
- ○ Strongly agree

28. To confirm you are really reading this, please select "Disagree"

- ☐ Strongly disagree
- ☐ Disagree
- ☐ Neutral
- ☐ Agree
- ☐ Strongly agree

[Programming note: If individual does not select disagree, then terminate survey]

PART D: YOUR CURRENT COMMUTE

The questions in this section relate to various aspects of your current trips to and from work.

29. How did you usually get to work *LAST WEEK*? *If you usually used more than one method of transportation during the trip, choose the one used for most of the distance.*

- ☐ Car, truck, or van
- ☐ Bus or trolley bus
- ☐ Streetcar or trolley car
- ☐ Subway or elevated train
- ☐ Railroad
- ☐ Ferryboat
- ☐ Taxicab
- ☐ Rideshare (Lyft/Uber)
- ☐ Motorcycle
- ☐ Bicycle
- ☐ Walking
- ☐ Worked at home
- ☐ Other method (specify) _____

[Programming note:
If individual selects bus or trolley bus then go to Question 30
Else if individual selects streetcar or trolley car then go to Question 31
Else if individual selects subway or elevated train then go to Question 32
Else if individual selects railroad then go to Question 33
Else if individual selects ferryboat then go to Question 34
Else go to Question 41]

[Question 29 is on ACS]

30. How long did it take you to travel from home to the bus?

Minutes

[Programming note: Go to Question 35]

31. How long did it take you to travel from home to the streetcar or trolley car?

Minutes

[Programming note: Go to Question 36]

32. How long did it take you to travel from home to the subway or elevated train?

Minutes

[Programming note: Go to Question 37]

33. How long did it take you to travel from home to the train?

Minutes

[Programming note: Go to Question 38]

34. How long did it take you to travel from home to the ferryboat?

Minutes

[Programming note: Go to Question 39]

35. How long did it take you to travel from the bus to work?

Minutes

[Programming note: Go to Question 40]

36. How long did it take you to travel from the streetcar or trolley car to work?

Minutes

[Programming note: Go to Question 40]

37. How long did it take you to travel from the subway or elevated train to work?

Minutes

[Programming note: Go to Question 40]

38. How long did it take you to travel from the train to work?

Minutes

[Programming note: Go to Question 40]

39. How long did it take you to travel from the ferryboat to work?

Minutes

40. Did you make any transfers?

- Yes
- No

41. What time did you usually leave home to go to work *LAST WEEK (or the most recent week you worked)*?

Departure Time

[Programming note: dropdown options include 12:00-5:59 AM; 6:00-6:29 AM; 6:30-6:59 AM; 7:00-7:29 AM; 7:30-7:59 AM; 8:00-8:29 AM; 8:30-8:59 AM; 9:00 AM-2:59 PM; 3:00-5:59 PM; 6:00-8:59 PM; 9:00-11:59 PM]

[Question 41 is on ACS]

42. What time did you usually leave work *LAST WEEK (or the most recent week you worked)*?

Departure Time

[Programming note: dropdown options include 12:00-5:59 AM; 6:00-8:29 AM; 9:00 AM-2:59 PM; 3:00-3:29 PM; 3:30-3:59 PM; 4:00-4:29 PM; 4:30-4:59 PM; 5:00-5:29 PM; 5:30-5:59 PM; 6:00-6:29 PM; 6:3-6:59 PM; 7:00-7:29 PM; 7:30-7:59 PM; 8:00-8:29 PM; 8:30-8:59 PM; 9:00-11:59 PM]

43. For each of the following segments of your ***usual*** trip to or from work, please select the option that most closely describes the conditions your experience

	Little to no congestion	Minor congestion	Moderate congestion	Heavy congestion
Near your home when you ***leave*** for work?	☐	☐	☐	☐
Near your work when you ***arrive*** for work?	☐	☐	☐	☐
Near your work when you ***leave*** for work?	☐	☐	☐	☐
Near your home when you ***arrive*** home?	☐	☐	☐	☐

44. Do you regularly make stops on the way to and/or from work?

☐ Yes

☐ No

[Programming note: If response = yes then go to question 45, otherwise go to question 46]

45. Why do you make stops on the way to and/or from work? (choose all that apply)

- ☐ Purchase breakfast/coffee
- ☐ Purchase dinner
- ☐ Drop-off or pick-up children
- ☐ Pick-up or drop-off dry-cleaning
- ☐ Run errands
- ☐ Other (specify) _____

46. How often do you use ride-sharing services (in any city), such as Lyft or Uber?

- ○ I have never used a ride-sharing service
- ○ Once a week or more often
- ○ Two or three times a month
- ○ About once a month (12 times a year or so)
- ○ About four to eleven times a year
- ○ About two or three times a year
- ○ About once a year
- ○ Less than once a year

[Programming note: If response is not "I have never used a ride-sharing service, go to Question 47 otherwise go to Question 48]]

47. Which of the following explains how you use ride-sharing services? (choose all that apply)

- ☐ To get to/from the airport
- ☐ To get to/from work on a regular basis
- ☐ To get to/from work occasionally (e.g., when my car is in the shop)
- ☐ To get home after a night out
- ☐ For socialization and nightlife
- ☐ Other (specify) _____

48. How many vehicles does your household own or lease?

- ○ None
- ○ One
- ○ Two
- ○ Three or more

49. Do you own or lease a hybrid or battery-powered vehicle?

- ☐ Yes
- ☐ No

[Programming note: If response = yes then go to question 50, otherwise go to PART E]

50. Do you drive your hybrid or battery-powered vehicle in a high-occupancy vehicle (HOV) lane to reduce your time to get to and from work?

- ☐ Yes
- ☐ No

PART E: INTRO TO AIR TAXI SERVICE

NASA and many companies are spearheading research to develop an air taxi service for cities. The aircraft

- Are battery powered
- Carry two to four passengers
- Travel within a city at cruise speeds of 150 mph
- Could be used for getting to and from work faster
- Have efficient security checks with no lines
- Take off and land vertically like a helicopter
- Take off and land at locations in a city such as tops of buildings and parking decks
- Have a ride quality and cabin noise level similar to large aircraft
- Are much quieter than helicopters, both for the community and for the occupants of the aircraft
- Travel at about the altitude where traffic helicopters fly
- Are flown by certified pilots
- Do not fly in hazardous weather conditions (such as thunderstorms)
- Meet stringent safety requirements mandated by the U.S. Federal Aviation Administration

In this section, we ask you to imagine that you are flying in one of the new electric vertical take off and landing (or eVTOL) aircraft shown below.

[Programming note: Four pictures of eVTOL aircraft are shown but are suppressed here due to copyright restrictions. See [7-10] to pictures for images].

51. Based on the description of the new aircraft provided so far, how appealing do you find this idea?

- ○ Very unappealing
- ○ Somewhat unappealing
- ○ Neutral
- ○ Somewhat appealing
- ○ Very appealing

52. Carefully considering your circumstances, how likely would you be to use such a service for your own local travel?

- ○ Very unlikely
- ○ Somewhat unlikely
- ○ Neutral
- ○ Somewhat likely
- ○ Very likely

53. In the following questions, we will present you with features that the eVTOL aircraft could have. We are interested in knowing how much more or less likely you would be to fly in an eVTOL aircraft if each feature were present.

	Much less likely	Less likely	Would not affect my decision	More likely	Much more likely
Uses both fuel and batteries	○	○	○	○	○
Uses only fuel	○	○	○	○	○
Uses only batteries	○	○	○	○	○
Has a large parachute for the entire aircraft, so that you and the aircraft could descend safely to the ground if there were an emergency	○	○	○	○	○
Has multiple propellers for redundancy in case of failures	○	○	○	○	○

54. Small aircraft need to pay attention to how much total weight they are carrying. Compared to your original response, how likely would you be to take one of these aircraft if you...

	Much less likely	Less likely	Would not affect my decision	More likely	Much more likely
Had to verbally state your weight to the agent in order to board?	○	○	○	○	○
Had to be weighed on a scale?	○	○	○	○	○

[Programming note: This question was moved before question 54 after about 1,500 responses were completed as we were concerned after looking at the distribution of responses that respondents may be biased after seeing the safety questions, as a large number were answering "more likely" or "much more likely"]

55. eVTOL aircraft will likely not be able to fly in bad weather. Compared to your original response, how likely would you be to take one of these aircraft if...

	Much less likely	Less likely	Would not affect my decision	More likely	Much more likely
The aircraft could not fly 5% of the time (or one trip out of 20)	○	○	○	○	○
The aircraft could not fly 5% of the time (or one trip out of 20) but you had a guaranteed ride to and/or from work in bad weather (e.g., via a free or reduced price Lyft or Uber ride?)	○	○	○	○	○

[Programming note: We added an additional open-ended question after about 1,500 responses were completed as we unclear why some individuals were answering "more likely" or "much more likely." We asked the respondent to explain the response, which could potentially be due to perceived increases in safety].

56. There are two ways that an eVTOL aircraft might save you time:

- You may use your travel time to do various things which you would otherwise have to do at another time.
- It may take less time for you to travel to and from work.

Considering these possible savings, how would you be most likely to use that extra time?

- ☐ I would work more
- ☐ I would spend more time with my family
- ☐ I would spend more time on myself
- ☐ Other option (specify) ☐

57. Would you move to a different location if you could regularly take an eVTOL aircraft to and from work and the service were reliable and affordable?

- ☐ I would move further from work (e.g., to a more attractive or more spacious location)
- ☐ I would move closer to work
- ☐ I would not move

58. Would you change the number of vehicles your household owns or leases if you could regularly take an eVTOL aircraft to work and the service were reliable and affordable?

- ☐ Very likely to own fewer
- ☐ Somewhat likely to own fewer
- ☐ Most likely to own the same number
- ☐ Somewhat likely to own more
- ☐ Very likely to own more

PART F: TRAVEL TRADE-OFFS

[*Programming note: This section contains eight trade-off questions. These questions were customized based on how the respondent answered Questions 3, 4, and 29. In particular, we used the reported home and work zip codes from Questions 3 to 4 to place the individual into one of four distance categories (using the centroids of the zip codes and a straight-line distance calculation): 0-24 miles, 25-39 miles, 40-54 miles and 55 or more miles. We then used the response to Question 29 to place the individual into one of three "typical" modes: auto, transit, or ride-share. Those who answered (1) car, truck or van; (2) motorcycle; or (3) other were assigned to the "auto" mode. Those who answered: (1) bus or trolley car; (2) streetcar or trolley car; (3) subway or elevated train; (4) ferryboat; (5) railroad; (6) biking; and (7) walking were put into the "transit" mode. Those who answered: (1) taxicab, or (2) rideshare (Lyft/Uber) were assigned to the "rideshare" mode. For each trade-off question, the eVTOL option and "typical" mode were shown to respondents. The levels associated with each factor varied as a function of distance and each mode (as described in the main text). Within each distance range and typical mode, respondents were randomly assigned to one of four blocks (defined as a set of eight trade-off questions). Here, we show one representative question for the auto, transit, and ride share modes. Note that a total of 4 distance ranges × 4 blocks × 8 questions per block or 128 questions were programmed for each pair of trade-offs as part of this section; each respondent was shown 8 questions. See Appendix 2 for the trade-off questions (and associated levels) corresponding to these 128 questions. See references 11-14 for sources we used for the images.]*

In the next series of questions, we would like for you to compare two hypothetical options for traveling to and from work. The first option has features similar to your current trip. The second option is a trip on a new eVTOL aircraft.

The eVTOL aircraft will operate as an air taxi service that you could request from your phone – similar to what you would do now to request a Lyft or Uber. This idea is shown in the image on the left. The air taxi service may come with a **ride guarantee**. In the event that the eVTOL option is not available (for example due to bad weather) a ride guarantee makes sure you receive priority for taking a Lyft or Uber car. To compensate you for the inconvenience, the rideshare option would be discounted and you would pay less than what the cost of an eVTOL flight would have been. This idea is shown in the image on the right. For the questions that follow, some options include this ride guarantee and some options do not include this ride guarantee.

[*Programming note: we show two images based on the Lyft application but have suppressed them here due to copyright restrictions]*

59. *For Your Regular Commute, Which Option Would You Choose?*

Travel by a car with the following characteristics:

Cost (one-way): $5
Travel Time (one-way): 40 minutes

Travel by an aircraft with the following characteristics:

Cost (one-way): $10
Flight Time (one-way): 15 minutes
Time To/From Aircraft: 20 minutes
Guaranteed Lyft/Uber Ride: No

Travel by transit with the following characteristics:

Cost (one-way): $4
Transit Time (one-way): 45 minutes
Time To/From Transit: 10 minutes
Guaranteed Lyft/Uber Ride: Yes
Transfer: No

Travel by an aircraft with the following characteristics:

Cost (one-way): $20
Flight Time (one-way): 15 minutes
Time To/From Aircraft: 20 minutes
Guaranteed Lyft/Uber Ride: No

Travel by rideshare with the following characteristics:

Cost (one-way): $3
Travel Time (one-way): 1 hour 15 minutes
Wait Time: 20 minutes

Travel by an aircraft with the following characteristics:

Cost (one-way): $5
Flight Time (one-way): 10 minutes
Time To/From Aircraft: 10 minutes
Guaranteed Lyft/Uber Ride: No

[Programming note: If the respondent never selected the eVTOL option (out of the 8 trade-off questions shown) go to Question 60, otherwise go to Question 61]

60. You never selected the eVTOL aircraft option. Is there anything that would change your mind/any circumstances under which you would take an eVTOL aircraft?

- ☐ Yes (Please describe these circumstance) ____
- ☐ No

61. You selected the eVTOL aircraft a few times. Are there any circumstances under which you would take an eVTOL aircraft more often?

- ☐ Yes (Please describe these circumstance) ____
- ☐ No

PART G: YOUR CURRENT AIR TRAVEL AND PERCEPTIONS ABOUT FLYING

The questions in this section relate to various aspects of your air travel.

62. Approximately how often do you make air trips (for any trip purpose)?

- ☐ One round trip per **week** or more
- ☐ 1-3 round trips per **month**
- ☐ 7-11 round trips per **year**
- ☐ 1-6 round trips per **year**
- ☐ Fewer than one round trip per **year**

63. How many air trips for work and personal travel have you made from the following airport in the last 12 months?

[Programming note: this question was customized to areas in the Atlanta, Boston, Dallas, San Francisco, and Los Angeles areas as determined from the home zip code in Question 3. All variants of this question are shown below].

	Number of Trips per **Year**	
	Work Trips	Personal Trips
Hartsfield-Jackson Atlanta International Airport (ATL)		

	Number of Trips per **Year**	
	Work Trips	Personal Trips
Boston Logan International Airport (BOS)		
Providence T.F. Green Airport (PVD)		

	Number of Trips per **Year**	
	Work Trips	Personal Trips
Dallas/Fort Worth International Airport (DFW)		
Dallas Love Field (DAL)		

	Number of Trips per **Year**	
	Work Trips	Personal Trips
San Francisco International Airport (SFO)		
Metropolitan Oakland International Airport (OAK)		
Norman Y Mineta San Jose International Airport (SJC)		
Sacramento International Airport (SMF)		

	Number of Trips per **Year**	
	Work Trips	Personal Trips
Los Angeles International Airport (LAX)		
Ontario International Airport (ONT)		
John Wayne Airport (SNA)		
San Bernardino International Airport (SBD)		
Burbank Bob Hope Airport (BUR)		
Long Beach Airport (LGB)		

64. For each of the following statements, please check the response that best expresses your opinion.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
I like travelling by airplane	☐	☐	☐	☐	☐
I would be afraid to fly in an aircraft that takes off and lands vertically within a city with tall buildings	☐	☐	☐	☐	☐
I would find it exciting to travel in one of these eVTOL aircraft	☐	☐	☐	☐	☐
I would be afraid to travel in a battery-operated aircraft	☐	☐	☐	☐	☐
Traveling by air makes me nervous	☐	☐	☐	☐	☐
I like that these aircraft can take off and land close to my home and work locations	☐	☐	☐	☐	☐
These aircraft would cause more problems than they would solve	☐	☐	☐	☐	☐
I like the idea of battery-powered aircraft for helping the environment	☐	☐	☐	☐	☐

[Programming note: The two questions highlighted above were moved to Part C after about 700 responses were completed as we were concerned after looking at the distribution of responses that respondents may be biased after seeing the eVTOL aircraft. We will test for this bias once all responses are collected]

PART H: YOUR PERSONALITY AND LIFESTYLE

The questions in this section relate to various aspects of your personality and lifestyle. There are no right or wrong answers**.**

65. For each of the following statements, please check the response that best expresses your opinion.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
My phone is so important to me, it's almost a part of my body	☐	☐	☐	☐	☐
At this stage in my life, having fun is more important to me than working hard	☐	☐	☐	☐	☐
I like the idea of living in a neighborhood where I can walk to shops	☐	☐	☐	☐	☐
I'm too busy to do many of the things I'd like to do	☐	☐	☐	☐	☐
I often introduce new trends to my friends or family	☐	☐	☐	☐	☐
I'm worried that technology invades my privacy too much	☐	☐	☐	☐	☐
I like to wait a while rather than being first to buy new products	☐	☐	☐	☐	☐
People are generally trustworthy	☐	☐	☐	☐	☐

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
I like the idea of living somewhere with large yards and lots of space between homes	☐	☐	☐	☐	☐
I am generally satisfied with my life	☐	☐	☐	☐	☐
To confirm you are really reading this, select "Agree"	☐	☐	☐	☐	☐

PART I: SOME INFORMATION ABOUT YOURSELF

Your responses in this section enable us to project results from this small sample to the population as a whole. By **household members**, we mean people who live together, and share at least some activities and some financial resources. Ordinary roommates would not usually be considered household members.

66. What is your gender?

- ☐ Male
- ☐ Female

67. What is the highest degree or level of school you have *COMPLETED?*

- ☐ No schooling completed
- ☐ Regular high school diploma
- ☐ GED or alternative credential
- ☐ Some college credit, but less than 1 year of college credit
- ☐ 1 or more years of college credit, no degree
- ☐ Associate's degree (for example: AA, AS)
- ☐ Bachelor's degree (for example: BA, BS)
- ☐ Master's degree (for example: MA, MS, MEng, MEd, MSW, MBA)

- ☐ Professional degree beyond bachelor's degree (for example: MD, DDS, DVM, LLB, JD)
- ☐ Doctoral degree (for example: PhD, EdD)

68. How many adults *(ages 18 and older)*, including yourself, live in your household?

[Question 67 is on ACS]

69. How many children *(under the age of 18)* live in your household?

[Question 68 is on ACS]

70. Which single category best describes your occupation?

- ☐ Management
- ☐ Business and Financial Operations
- ☐ Computer and Mathematical
- ☐ Architecture and Engineering
- ☐ Life, Physical, and Social Science
- ☐ Community and Social Services
- ☐ Legal Occupations
- ☐ Education, Training, and Library
- ☐ Arts, Design, Entertainment, Sports, and Media
- ☐ Healthcare
- ☐ Protective Service Occupations
- ☐ Food Preparation and Serving-Related
- ☐ Building and Grounds Cleaning and Maintenance
- ☐ Personal Care and Service
- ☐ Sales and Related
- ☐ Office and Administrative Support
- ☐ Farming, Fishing, and Forestry
- ☐ Construction and Extraction
- ☐ Installation, Maintenance, and Repair
- ☐ Production
- ☐ Transportation and Material-Moving
- ☐ Military-Specific

☐ Other (specify) _____

71. Before, we asked you to report your personal income**.** In this question, we ask you to report your **household** income. What was <u>your</u> total household income during the *PAST 12 MONTHS*? (This is the income your household earned before taxes and deductions).

☐ Under $10,000
☐ $10,000 - $19,999
☐ $20,000 - $29,999
☐ $30,000 - $39,999
☐ $40,000 - $49,999
☐ $50,000 - $74,999
☐ $75,000 - $99,999
☐ $100,000 - $149,999
☐ $150,000 - $199,999
☐ $200,000 - $249,999
☐ $250,000 - $299,999
☐ $300,000 - $349,999
☐ $350,000 - $399,999
☐ $400,000 - $449,999
☐ $450,000 - $499,999
☐ $500,000 or more

[Based on Question 70 from ACS]

Appendix 2: Levels Used in Survey

This appendix includes the levels we used for the 128 trade-off questions in the survey. Note that we used the same levels for each pair of trade-offs. That is, the factors and levels we used for the eVTOL vs. auto, eVTOL versus transit, and eVTOL versus rideshare are identical; we only changed the image shown, the labeling of the "other" travel time components, and which attributes were shown (based on which attributes were relevant to the non-eVTOL mode). The "other travel time component" is referred to as "time to/from eVTOL," "time to/from transit," and "wait time" for the eVTOL, transit, and rideshare modes, respectively. The last column was only used for the transit vs. eVTOL trade-off. The trade-off questions that correspond to Block 1 in Table A2.1 are presented in Figures A2.1 – A2.3, showing how the levels in the table translate to the trade-off questions shown to respondent.

Figure A2.1. Question 1 of Block 1 for Distance Range of 0-24 miles for eVTOL vs.Auto

Figure A2.2. Question 1 of Block 1 for Distance Range of 0-24 miles for eVTOL vs. Transit

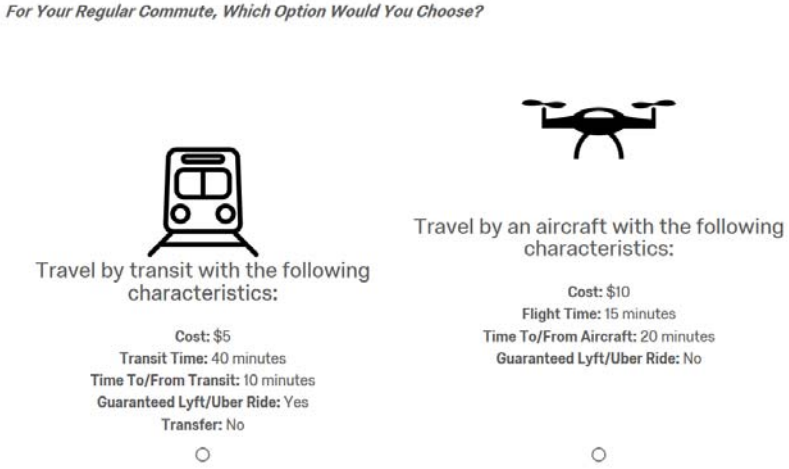

Figure A2.3. Question 1 of Block 1 for Distance Range of 0-24 miles for eVTOL vs. Rideshare

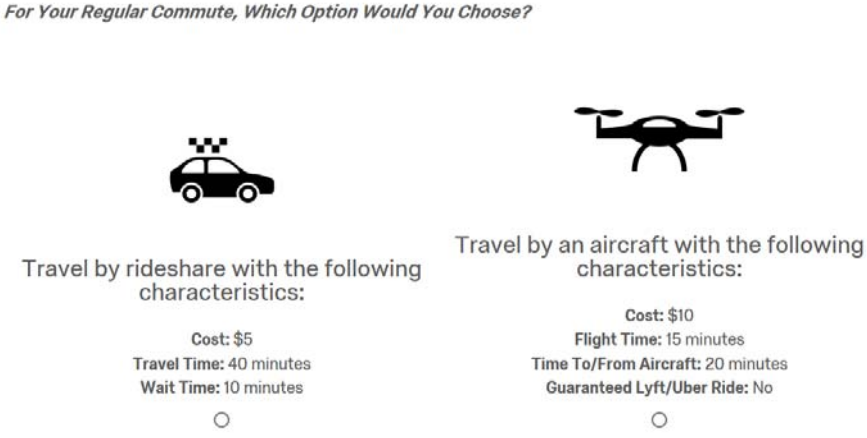

Table A2.1 Levels for Distances between 0-24 Miles

Block	Ques	Cost NAir	Cost Air	TT NAir	TT Air	Other TT NAir	Other TT Air	Ride G. NAir	Ride G. Air	Transfer Transit
1	**1**	5	10	40	15	10	20	Yes	No	No
	2	2.5	10	50	20	20	10	Yes	No	Yes
	3	5	5	40	25	20	10	Yes	No	Yes
	4	5	10	30	10	10	20	No	Yes	Yes
	5	2.5	5	50	10	10	20	Yes	No	No
	6	2.5	5	60	15	10	20	No	Yes	Yes
	7	2.5	10	60	25	20	10	No	Yes	No
	8	5	5	30	20	20	10	No	Yes	No
2	**1**	5	5	50	10	10	10	No	No	Yes
	2	2.5	5	40	25	20	20	No	No	No
	3	2.5	10	40	10	20	20	Yes	Yes	No
	4	5	5	60	15	10	10	Yes	Yes	No
	5	5	10	60	20	10	10	No	No	No
	6	2.5	5	30	20	20	20	Yes	Yes	Yes
	7	2.5	10	30	15	20	20	No	No	Yes
	8	5	5	50	25	10	10	Yes	Yes	Yes
3	**1**	2.5	5	40	20	10	10	Yes	Yes	Yes
	2	5	5	60	10	20	20	No	No	Yes
	3	2.5	5	30	25	10	10	No	No	No
	4	5	10	40	10	20	10	No	Yes	Yes
	5	5	5	50	15	20	20	Yes	Yes	No
	6	5	10	30	15	20	10	Yes	No	No
	7	2.5	10	50	25	10	20	No	Yes	No
	8	2.5	10	60	20	10	20	Yes	No	Yes
4	**1**	2.5	5	60	10	20	10	Yes	No	No
	2	5	10	60	25	20	20	Yes	Yes	Yes
	3	5	5	30	25	10	20	Yes	No	Yes
	4	2.5	5	50	15	20	10	No	Yes	Yes
	5	2.5	10	40	15	10	10	No	No	Yes
	6	2.5	10	30	10	10	10	Yes	Yes	No
	7	5	5	40	20	10	20	No	Yes	No
	8	5	10	50	20	20	20	No	No	No

Notes: NAir=Non-air (i.e., non-eVTOL) mode; Air=eVTOL; TT=travel time; Ride G. =ride guarantee

Table A2.2 Levels for Distances between 25-39 Miles

Block	Ques	Cost NAir	Cost Air	TT NAir	TT Air	Other TT NAir	Other TT Air	Ride G. NAir	Ride G. Air	Transfer Transit
1	**1**	4	20	45	15	10	20	Yes	No	No
	2	2.5	20	1:00	20	20	10	Yes	No	Yes
	3	5	10	45	25	20	10	Yes	No	Yes
	4	5	15	30	10	10	20	No	Yes	Yes
	5	3	10	1:00	10	10	20	Yes	No	No
	6	2.5	5	1:15	15	10	20	No	Yes	Yes
	7	3	15	1:15	25	20	10	No	Yes	No
	8	4	5	30	20	20	10	No	Yes	No
2	**1**	4	5	1:00	10	10	10	No	No	Yes
	2	2.5	5	45	25	20	20	No	No	No
	3	2.5	15	45	10	20	20	Yes	Yes	No
	4	5	10	1:15	15	10	10	Yes	Yes	No
	5	5	20	1:15	20	10	10	No	No	No
	6	3	10	30	20	20	20	Yes	Yes	Yes
	7	3	20	30	15	20	20	No	No	Yes
	8	4	15	1:00	25	10	10	Yes	Yes	Yes
3	**1**	3	5	45	20	10	10	Yes	Yes	Yes
	2	4	10	1:15	10	20	20	No	No	Yes
	3	2.5	10	30	25	10	10	No	No	No
	4	5	20	45	10	20	10	No	Yes	Yes
	5	5	5	1:00	15	20	20	Yes	Yes	No
	6	4	15	30	15	20	10	Yes	No	No
	7	3	20	1:00	25	10	20	No	Yes	No
	8	2.5	15	1:15	20	10	20	Yes	No	Yes
4	**1**	3	5	1:15	10	20	10	Yes	No	No
	2	4	20	1:15	25	20	20	Yes	Yes	Yes
	3	5	5	30	25	10	20	Yes	No	Yes
	4	2.5	10	1:00	15	20	10	No	Yes	Yes
	5	3	15	45	15	10	10	No	No	Yes
	6	2.5	20	30	10	10	10	Yes	Yes	No
	7	4	10	45	20	10	20	No	Yes	No
	8	5	15	1:00	20	20	20	No	No	No

Notes: NAir=Non-air (i.e., non-eVTOL) mode; Air=eVTOL; TT=travel time; Ride G. =ride guarantee

Table A2.3 Levels for Distances between 40-54 Miles

Block	Ques	Cost NAir	Cost Air	TT NAir	TT Air	Other TT NAir	Other TT Air	Ride G. NAir	Ride G. Air	Transfer Transit
1	**1**	8	40	1:15	25	10	20	Yes	No	No
	2	4	40	1:30	35	20	10	Yes	No	Yes
	3	10	20	1:15	45	20	10	Yes	No	Yes
	4	10	30	1:00	15	10	20	No	Yes	Yes
	5	6	20	1:30	15	10	20	Yes	No	No
	6	4	10	1:45	25	10	20	No	Yes	Yes
	7	6	30	1:45	45	20	10	No	Yes	No
	8	8	10	1:00	35	20	10	No	Yes	No
2	**1**	8	10	1:30	15	10	10	No	No	Yes
	2	4	10	1:15	45	20	20	No	No	No
	3	4	30	1:15	15	20	20	Yes	Yes	No
	4	10	20	1:45	25	10	10	Yes	Yes	No
	5	10	40	1:45	35	10	10	No	No	No
	6	6	20	1:00	35	20	20	Yes	Yes	Yes
	7	6	40	1:00	25	20	20	No	No	Yes
	8	8	30	1:30	45	10	10	Yes	Yes	Yes
3	**1**	6	10	1:15	35	10	10	Yes	Yes	Yes
	2	8	20	1:45	15	20	20	No	No	Yes
	3	4	20	1:00	45	10	10	No	No	No
	4	10	40	1:15	15	20	10	No	Yes	Yes
	5	10	10	1:30	25	20	20	Yes	Yes	No
	6	8	30	1:00	25	20	10	Yes	No	No
	7	6	40	1:30	45	10	20	No	Yes	No
	8	4	30	1:45	35	10	20	Yes	No	Yes
4	**1**	6	10	1:45	15	20	10	Yes	No	No
	2	8	40	1:45	45	20	20	Yes	Yes	Yes
	3	10	10	1:00	45	10	20	Yes	No	Yes
	4	4	20	1:30	25	20	10	No	Yes	Yes
	5	6	30	1:15	25	10	10	No	No	Yes
	6	4	40	1:00	15	10	10	Yes	Yes	No
	7	8	20	1:15	35	10	20	No	Yes	No
	8	10	30	1:30	35	20	20	No	No	No

Notes: NAir=Non-air (i.e., non-eVTOL) mode; Air=eVTOL; TT=travel time; Ride G. =ride guarantee

Table A2.4 Levels for Distances of 55 Miles or More

Block	Ques	Cost NAir	Cost Air	TT NAir	TT Air	Other TT NAir	Other TT Air	Ride G. NAir	Ride G. Air	Transfer Transit
1	1	15	45	1:30	30	10	20	Yes	No	No
	2	5	45	1:45	40	20	10	Yes	No	Yes
	3	20	25	1:30	50	20	10	Yes	No	Yes
	4	20	35	1:00	20	10	20	No	Yes	Yes
	5	10	25	1:45	20	10	20	Yes	No	No
	6	5	20	2:00	30	10	20	No	Yes	Yes
	7	10	35	2:00	50	20	10	No	Yes	No
	8	15	20	1:00	40	20	10	No	Yes	No
2	1	15	20	1:45	20	10	10	No	No	Yes
	2	5	20	1:30	50	20	20	No	No	No
	3	5	35	1:30	20	20	20	Yes	Yes	No
	4	20	25	2:00	30	10	10	Yes	Yes	No
	5	20	45	2:00	40	10	10	No	No	No
	6	10	25	1:00	40	20	20	Yes	Yes	Yes
	7	10	45	1:00	30	20	20	No	No	Yes
	8	15	35	1:45	50	10	10	Yes	Yes	Yes
3	1	10	20	1:30	40	10	10	Yes	Yes	Yes
	2	15	25	2:00	20	20	20	No	No	Yes
	3	5	25	1:00	50	10	10	No	No	No
	4	20	45	1:30	20	20	10	No	Yes	Yes
	5	20	20	1:45	30	20	20	Yes	Yes	No
	6	15	35	1:00	30	20	10	Yes	No	No
	7	10	45	1:45	50	10	20	No	Yes	No
	8	5	35	2:00	40	10	20	Yes	No	Yes
4	1	10	20	2:00	20	20	10	Yes	No	No
	2	15	45	2:00	50	20	20	Yes	Yes	Yes
	3	20	20	1:00	50	10	20	Yes	No	Yes
	4	5	25	1:45	30	20	10	No	Yes	Yes
	5	10	35	1:30	30	10	10	No	No	Yes
	6	5	45	1:00	20	10	10	Yes	Yes	No
	7	15	25	1:30	40	10	20	No	Yes	No
	8	20	35	1:45	40	20	20	No	No	No

Notes: NAir=Non-air (i.e., non-eVTOL) mode; Air=eVTOL; TT=travel time; Ride G. =ride guarantee