Safety Systems, Culture, and Passengers’ Willingness to Fly in Autonomous Air Taxis

Kenneth Alexander Ward

Follow this and additional works at: https://commons.erau.edu/edt

Part of the Aerospace Engineering Commons, and the Aviation Safety and Security Commons

Scholarly Commons Citation
https://commons.erau.edu/edt/543

This Dissertation - Open Access is brought to you for free and open access by Scholarly Commons. It has been accepted for inclusion in PhD Dissertations and Master's Theses by an authorized administrator of Scholarly Commons. For more information, please contact commons@erau.edu.
SAFETY SYSTEMS, CULTURE, AND PASSENGERS’ WILLINGNESS TO FLY IN AUTONOMOUS AIR TAXIS

By

Kenneth Alexander Ward

A Dissertation Submitted to the College of Aviation
in Partial Fulfillment of the Requirements for the Degree of
Doctor of Philosophy in Aviation

Embry-Riddle Aeronautical University
Daytona Beach, Florida
May 2020
SAFETY SYSTEMS, CULTURE, AND PASSENGERS’ WILLINGNESS TO FLY IN AUTONOMOUS AIR TAXIS

By

Kenneth Alexander Ward

This Dissertation was prepared under the direction of the candidate’s Dissertation Committee Chair, Dr. Scott R. Winter, and has been approved by the members of the dissertation committee. It was submitted to the College of Aviation and was accepted in partial fulfillment of the requirements for the Degree of Doctor of Philosophy in Aviation

Scott R. Winter, Ph.D.
Committee Chair

David S. Cross, Ph.D.
Committee Member

Steven Hampton, Ed.D.
Associate Dean, Research and the School of Graduate Studies, College of Aviation

John M. Robbins, Ph.D.
Committee Member

Alan J. Stolzer, Ph.D.
Dean, College of Aviation

Rian Mehta, Ph.D.
Committee Member (External)

Lon D. Moeller, J.D.
Senior Vice President for Academics and Provost

May 12, 2020
Date
ABSTRACT

Researcher: Kenneth Alexander Ward
Title: SAFETY SYSTEMS, CULTURE, AND PASSENGERS’ WILLINGNESS TO FLY IN AUTONOMOUS AIR TAXIS
Institution: Embry-Riddle Aeronautical University
Degree: Doctor of Philosophy in Aviation
Year: 2020

As city populations grow, the transportation industry plans to alleviate traffic congestion by introducing the urban air mobility (UAM) concept, in which small passenger and cargo aircraft augment metropolitan transportation networks. A key component of UAM is that of air taxis, which are on-demand air services for individuals and small groups. In addition, UAM companies are designing the aircraft to operate fully autonomously: The intent is for the vehicles to arrive and transport people from point to point without input from human pilots.

In studies of passengers’ perceptions, researchers found that safety was among the top passenger concerns. The international market complicates the matter, as research indicates people from different nations differ in their willingness to fly in autonomous aircraft. Past research hypothesized that individuals’ cultural orientation, specifically their degree of individualism or communalism, was a factor of the differences in willingness to fly.

A quantitative survey experiment in two studies was conducted to investigate willingness to fly in autonomous air taxis among people from the United States and India. The first study used a 2 x 2 x 2 factorial analysis to test the effects of nationality, automatic airframe parachute availability, and remote pilot system availability on
willingness to fly. People from India were more willing to fly than people from the United States, and people in general were more willing to fly in an aircraft equipped with an automatic airframe parachute. The second study replicated the effects of the first and tested whether two aspects of cultural orientation mediated the relationship between safety system availability and willingness to fly. Cultural orientation was not found to significantly mediate the relationship among people from the United States or India.
DEDICATION

For my wife, Valerie, who encouraged me to take the first steps down this path and reassured me along the way. For my daughters, Samantha and Charlotte, your love meant the world to me. And for my father, who inspired my lifelong passion in aviation and space.
ACKNOWLEDGEMENTS

I first would like to thank my dissertation committee chair, Dr. Scott Winter, for all his mentorship and guidance throughout my time in the Embry Riddle Ph.D. in Aviation program. In our first seminars, he broke down barriers to understanding and made us believe that the end was achievable. Over the next few years, he provided more guidance than I could have expected, demonstrating a commitment to his students and furthering research in the field. I could not have asked for more in a dissertation committee chair, and for that, I am immensely grateful.

I also send my gratitude to the dissertation committee for taking me on. Dr. David Cross, Dr. John Robbins, and Dr. Rian Mehta, your words of encouragement and valuable insight during the editing process have made this document all the better. I have learned from each of you, and those experiences will shape all my future work. I also thank Dr. Stephen Rice, who worked with us early in the process; his insights as we applied the willingness to fly scale in new settings were invaluable.

I extend my gratitude to Dr. Steven Hampton as well. It was in his class that I first began to research urban air mobility in earnest; this dissertation was first conceived under his tutelage. Dr. Dothang Truong also heavily influenced this work. His class on modeling and simulation proved a useful analysis technique that popped up more than I had expected. It is the mark of a masterful professor to instill knowledge so deep it felt like second nature using it; for that, I thank you.

Finally, I would like to thank the faculty and administration of the Embry-Riddle Ph.D. in Aviation program. I am grateful that you extended me one of the precious few admissions available each year. It was a wonderful opportunity.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Signature Page</th>
<th>..........................................................</th>
<th>iii</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abstract</td>
<td>..................................................................................</td>
<td>iv</td>
</tr>
<tr>
<td>Dedication</td>
<td>..................................................................................</td>
<td>vi</td>
</tr>
<tr>
<td>Acknowledgements</td>
<td>..............................................................................</td>
<td>vii</td>
</tr>
<tr>
<td>List of Tables</td>
<td>..................................................................................</td>
<td>xiii</td>
</tr>
<tr>
<td>List of Figures</td>
<td>..................................................................................</td>
<td>xv</td>
</tr>
<tr>
<td>Chapter I</td>
<td>Introduction ........................................................................</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Background .................................................................</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Statement of the Problem ................................................</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Purpose Statement .......................................................</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Significance of the Study .............................................</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Research Questions and Hypotheses ................................</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Study 1 ..........................................................................</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Study 2 ..........................................................................</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Delimitations ....................................................................</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>Limitations and Assumptions .........................................</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Summary ...........................................................................</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>Definitions of Terms ....................................................</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>List of Acronyms ..........................................................</td>
<td>17</td>
</tr>
</tbody>
</table>
Chapter II  Review of the Relevant Literature ......................................................... 19

Sources .................................................................................................................... 20

Gaps in the Literature ............................................................................................. 20

Theoretical Foundation ......................................................................................... 21

Cultural Theory of Risk ......................................................................................... 22

Cultural Cognition Theory ................................................................................. 29

Extending Beyond Risk Perception ............................................................... 32

Cultural Orientation ............................................................................................. 38

Nationality and Culture ....................................................................................... 45

Autonomous Vehicles ......................................................................................... 48

Planes, Trains, and Automobiles .................................................................... 48

Urban Air Mobility ............................................................................................... 55

Variables ............................................................................................................ 59

Safety System Availability .............................................................................. 59

Automatic Airframe Parachute Availability ............................................... 61

Remote Pilot System Availability ................................................................ 63

Nationality ......................................................................................................... 65

Cultural Orientation ......................................................................................... 66

Passenger Willingness to Fly ........................................................................... 67

Use of Likert Scales ......................................................................................... 69

Hypotheses and Support ............................................................................... 71

Summary ............................................................................................................ 74
Chapter III  Methodology.................................................................76

Research Method Selection.......................................................76

Research Questions and Hypotheses.........................................77

Population/Sample........................................................................82

Population and Sampling Frame ..............................................82

Sample Size ..............................................................................83

Sampling Strategy .....................................................................85

Data Collection Process............................................................88

Experimental Scenario..............................................................88

Design and Procedures ..............................................................89

Sources of the Data....................................................................97

Ethical Consideration ...............................................................97

Participant Eligibility Criteria ..................................................98

Participant Protections .............................................................98

Measurement Instrument..........................................................99

Independent Variables..............................................................99

Mediating Variables ................................................................100

Dependent Variable ................................................................101

Factor Weights ..........................................................................102

Demographic Variables ............................................................104

Data Analysis Approach ............................................................108

Reliability Assessment Method ...............................................108

Validity Assessment Method ....................................................108
Chapter V  
Discussion, Conclusions, and Recommendations ................................ 174

Discussion ................................................................................. 174

Nationality ............................................................................. 174

Automatic Airframe Parachute Availability ......................... 175

Remote Pilot System Availability ........................................... 176

Nationality and Two-Way Interactions ................................. 176

Cultural Orientation as a Mediator ......................................... 177

Conclusions ............................................................................ 179

Theoretical Contributions ......................................................... 180

Practical Contributions ............................................................. 181

Limitations of the Findings ....................................................... 183

Recommendations ..................................................................... 185

Recommendations for the UAM Industry ......................... 185

Recommendations for Future Research .............................. 186

Summary ................................................................................. 187

References .................................................................................. 188

Appendices ............................................................................... 205

A  Permission to Conduct Research ........................................ 205

B  Data Collection Device ....................................................... 211
# LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Scenario Statements and Purpose</td>
<td>89</td>
</tr>
<tr>
<td>2</td>
<td>Cultural Worldview Scale Component Coefficients</td>
<td>103</td>
</tr>
<tr>
<td>3</td>
<td>Willingness to Fly Component Coefficients</td>
<td>104</td>
</tr>
<tr>
<td>4</td>
<td>Possible Squared Discrepancy Scores for Same Response to All Questions</td>
<td>112</td>
</tr>
<tr>
<td>5</td>
<td>Cultural Worldview Scale Rotated Component Matrix</td>
<td>113</td>
</tr>
<tr>
<td>6</td>
<td>Reliability Assessment of Cultural Worldview Scale</td>
<td>114</td>
</tr>
<tr>
<td>7</td>
<td>Willingness to Fly Component Matrix</td>
<td>115</td>
</tr>
<tr>
<td>8</td>
<td>Study 1 Demographics, U.S. Participants</td>
<td>130</td>
</tr>
<tr>
<td>9</td>
<td>Study 1 Demographics, Indian Participants</td>
<td>131</td>
</tr>
<tr>
<td>10</td>
<td>Study 1 Household Income Quintiles</td>
<td>131</td>
</tr>
<tr>
<td>11</td>
<td>Study 1 Descriptive Statistics for Willingness to Fly</td>
<td>132</td>
</tr>
<tr>
<td>12</td>
<td>Actual and Simulated Willingness to Fly Data</td>
<td>137</td>
</tr>
<tr>
<td>13</td>
<td>ANOVA Results from Actual and Simulated Data</td>
<td>138</td>
</tr>
<tr>
<td>14</td>
<td>Tests of Between-Participants Effects</td>
<td>140</td>
</tr>
<tr>
<td>15</td>
<td>Study 2 Demographics, U.S. Participants</td>
<td>145</td>
</tr>
<tr>
<td>16</td>
<td>Study 2 Demographics, Indian Participants</td>
<td>146</td>
</tr>
<tr>
<td>17</td>
<td>Study 2 Household Income Quintiles</td>
<td>146</td>
</tr>
<tr>
<td>18</td>
<td>Study 2 Descriptive Statistics for Willingness to Fly</td>
<td>147</td>
</tr>
<tr>
<td>19</td>
<td>Study 2 Descriptive Statistics for Communitarianism-Individualism</td>
<td>148</td>
</tr>
<tr>
<td>20</td>
<td>Study 2 Descriptive Statistics for Egalitarianism-Hierarchism</td>
<td>148</td>
</tr>
<tr>
<td>21</td>
<td>Actual and Simulated Willingness to Fly Data</td>
<td>160</td>
</tr>
<tr>
<td>Page</td>
<td>Section</td>
<td>Page</td>
</tr>
<tr>
<td>------</td>
<td>----------------------------------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>22</td>
<td>ANOVA Results from Actual and Simulated Data</td>
<td>160</td>
</tr>
<tr>
<td>23</td>
<td>Tests of Between-Participants Effects</td>
<td>161</td>
</tr>
<tr>
<td>24</td>
<td>Mediation Analysis of Communitarianism-Individualism, All Participants</td>
<td>164</td>
</tr>
<tr>
<td>25</td>
<td>Mediation Analysis of Communitarianism-Individualism, U.S. Participants</td>
<td>165</td>
</tr>
<tr>
<td>26</td>
<td>Mediation Analysis of Communitarianism-Individualism, Indians</td>
<td>166</td>
</tr>
<tr>
<td>27</td>
<td>Mediation Analysis of Egalitarianism-Hierarchism, All Participants</td>
<td>167</td>
</tr>
<tr>
<td>28</td>
<td>Mediation Analysis of Egalitarianism-Hierarchism, U.S. Participants</td>
<td>168</td>
</tr>
<tr>
<td>29</td>
<td>Mediation Analysis of Egalitarianism-Hierarchism, Indians</td>
<td>169</td>
</tr>
<tr>
<td>Figure</td>
<td>Title</td>
<td>Page</td>
</tr>
<tr>
<td>--------</td>
<td>----------------------------------------------------------------------</td>
<td>--------</td>
</tr>
<tr>
<td>1</td>
<td>Cultural Theory Grid-Group Model and Cultural Orientations</td>
<td>24</td>
</tr>
<tr>
<td>2</td>
<td>Cultural Cognition Model of Cultural Orientation</td>
<td>30</td>
</tr>
<tr>
<td>3</td>
<td>Code to Randomly Assign Participants to Experimental Groups</td>
<td>91</td>
</tr>
<tr>
<td>4</td>
<td>Communitarianism-Individualism Mediator, All Participants, Hypothesis 9a</td>
<td>122</td>
</tr>
<tr>
<td>5</td>
<td>Communitarianism-Individualism Mediator, U.S. participants, Hypothesis 9b</td>
<td>122</td>
</tr>
<tr>
<td>6</td>
<td>Communitarianism-Individualism Mediator, Indians, Hypothesis 9c</td>
<td>122</td>
</tr>
<tr>
<td>7</td>
<td>Egalitarianism-Hierarchism Mediator, Hypothesis 10a</td>
<td>123</td>
</tr>
<tr>
<td>8</td>
<td>Egalitarianism-Hierarchism Mediator, U.S. participants, Hypothesis 10b</td>
<td>123</td>
</tr>
<tr>
<td>9</td>
<td>Egalitarianism-Hierarchism Mediator, Indians, Hypothesis 10c</td>
<td>124</td>
</tr>
<tr>
<td>10</td>
<td>Distribution of Willingness to Fly by Condition</td>
<td>134</td>
</tr>
<tr>
<td>11</td>
<td>Histograms of Study 1 Conditions</td>
<td>135</td>
</tr>
<tr>
<td>12</td>
<td>Main Effects and Standard Error</td>
<td>140</td>
</tr>
<tr>
<td>13</td>
<td>Three-Way Between-Participants Means</td>
<td>141</td>
</tr>
<tr>
<td>14</td>
<td>Distribution of Willingness to Fly by Condition</td>
<td>152</td>
</tr>
<tr>
<td>15</td>
<td>Distribution of Communitarianism-Individualism by Condition</td>
<td>153</td>
</tr>
<tr>
<td>16</td>
<td>Distribution of Egalitarianism-Hierarchism by Condition</td>
<td>154</td>
</tr>
<tr>
<td>17</td>
<td>Histograms of Study 2 Willingness to Fly</td>
<td>155</td>
</tr>
<tr>
<td>18</td>
<td>Histograms of Study 2 Communitarianism-Individualism</td>
<td>155</td>
</tr>
<tr>
<td>19</td>
<td>Histograms of Study 2 Egalitarianism-Hierarchism</td>
<td>155</td>
</tr>
<tr>
<td>20</td>
<td>Residuals, Communitarianism-Individualism as Dependent Variable</td>
<td>157</td>
</tr>
<tr>
<td>21</td>
<td>Residuals, Communitarianism-Individualism as Independent Variable</td>
<td>158</td>
</tr>
</tbody>
</table>
22  Residuals, Egalitarianism-Hierarchism as Dependent Variable ....................... 158
23  Residuals, Egalitarianism-Hierarchism as Independent Variable ..................... 159
24  Study 2 Main Effects and Two-Way Interaction ............................................. 162
CHAPTER I

INTRODUCTION

This dissertation describes a quantitative, between-participants survey experiment, using a multi-study format, designed to assess the effects of nationality and safety system on passengers’ willingness to fly in autonomous air taxis and whether passengers’ cultural orientation mediates the relationship. The dissertation consists of five chapters that, respectively, introduce the study, discuss the relevant literature, describe the methodology, present the results, and discuss the findings. The permission to conduct research and the survey instruments can be found in the appendices.

The first chapter describes the background and rationale for the dissertation and the significance of the study. It includes a listing of the research questions and hypotheses that establish the framework for analysis and describes the delimitations, limitations, and assumptions associated with the research design. Finally, the first chapter provides a list of definitions and acronyms for reference.

Background

As city populations grow and ground transportation networks face physical constraints to expansion, the transportation industry is seeking to alleviate traffic congestion by introducing aircraft into metropolitan transportation networks, a concept termed urban air mobility (UAM) (Holden & Goel, 2016; Reiche, McGillen, Siegel, & Brody, 2019). While it is difficult to increase the capacity of roads, highways, and railways servicing the region, the point-to-point nature of air travel means UAM aircraft may be able to integrate into cities with a relatively small footprint, such as by using rooftops and parking garages (Fu, Rothfeld, & Antoniou, 2019; Holden & Goel, 2016;
Lineberger, Hussain, Mehra, & Pankratz, 2018). Passenger UAM concepts also mirror other public transportation options such as with air metros—regularly scheduled public transportation with set stops similar to busses—and air taxis—on-demand air services for individuals and small groups (National Aeronautics and Space Administration [NASA], Crown Consulting, McKinsey and Company, Ascension Global, & Georgia Tech Aerospace Systems Design Lab, 2018).

Companies building UAM aircraft and prototypes are exploring new technologies to adapt aircraft to the urban environment, such as by using all-electric propulsion (eliminating fuel storage requirements), designing aircraft to take off and land vertically, and designing the aircraft to be quieter (Holden & Goel, 2016; Holmes et al., 2017; Lineberger et al., 2018). In particular, the aviation and automotive industries are pursuing technology and systems to reduce the need for human control, and support fully autonomous operations (Bilimoria, Johnson, & Schutte, 2014; Lim, Bassien-Capsa, Ramasamy, Liu, & Sabatini, 2017; Talebian & Mishra, 2018). UAM aircraft are also being designed to be fully autonomous (Fu et al., 2019; Lineberger et al., 2018).

The general problem with fully autonomous aircraft is that people are less willing to use them than piloted aircraft (Eker, Ahmed, Fountas, & Anastasopoulos, 2019; Mehta, Rice, Winter, & Eudy, 2017). UAM companies’ solvency requires steady ridership and understanding of consumer preferences; passengers are not likely to fly in autonomous air taxis if they do not perceive them as safe (Fu et al., 2019; Holmes et al., 2017; König & Neumayr, 2017). The international market complicates this matter, however, as research indicates people from different nations differ in their willingness to
fly in autonomous aircraft (Mehta et al., 2017; Ragbir, Baugh, Rice, & Winter, 2018; Winter, Rice, et al., 2015).

In other studies of passengers’ perceptions of autonomous vehicles, researchers found that concerns about safety and system failure were the most significant factors contributing to their willingness to fly (Daziano, Sarrias, & Leard, 2017; Hulse, Xie, & Galea, 2018). In particular, potential passengers of autonomous aircraft appear to prefer aircraft if safety systems such as airframe parachutes and remote pilot systems are available (Lee, Kim, & Sim, 2019; Ward, Winter, & Rice, 2019). Like willingness to fly in general, the effects of safety system availability on willingness to fly varied with nationality (Ward et al., 2019).

The body of knowledge does not provide a consistent reason for the difference between people of different nationalities because the concept of nationality includes a multitude of factors, such as national history, attitudes toward local public transportation systems, and daily exposure to risk (Cha, 2000; Olofsson & Öhman, 2015). Some studies have posited that the national cultural orientation, specifically the degree of individualism and collectivism, may be an underlying reason for the difference in willingness to fly between nationalities (Rice et al., 2014; Winter, Rice, et al., 2015). Societal norms of individualism, collectivism, and relationships with power affect individuals’ risk perception are partially explained by both the cultural theory of risk and cultural cognition theory (Douglas & Wildavsky, 1982; Kahan, 2012).

**Statement of the Problem**

The specific problem addressed in the present research is that there are unexplained differences in willingness to fly and perceptions of safety systems between
people of different nationalities. Cultural orientation is suspected to be a factor, but it has not been measured directly in studies of autonomous aircraft. Researchers, policymakers, and UAM operators need information about potential UAM passengers’ attitudes as they develop UAM systems; it becomes even more important to understand the factors underlying national differences as systems are developed throughout the world.

**Purpose Statement**

The purpose of this research is to investigate whether nationality and safety system availability in autonomous air taxis affect passengers’ willingness to fly and whether their cultural orientation mediates the relationship. Two survey experiments were conducted to serve this purpose by sampling more than 2,500 potential passengers and using a quantitative methodology and factorial design. The first study is designed to determine if nationality, automatic airframe parachute availability, and remote pilot system availability affect passenger willingness to fly. Study 2 investigates how passengers’ cultural orientations mediate the relationship between safety system availability and willingness to fly.

**Significance of the Study**

UAM system operators need information about their potential customers’ preferences and willingness to fly and vehicle use rates, as steady ridership is critical to sustained business and future expansion of the industry (Fu et al., 2019; Shaheen, Cohen, & Farrar, 2018; Tennant, Stares, & Howard, 2019). Developers need information about societal barriers and passenger willingness in order to improve system access and efficiency (Shaheen et al., 2018). Beyond the individual businesses and operators, research into consumer attitudes toward UAM can yield information about the viability
and size of the market itself (Reiche et al., 2019). As customer preferences influence operations rate and modes of operations—such as parachute landings during an emergency—policymakers need the information to develop regulations integrating pilotless aircraft into urban areas and national airspace (Clothier, Williams, & Fulton, 2015).

The present study is designed to provide insight into passenger attitudes that autonomous aircraft manufacturers and system operators may find valuable. First, the present study seeks to understand how the availability of different aircraft safety systems affects passengers’ willingness to fly. With such results, UAM companies can weight decision criteria in aircraft purchase decisions to aircraft with airframe parachutes or remote pilot systems according to passenger preferences in their operating areas. Second, if culture mediates the relationship between system availability and willingness to fly, operators can adjust advertising strategies to appeal to the predominant cultural orientation in the local market and emphasize the most desirable vehicle qualities.

The study also adds to the broader research in willingness to use autonomous vehicles. Attitudes toward autonomous vehicles continue to change over time and generally will improve the more familiar people become with the technology. As such, the present study evaluates passenger perceptions early in the UAM industry’s development, allowing researchers to track trends over time.

The present research also is the first, to the authors’ knowledge, that directly assesses cultural orientation and nationality along with willingness to fly in autonomous vehicles. Regardless of whether culture is related to willingness to fly, the present study begins the long process of isolating component factors of nationality and building a better
understanding of why people from different nations differ in their willingness to fly in autonomous aircraft.

**Research Questions and Hypotheses**

The research questions and hypotheses are organized to support a two-study design. The first study is intended to determine whether a passenger’s nationality, automatic airframe parachute availability, remote pilot system availability, or a combination thereof affects passengers’ willingness to fly in autonomous air taxis. The second study replicates the first but seeks to understand how a potential passenger’s culture mediates the relationship between safety system availability and willingness to fly.

**Study 1.** Research questions and hypotheses associated with Study 1 investigate nationality, automatic airframe parachute availability, and remote pilot system availability and the difference in willingness to fly of people from the United States and India.

RQ1: What is the effect of participant nationality on willingness to fly in autonomous air taxis?

\[ H_{A1}: \text{There is a significant difference in willingness to fly in autonomous air taxis as a function of participant nationality.} \]

\[ H_{01}: \text{There is no significant difference in willingness to fly in autonomous air taxis as a function of participant nationality.} \]

RQ2: What is the effect of automatic airframe parachute availability on willingness to fly in autonomous air taxis?
HA2: There is a significant difference in willingness to fly in autonomous air taxis as a function of automatic airframe parachute availability.

H02: There is no significant difference in willingness to fly in autonomous air taxis as a function of automatic airframe parachute availability.

RQ3: What is the effect of remote pilot system availability on willingness to fly in autonomous air taxis?

HA3: There is a significant difference in willingness to fly in autonomous air taxis as a function of remote pilot system availability.

H03: There is no significant difference in willingness to fly in autonomous air taxis as a function of remote pilot system availability.

RQ4: What is the effect of any two-way interaction between nationality, automatic airframe parachute availability, and remote pilot system availability?

HA4a: There is a two-way interaction between nationality and automatic airframe parachute availability.

H04a: There is no two-way interaction between nationality and automatic airframe parachute availability.

HA4b: There is a two-way interaction between nationality and remote pilot system availability.

H04b: There is no two-way interaction between nationality and remote pilot system availability.

HA4c: There is a two-way interaction between automatic airframe parachute availability and remote pilot system availability.
H04c: There is no two-way interaction between automatic airframe parachute availability and remote pilot system availability.

RQ5: What is the effect of a three-way interaction between participant nationality, automatic airframe parachute availability, and remote pilot system availability on willingness to fly in autonomous air taxis?

H_A5: There is a three-way interaction between nationality, automatic airframe parachute availability, and remote pilot system availability.

H_05: There is no three-way interaction between nationality, automatic airframe parachute availability, and remote pilot system availability.

**Study 2.** Study 2 proceeds with testing the favored condition (automatic airframe parachute availability, remote pilot system availability, or both) from Study 1 that results in the largest change in willingness to fly. As that cannot be determined before the study is completed, the term “safety system” is used as a stand-in throughout Study 2. Research questions 6 through 8 replicate Study 1 and are followed by the mediation analysis in questions 9 and 10.

RQ6: What is the effect of participant nationality on willingness to fly in autonomous air taxis?

H_A6: There is a significant difference in willingness to fly in autonomous air taxis as a function of participant nationality.

H_06: There is no significant difference in willingness to fly in autonomous air taxis as a function of participant nationality.

RQ7: What is the effect of safety system availability on willingness to fly in autonomous air taxis?
H_{A7}: There is a significant difference in willingness to fly in autonomous air taxis as a function of aircraft safety system availability.

H_{07}: There is no significant difference in willingness to fly in autonomous air taxis as a function of aircraft safety system availability.

RQ8: What is the effect of a two-way interaction between nationality and safety system availability?

H_{A8}: There is a two-way interaction between nationality and aircraft safety system availability.

H_{08}: There is no two-way interaction between nationality and aircraft safety system availability.

RQ9: How does a person’s level of communitarianism-individualism mediate the relationship between safety system and willingness to fly?

H_{A9a}: Overall, communitarianism-individualism significantly mediates the relationship between aircraft safety system availability and willingness to fly in autonomous air taxis.

H_{09a}: Overall, communitarianism-individualism does not significantly mediate the relationship between aircraft safety system availability and willingness to fly in autonomous air taxis.

H_{A9b}: Among potential U.S. passengers, communitarianism-individualism significantly mediates the relationship between aircraft safety system availability and willingness to fly in autonomous air taxis.
$H_{09b}$: Among potential U.S. passengers, communitarianism-individualism does not significantly mediate the relationship between aircraft safety system availability and willingness to fly in autonomous air taxis.

$H_{A9c}$: Among potential Indian passengers, communitarianism-individualism significantly mediates the relationship between aircraft safety system availability and willingness to fly in autonomous air taxis.

$H_{09c}$: Among potential Indian passengers, communitarianism-individualism does not significantly mediate the relationship between aircraft safety system availability and willingness to fly in autonomous air taxis.

RQ10: How does a person’s level of egalitarianism-hierarchism mediate the relationship between safety system availability and willingness to fly?

$H_{A10a}$: Overall, egalitarianism-hierarchism significantly mediates the relationship between aircraft safety system availability and willingness to fly in autonomous air taxis.

$H_{010a}$: Overall, egalitarianism-hierarchism does not significantly mediate the relationship between aircraft safety system availability and willingness to fly in autonomous air taxis.

$H_{A10b}$: Among potential U.S. passengers, egalitarianism-hierarchism significantly mediates the relationship between aircraft safety system availability and willingness to fly in autonomous air taxis.

$H_{010b}$: Among potential U.S. passengers, egalitarianism-hierarchism does not significantly mediate the relationship between aircraft safety system availability and willingness to fly in autonomous air taxis.
HA10c: Among potential Indian passengers, egalitarianism-hierarchism significantly mediates the relationship between aircraft safety system availability and willingness to fly in autonomous air taxis.

H010c: Among potential Indian passengers, egalitarianism-hierarchism does not significantly mediate the relationship between aircraft safety system availability and willingness to fly in autonomous air taxis.

**Delimitations**

This study was delimited to English-speaking residents of the United States and India with internet access and an Amazon Mechanical Turk® (MTurk) account. MTurk® is a crowdsourcing tool, an online platform in which millions of people are available to complete tasks, such as completing research questionnaires, for compensation (Rice, Winter, Doherty, & Milner, 2017). While physical access may ensure more of the population is accessed locally, it is impossible to reach the breadth of the U.S. and Indian populations without electronic means and would excessively limit the study. MTurk® provides an opportunity to access a broad sampling of the U.S. and Indian populations and can still provide high-quality data that are not systematically different from lab-based data (Buhrmester, Kwang, & Gosling, 2011; Germine et al., 2012; Rice et al., 2017).

The present research was delimited to the United States and India for several reasons. First, the willingness to fly scale has been used previously in multinational studies sampling from the United States and India (Mehta et al., 2017; Rice et al., 2014). Using the same nations allows the present research to compare standard effects between studies, thereby comparing effects among multiple samples of the population and improving the generalizability of the present research (Mehta et al., 2019). Second, past
studies suggested that differences in cultural orientation may explain differences in willingness to fly, forming the foundation for the present research (Rice et al., 2014; Winter, Rice, et al., 2015). Selecting these two nations increased the potential for more variety in cultural orientations among study participants because the United States and India have tendencies toward different cultural orientations. Third, at the time of this writing, the United States and India were under consideration to be among the first nations to introduce urban air mobility (Uber Technologies, 2019). Any insight into passenger preferences builds upon the body of academic knowledge and provides valuable information about consumer preferences to aircraft engineers, system operators, and governments. Fourth, India has a large English-speaking population (Parshad, Bhowmick, Chand, Kumari, & Sinha, 2016), which presented the opportunity to study a different population from the United States with the same survey instrument and avoid problems associated with translating a questionnaire.

The present study was further delimited to a single point in time at which the questionnaire is distributed. At the time the questionnaire was distributed, no autonomous air taxi services were available to the population, keeping the scenario strictly hypothetical. Considering Vance and Malik (2015) found that a strong record of brand reliability was important to passenger willingness to fly, any findings here may not be generalizable in the long term as future autonomous air taxi systems build performance records and public perception changes.

Limitations and Assumptions

The present research was limited by the convenience sampling strategy using Amazon MTurk®, which may introduce selection bias (Larsen, 2007). The participants
decided whether to participate in the study based upon the title of the questionnaire available, the compensation for participation, the expected time to complete the questionnaire, and other internal motivations. However, online sampling granted access to a greater number of participants in a shorter period than would be possible with in-person or telephonic sampling because people from anywhere within the sampled nations could simultaneously access and complete the questionnaire.

We desired the broader selection and accepted the tradeoff of potential selection bias. The selection bias was mitigated by not publishing any details of the study (other than that it was a short questionnaire) such as title or topic until people chose to participate. Bias therefore was toward people who choose to participate in research surveys in general and not toward UAM or autonomous vehicles.

The sampling strategy limited the generalizability of the study to a subsection of the intended population of the adult general public of the United States and India. The time and cost of random sampling can be infeasible for researchers (Mehta et al., 2019). A convenience sample using MTurk® increases access to a broader subset of the population than would be possible in a laboratory setting, although MTurk® users are not representative of the overall population.

MTurk® workers in both the United States and India have more education than the overall population, and workers from the United States tend to be younger on average; the demographic composition of MTurk® workers more closely approximates that of Internet users than the nations as a whole (Chandler & Shapiro, 2016). MTurk® workers also tend to have lower personal income as a result of unemployment or underemployment, yet counterintuitively, whole-household income approximates the
national average (Chandler & Shapiro, 2016). MTurk® users are more likely to be from urban areas than rural areas (Huff & Tingley, 2015).

While MTurk® users differ from the general population, the demographic differences are useful in the present research when one examines the demographics of extant rideshare companies. The rideshare Uber® is a useful stand-in for a UAM company because it follows a similar usage profile: A user requests a ride within a local area using an Internet-based application, and the ride is accomplished in a vehicle not owned or operated by the passenger. In addition, Uber® is currently developing UAM plans, so it is a worthwhile comparison. As with MTurk® users, Uber’s® U.S. riders are younger than the general population, with 65% of riders younger than 35 (Blair, 2019). Also like MTurk® users, very few Uber® riders are from rural settings (Blair, 2019; Jiang, 2019). However, Uber® riders do come from all income ranges and are nearly evenly split between genders, so the comparison is not perfect (Blair, 2019; Jiang, 2019).

When considering the broader body of work, generalizability improves. The results should be treated as a single sampling among the body of research, taking into account effect sizes found in other research before inferring effects within the broader population (Mehta et al., 2019). Every study is inherently unique in terms of quality, variables, and error, but when analyzed together, effect sizes can be compared to gain insight into the true effect among the population and improve generalizability (Mehta et al., 2019). In this regard, the present study was generalizable to MTurk® users in the United States and India because it replicated results of studies that used similar MTurk® samples and the same willingness to fly scale (Mehta et al., 2017; Ragbir et al., 2018; Rice et al., 2014; Ward et al., 2019).
While the researchers acknowledge this limitation and the potential bias, it is somewhat mitigated by research indicating that data obtained through MTurk® are useful. MTurk® participants are more diverse than would be available through random sampling in a university setting or with standard internet samples (Buhrmester et al., 2011). MTurk® data quality does not decline with inadequate compensation, although data collection speed decreases with low compensation (Litman, Robinson, & Rosenzweig, 2015). In addition, surveys conducted using the MTurk® platform achieve similar psychometric quality compared to laboratory samples (Germine et al., 2012; Mason & Suri, 2012).

As the survey instrument requests participants to self-assess their attitudes, we assume the responses are truthful. The survey instruments have no obvious screening questions, and misrepresentation on MTurk® decreases if there is no such incentive to misrepresent oneself (Chandler & Shapiro, 2016; MacInnis, Boss, & Bourdage, 2020; Wessling, Huber, & Netzer, 2017). Half of the component questions in each cultural orientation factor were reverse coded as well, functioning as a check on participant truthfulness (Kahan, Jenkins-Smith, & Braman, 2011; Litman et al., 2015).

The present study was limited by the cross-sectional approach because significant events in recent news involving urban air mobility, autonomous vehicles, or aircraft may affect participants’ perceptions (Leighton, 2012). Individuals’ familiarity with UAM may also affect perceptions: In November 2018, less than one-third of people surveyed in each of five major U.S. cities reported that they were familiar with the concept of urban air mobility (NASA et al., 2018).
There was no pre-test or post-test, and questionnaires for the two-component studies of the present research were distributed in less than one week, somewhat mitigating differential history effects between participants of the two studies. Within each study, participants were randomly assigned to experimental conditions to distribute such effects equally among all groups.

**Summary**

Chapter 1 described the background to the present study, followed by the problem statement and purpose statement, in order to provide an understanding of the logical progression from question to design that will be expanded upon in the literature review. The research questions, hypotheses, delimitations, limitations, and assumptions introduce the specific questions and structure of the present study that form the basis of the methodology and analysis. Finally, definitions and acronyms are provided here as references for the reader.

**Definitions of Terms**

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airframe Parachute</td>
<td>Parachutes attached to the body of an aircraft designed to be deployed during an emergency in which landing the aircraft is impossible or inadvisable (Winter, Fanjoy, Lu, Carney, &amp; Greenan, 2014).</td>
</tr>
<tr>
<td>Air Taxi</td>
<td>“A near-ubiquitous (or door-to-door) ridesharing operation that allows consumers to call vertical takeoff and landing aircraft (VTOLs) to their desired pickup locations and specify drop-off destinations at rooftops throughout a given city” (NASA et al., 2018, p. 5).</td>
</tr>
</tbody>
</table>
Autonomous

For the purposes of the present research, the highest applicable level of autonomy for a vehicle where the “autonomous systems can function in an open environment under unstructured and dynamic circumstances” (Trentesaux et al., 2018, p. 515).

Nationality

A person’s country of origin.

Remote Pilot System

An aircraft system enabling a human pilot physically located in a ground-based station to control an aircraft (Molesworth & Koo, 2016, p. 52).

Safety System

A passive system designed to mitigate the effects of a crash or emergency.

Urban Air Mobility

A concept in which small aircraft are used to supplement existing transportation infrastructure by transporting people and cargo within a single city or metropolitan area (Reiche et al., 2019).

Willingness to Fly

A person’s behavioral intent to fly, self-assessed from responses about how he or she feels willing, comfortable, happy, safe, confident, has no problem, and has no fear to fly in a given scenario (Rice, Mehta, et al., 2015).

List of Acronyms

- ERAU: Embry-Riddle Aeronautical University
- HIT: Human Intelligence Task
- INR: Indian Rupee
IRB  Institutional Review Board
MTurk  Amazon Mechanical Turk®
NASA  National Aeronautics and Space Administration
NHTSA  National Highway Transportation Safety Administration
PIN  Postal Index Number
SAE  Society of Automotive Engineers
UAM  Urban Air Mobility
UITP  International Association of Public Transport
USD  United States Dollar
ZIP  Zone Improvement Plan (rarely used except as acronym)
CHAPTER II

REVIEW OF THE RELEVANT LITERATURE

This literature review describes the theories and variables underlying the conceptual questions posed in the present research regarding why people from the United States and India have different levels of willingness to fly in autonomous aircraft and whether safety systems on the aircraft affects their respective willingness to fly. The cultural theory of risk, also known as simply “cultural theory,” and cultural cognition theory are presented as the theoretical foundation for the present research. Cultural theory, in part, describes how people perceive risk differently based upon their cultural orientation. Cultural cognition theory quantifies cultural theory and bridges the divide between group and individual conceptualization of risk.

While risk perception is extensively discussed in the theoretical foundation of cultural theory, risk perception is not explicitly assessed in the present research. First, the broad, qualitative generalities that lay people—the flying public—use to describe risk, and the research showing different cultures interpret risk differently, make it a plausible mechanism to explain the previously observed relationship between nationality and willingness to fly. Second, researchers have demonstrated that while there is a robust relationship between cultural orientation and risk perception, the relationship is weak. Third, this deviation from the limitations of cultural theory is justified by the advancement of cultural cognition theory and the body of work that demonstrated that cultural orientation affects several other constructs. While there is not a unifying theory to explain the additional observed relationships, the literature hints at why cultural orientations may be related to decision making and behavioral intention.
This literature review then describes the advent and proliferation of autonomous vehicles and how willing people are to ride in them. The review then describes safety concerns and safety systems related to autonomous vehicles, and how they influence passenger perceptions. Cultural cognition theory is finally revisited to explain how potential means to mitigate a person’s perceived risk of flying in an autonomous aircraft—the safety systems built into such an aircraft—may affect the willingness to fly differently depending how they conform to the individual’s cultural values.

**Sources**

This literature review includes information synthesized from multiple sources and databases. The Embry-Riddle Aeronautical University Hunt Library was the primary interface to access research databases and search for journals, books, and other research material. The Hunt library provided access to ProQuest, Sage, PsycInfo, and other databases. Both the Hunt Library and Google Scholar were used as starting points for searching for electronic and print sources. The primary search keywords included, but were not limited to: air taxi, urban air mobility, individualism, collectivism, power distance, Hofstede, cultural theory, cultural cognition, autonomous vehicle, safety, willingness to fly, and behavioral intent. Reference sections from the various articles returned were also examined for relevant works to retrieve. The Hunt Library also provided interlibrary loans for reference material not directly available in the university library.

**Gaps in the Literature**

Much of the current literature on autonomous vehicles relates to technology, adoption, and benefits of such systems (Gkartzonikas & Gkritza, 2019). Research into
passenger willingness to ride or fly in such vehicles largely investigates how passengers’ characteristics such as nationality (Rice et al., 2014), gender (Mehta et al., 2017), and emotions (Rice & Winter, 2015) relate to general perceptions of autonomous aircraft. Studies such as these typically involve the theory of planned behavior or theory of reasoned action (Gkartzonikas & Gkritza, 2019).

There is a gap in research indicating what characteristics of autonomous vehicles themselves may be associated with passenger willingness to ride or fly. While the literature indicates passengers are concerned with safety (Vance & Malik, 2015), there are no studies known to the author that associate specific safety systems with willingness to fly.

While many studies assess the effects of nationality on willingness to ride or fly in autonomous vehicles (Mehta et al., 2017; Rice et al., 2014; Ward et al., 2019), few assess culture as a mediator of other effects. In this particular case, cultural theory and cultural cognition theory provide a novel theoretical framework for the present research as a mediator between safety system availability and willingness to fly.

**Theoretical Foundation**

Cultural theory and cultural cognition theory form the theoretical framework of the present research. Cultural theory introduced four categories of cultural orientation and described how each category leads to different perceptions of risk. Cultural cognition theory built upon cultural theory by providing a framework to quantify and assess individuals’ cultural orientation. In addition to the theoretical framework explaining how cultural orientation may influence one’s perceptions, a body of work has also
demonstrated cultural orientation may be related to other constructs such as behavior intention.

**Cultural theory.** Douglas originated the cultural theory of risk to describe how the perception of risk is a function of one’s culture (Douglas & Wildavsky, 1982). The theory describes how groups, with a common outlook and understanding of the environments in which they operate, interpret events and “impose order on reality in particular ways” (Tansey & O’Riordan, 1999, p. 73). While the theory has been explored throughout the intervening decades, the fundamental concept of the theory remains that every person’s risk perceptions are “shaped by the nature of the social groups of which they are a part” (Tansey & O’Riordan, 1999, p. 71).

In the context of cultural theory, risk does not simply relate to safety concerns. Risk is defined in societal terms as threats to social norms to which social groups moralize and politicize the risk to keep order and maintain their way of life (Dake, 1991; Tansey, 2004). Risk perception is a person or group’s “subjective assessment of the probability that an undesirable event should occur and the potential severity of consequences if such an event happens” (Nordfjærn, Jrgensen, & Rundmo, 2011, p. 658). Different types of social groups are typically adept at identifying the existence of a risk similarly but perceive the risk differently by disagreeing over the magnitude of the risk and who should be responsible for mitigating the risks (Tansey, 2004).

The definition of what constitutes a risk to a social worldview has varied throughout the literature exploring the theory. Researchers have found different perceptions of risk ranging from environmental risk (Douglas & Wildavsky, 1982), to the
risk to the social group’s way of life (Dake, 1991), to circumstances where the outcome is uncertain and a person, or something of value to the person, is at stake (Boholm, 2003).

Perhaps the reason there are so many definitions of risk to the society or individual is that the typical lay person does not think of risk in the same terms as a researcher (Cha, 2000; Marris, Langford, & O’Riordan, 1998). While researchers speak in terms of probabilities and quantified severity, the lay person conceives of risk qualitatively. They use emotionally charged terms such as fear, dread, equity, involuntariness, and newness to react to potential events (Cha, 2000; Marris et al., 1998; Pidgeon, 1998; Sjöberg, 2000).

In addition to perceived risk, cultural theory supports other constructs and terms depending on the degree to which the event of concern is engrained into the society. For example, in traditional societies, cultural taboos toward events perform similarly to risk perception in that they prompt a response from the social group to preserve the status quo (Boholm, 2003; Tansey & O’Riordan, 1999).

In developing the theory, Douglas and Wildavsky (1982) developed a typology to describe cultural groups in terms of orthogonal “group” and “grid” dimensions. Group is defined as the extent to which a person associates with a social group (similar to individualism and collectivism), and grid is “the degree to which an individual’s life is circumscribed by externally imposed prescriptions” (Thompson, Ellis, & Wildavsky, 1990, p. 5). The intersecting group and grid axes create four quadrants based on low and high group and grid values, which produce four types of social groups (see Figure 1). These ways of life are called hierarchy, egalitarianism, fatalism, and individualism. A fifth type of social group, autonomy, is found in the intersection of the graph,
representing low values in each other group type (Thompson et al., 1990). It is a mostly asocial worldview that is not commonly addressed further in studies of social risk perception (Dake, 1992).

![Cultural Theory Grid-Group Model and Cultural Orientations](attachment:grid_group_model.png)

*Figure 1. Cultural theory grid-group model and cultural orientations. Adapted from Cultural Theory (p. 8), by M. Thompson, R. Ellis, and A. Wildavsky, 1990, New York, NY: Routledge. Copyright 1990 by M. Thompson, R. Ellis, and A. Wildavsky. Reproduced by permission of Taylor and Francis Group, LLC, a division of Informa plc.*

It is important to emphasize that cultural theory does not model all differences in culture, as each is unique in innumerable ways. Instead, cultural theorists claim that despite differences in values, beliefs, and behaviors, all cultural worldviews are reducible to one of the five groups (Thompson et al., 1990).

Each type of cultural group perceives and responds to risk differently. These responses represent cultural orientations; orientations differ from attitudes in that
orientations represent a general disposition while attitudes are specific beliefs regarding specific objects and events (Eckstein, 1988). Adams (1995) provided an excellent example of how the four main cultural orientations within the same country responded to a single perceived risk. The example also is useful for demonstrating how the definition of perceived risk relates to a perceived threat to the way of life in society rather than a threat to the individual.

Hierarchical social groups, exhibiting high group and high grid values, form close social groups with a high degree of control in their daily life. In the debate whether to introduce mandatory seatbelt laws, hierarchists were in favor of such laws as it represented a way to use governance to save lives (Adams, 1995). Individualists—low group and low grid values—were against such laws, not because they were against saving lives, but because they advocated against government intervention in what they viewed as personal risk decisions (Adams, 1995).

Egalitarians—high group and low grid—only responded to the seatbelt law debate when they saw the potential that the government may institutionalize differences in social classes (Adams, 1995); they believed seatbelt laws protect those wealthy enough to afford cars, while pedestrians and cyclists have no such luxury. The law represented a threat to their worldview that valued equality. Fatalists—low group and high grid—believe themselves to be individual actors but with external social constraints on their actions beyond their control. As a result, fatalists usually do not participate in such policy debates (Adams, 1995).

In addition to differing responses to the same perceived risk, those of different worldviews also vary in the type of risk to their way of life with which they are
concerned. Hierarchists are most concerned with risks associated with law and order, individualists are most concerned with risks to the market, and egalitarians are most concerned with hazards involving technology and the environment (Sjöberg, 2002a). Some of the worldviews are also more likely to rate risk high in general. Groups with high egalitarian values—high group, low grid—are more likely to perceive risk, and those with high individualist values—low group, low grid—were less likely to perceive risk in general (Sjöberg, 2002a). Most studies relating cultural theory to different types of risk, however, described the risk in broad categories, too generalized to draw meaningful conclusions; the importance of the object of the perceived risk was often overlooked (Sjöberg, 2000).

Cultural theory remained only meaningful at the social group level and lacked predictive utility—although we are careful to note the theory is not intended to be deterministic (Tansey, 2004). One problem was that the boundaries of the assessed cultural group were notoriously fluid; other than considering the geopolitical boundaries of a nation, the unit of analysis for a culture is difficult to define (Ross, 2004). Further, within a nation, there are countless cultural subgroups of geographical areas (e.g., municipalities, regions), ethnic groups, and political parties that may share worldviews different from the aggregated nation. The theory needed either better definitions of boundaries or another approach if it was to be empirically tested.

Dake, a student of Wildavsky and proponent of cultural theory, sought such a means to quantify and empirically test cultural theory. His approach was shaped by his sociological worldview and early work with cultural theory, perhaps overemphasizing the role of social orientation over other individual factors (Sjöberg, 2000). Dake’s
quantitative work to follow was grounded in his earlier research with his mentor in which they found that one’s cultural biases could predict risk perception to a greater degree than prior knowledge of the risk or measures of personality (Wildavsky & Dake, 1990).

Dake investigated the cultural orientation of individuals and how that related to their perception of risk (Dake, 1991); this broadened cultural theory, which had previously focused almost exclusively on group behavior. Such research incorporating cultural orientations assessed among individuals demonstrated that one’s cultural orientation can indeed predict his or her risk perception regarding a wide range of topics including natural environmental risks (Dake, 1991), general technological risks such as nuclear power (Xue, Hine, Loi, Thorsteinsson, & Phillips, 2014), and specific individual financial risks (Weber & Hsee, 1998). While broad topics were related to risk perception, such research also revealed that the object or concept of which the risk perception is measured is an equally important consideration; for example, egalitarians are more likely to take more personal risks yet are risk adverse when considering societal issues (Wildavsky & Dake, 1990).

When transitioning from group to individual analysis, Dake could account for the fact that not every individual conforms to the same worldview as his or her social group, as group worldviews represent the aggregate of a heterogeneous association of individuals (Kahan, 2012). In addition, Dake’s approach of measuring the four primary cultural worldviews represented each as a separate scale; he found that individuals could be associated with more than one group depending on the social setting and object of study (Dake, 1992).
Dake’s attempts to introduce empirical measures in cultural theory brought criticism of both his research and the theory itself. In particular, critics wrote that his use of multiple scales contradicted cultural theory’s presupposition that each person would map to a single worldview (Boholm, 1996). In addition to allowing high values in multiple groups, Dake’s (1991, 1992) scales suffered from low internal validity (Kahan, 2012). According to Boholm (1996), Dake’s (1991) work demonstrated that the theory had underlying circular logic: For example, hierarchists are concerned with risks concerning law and order, but because they are interested in law and order, they are defined as hierarchists.

Dake’s (1991, 1992) studies demonstrated that cultural orientation, assessed at the individual level, can affect a person’s risk perception. Yet, while the effects of cultural orientation on risk perception are robust and persistent throughout the body of work, the effects are consistently weak (Sjöberg, 2000). This early quantitative work and similar studies were criticized because they were only able to explain 10% of the variance in individuals’ risk perception on average from a person’s cultural orientation (Sjöberg, 2000, 2002a).

Sjöberg (2000) wrote that one’s attitude toward risk comprised a much more prominent role in the models than cultural theory suggested. In addition, he argued, cultural theory was too generalist in its descriptions of ideology (Sjöberg, 2000). Later, he also identified failings in the pure psychometric, individualist model of describing risk perception and called for the field to move beyond both the psychometric model and cultural theory (Sjöberg, 2002a).
Rather than discarding the competing models, a new theory could incorporate perspectives from both sociologists and psychologists. From the psychological perspective, such a joint effort would analyze the means through which social norms and cultural orientation affect cognition (DiMaggio, 1997). From the sociologist perspective, creating a bridge between the social and psychological models would acknowledge both that groups are composed of individuals with heterogeneous worldviews engrained from social settings and that those worldviews influence one’s perception (DiMaggio, 1997).

Such an approach would avoid the constant criticism of culture theory that it disregards within-group variations of cultural orientation among group members (Ross, 2004). It also would avoid the fallacy present in studies of differences between nations where national-level cultural orientations are assumed to be held by individuals (Yoo, Donthu, & Lenartowicz, 2011).

**Cultural cognition theory.** Cultural cognition theory was developed in answer to criticisms of the cultural theory and to bridge the social and psychological perspectives. The theory was developed to support measures and variables illustrative of how individuals form “packages of risk perceptions characteristic of their groups in proportion to the strength or degree of attachment to the cultural groups with whom they are most closely affiliated” (Kahan, 2012, p. 734). Thus, in this context, cultural orientation is the lens through which a rational actor perceives risk. It is not a radical departure from early assertions that cultural orientation mediates response (Eckstein, 1988), except perhaps in reducing the overemphasis on orientation above all else. Instead, cultural cognition theory provides the framework to empirically test cultural theory and assumes cultural orientations are “latent predispositions of individuals” (Kahan, 2012, p. 736).
One departure Kahan made from Dake’s work was to treat grid and group as two orthogonal continuums (see Figure 2) and to assess each person’s individual cultural orientation as a single point in a two-dimensional grid (Kahan, 2012). Doing so both quantified the strength of an individual’s cultural orientations and overcame past criticisms where a person exhibited multiple orientations simultaneously or that the definitions of the groups were reductionist (Boholm, 1996).

![Figure 2: Cultural cognition model of cultural orientation. Adapted from Handbook of Risk Theory: Epistemology, Decision Theory, Ethics, and Social Implications of Risk (p. 733) by S. Roeser. New York, NY: Springer. Copyright 2012 by Springer. Reproduced by permission of Springer; permission conveyed through Copyright Clearance Center, Inc.](image)

Kahan stated that the worldviews were instead latent constructs, measured by other observed indicators (Kahan, 2012). Thus, he also softened earlier definitions of the four (or five) cultural worldviews by removing rigid and circular definitions. What resulted was an internally valid method for measuring cultural orientations among
individuals, which he claimed has more useful for explaining relationships than attempting to conform to the abstract nature of cultural theory (Kahan, 2012).

Cultural cognition theory has demonstrated its ability to fit into the broader cultural theory. For example, individuals with opposing cultural orientations—quadrants diagonal from each other in the group and grid culture space—had diverging risk perceptions of new technology (Kahan, Braman, Slovic, Gastil, & Cohen, 2009). Thus, the core element of cultural theory—that the four cultural worldviews provoke different responses—was demonstrated quantitatively when assessed among individual people.

While cultural cognition theory advanced research in cultural orientations, it remains somewhat limited in its cultural theory roots by only modeling how cultural worldview influences one’s risk perception. Using the cultural theory framework, cultural biases only accounted for approximately 10% of differences in risk perception (Sjöberg, 2000, 2002a). Neither cultural theory nor cultural cognition theory model other ways in which cultural orientation may affect behavior. And risk perception itself is perhaps explained better by other indicators such as attitude, risk sensitivity, and morality (Sjöberg, 2002a).

Sjöberg (2000) questioned the utility of using cultural orientation to explain risk perception when it was such a small influence and risk perception could be explained with other measures. In the context of the present research, we must point out the difference is that we do not have a satisfactory model of the relationship between a potential passenger’s nationality, culture, and willingness to fly in an autonomous aircraft. This research builds upon existing studies indicating there is a significant relationship between nationality and willingness to fly in an autonomous aircraft (Mehta
et al., 2017; Rice et al., 2014; Ward et al., 2019; Winter, Rice, et al., 2015)—and a hypothesized relationship between cultural orientation and willingness to fly. The internal relationships have not been adequately explored in the literature; thus, every intermediary variable represents opportunities for new findings. Thus, at this point, even potentially explaining 10% of a relationship is 10% more than was known before. Such incremental progress is required for future researchers to construct a viable model.

**Extending beyond risk perception.** Cultural theory may be popular because of its intuitiveness and simplicity in explaining cultural values (Simmons, 2018), but it has faced persistent criticism for its resistance to empirical measurement. Attempts to replicate Dake’s (1991, 1992) tests of the theory and other subsequent work has only produced weak correlations with perceived risk (Sjöberg, 2000, 2002a). Recent attempts achieved similar results, leading researchers to claim that “culture does not seem to be important for risk perception” (Rundmo, Granskaya, & Klempe, 2012, p. 1,265).

This may indicate that cultural theory, to put it simply, is wrong in its description of the relationship between cultural worldview and risk perception (Marris et al., 1998; Oltedal, Moen, Klempe, & Rundmo, 2004). It could also be that the survey instruments used to assess cultural orientation are the “wrong tool for the wrong job” (Tansey, 2004, p. 29). Cultural theory was not originally conceived to explain how people with different cultural orientations perceive the likelihood or severity of risk; instead it was meant to explain how those of the different worldviews perceive risk differently, how they believe risk should be managed, and who should manage risk in the social group (Marris et al., 1998).
Yet if cultural theory is wrong, how does one explain the continued research in cultural orientations and subsequent developments in cultural cognition theory? First, one can examine both ends of the theorized relationship between orientation and risk perception. The cultural theory typology has remained relevant, especially in some fields such as political science and policy analysis (Mahmadouh, 1999). We must also consider that individuals may change their cultural orientation depending on the group context in which they are responding; the way a survey question is phrased may affect which cultural orientation a person uses to frame a response (Oltedal et al., 2004). More recently, cultural cognition theory provided an avenue in which to operationalize the group and grid typology as continuous variables, thus avoiding rigidity in categorization. Together, these point to a problem in past operationalization rather than a fundamental flaw in the typology.

Upon examining the other end of the relationship—perceived risk—we find an extensive body of work that reported the cultural dimensions from cultural theory only weakly predicts risk perception (Sjöberg, 2000). Even other measures of culture form weak relationships with risk perception (Rundmo et al., 2012). The problem appears to be in using perceived risk as a dependent variable or as an explanation of how cultural orientation relates to decision making and behavior.

So why do so many studies rigidly adhere to the original theory and the hypothesized relationship to risk perception despite mounting evidence? Perhaps this is partially because that while the relationship to risk perception is weak, it is consistent (Sjöberg, 2000). It also makes intuitive sense, as “people are assumed to oppose a technology because of its risk. The whole field of risk perception research has arisen on
the assumption of the importance of the perceived risk of technologies, and of other societal activities” (Sjöberg, 2002b, p. 380). Nevertheless, identifying and perceiving risk are only part of the process.

Cultural theory and risk perception may create a “bird spotting” scenario in which researchers find differences in culture or perception but do not seek relationships that may be more meaningful (Mahmadouh, 1999, p. 405). For example, an individual’s perception of risk does not mean the individual seeks risk mitigation; the two concepts are different constructs (Sjöberg, 2003). In other words, researchers have focused on minute differences between cultural orientations in their risk perceptions, yet only have sought links to actual behavior in a limited number of studies (Rundmo et al., 2012).

Others recognized the utility of the underlying explanatory framework of the cultural theory and sought to test relationships between cultural orientation and constructs involving preferences, behavior, and behavioral intention to act. Significant differences in responses to advertising appeals have been found between individuals with different cultural orientations (Shavitt, Johnson, & Zhang, 2011). Hofstede’s cultural dimensions were also shown to be related to economic and political facets of national groups (Yoo et al., 2011). Weber and Hsee (1998) found that individuals’ willingness to make risky purchases varied significantly more between groupings of cultural orientation than within groups. Olofsson and Öhman (2015) found significant relationships between the fatalist and individualist cultural orientations with both risk perception and behavior.

Even so, no one claims that behavior, or behavioral intention, is directly related to cultural orientation. Cultural theory explicitly states that it is non-deterministic, and such an approach ignores the psychological processes of the individual (Douglas &
Wildavsky, 1982; Tansey, 2004). Instead, the route to behavioral intention requires considering one’s attitudes, affect, and behavioral and social norms (Kahan, Braman, Monahan, Callahan, & Peters, 2010; Tikir & Lehmann, 2011).

This path appears promising as researchers have found negative correlations between risk perception and attitude (Hulse et al., 2018; Sjöberg, 2002b) and from risk perception to both intention and behavior (Rundmo et al., 2012). Weber and Hsee (1998) found that differences in risk perception between cultural orientations predicted differences in willingness to make risky purchases. Others emphasized the cultural cognition perspective and suggested that it is both one’s social experiences and cognition that work together to form a foundation for attitudes toward perceived dangerous activities or objects (Marris et al., 1998). Together, these findings indicate that there may be a “causal chain running from social structure to social practice to attention and perception to cognition” (Nisbett & Masuda, 2003, p. 1170).

Cultural cognition principles—the blending of social and psychological approaches—provide the hypothesized mechanism of this relationship. Three prominent theories—the technology acceptance model, theory of planned behavior, and theory of reasoned action—have been used to explain the observed relationships, although the details and pathways of the additional theories are beyond the scope of the present research.

The technology acceptance model illustrates the relationships between external variables and both perceived usefulness and perceived ease of use of new technology, which in turn relate to one’s attitude toward using a technology and behavioral intention to do so (King & He, 2006). Attitudes and norms toward technology in general, and the
application specifically, originate from a person’s social environment and shape both perceived usefulness and attitudes towards use (Sjöberg, 2002b). Accordingly, there may be a path of relationships from cultural orientation to behavioral intention, albeit mediated through several intermediary variables.

The theory of reasoned action relates attitudes and subjective norms to behavioral intention (Madden, Ellen, & Ajzen, 1992). The theory of planned behavior built upon the theory of reasoned action and added perceived behavioral control as an exogenous entry point to the model (Madden et al., 1992). In a study that attempted to merge cultural theory and the theory of planned behavior, attitudes and norms were found to mediate the relationship between cultural orientation and behavioral intention (Tikir & Lehmann, 2011). In particular, attitudes and norms completely moderated cultural orientations in the individualism and egalitarianism quadrants of the group and grid model (Tikir & Lehmann, 2011).

We must note that this description of a mediation analysis, however, follows the Baron and Kenny technique of mediation analysis. While “full mediation” is the strongest result in that there is no observed direct effect when controlling for the mediator, the method does not quantify the strength of correlations on each path, and there may be other effects overlooked (Zhao, Lynch, & Chen, 2010). Baron and Kenny mediation techniques also miss potential interference of mediation relationships by requiring three significant hypothesis tests, one for each relationship in the model (Zhao et al., 2010). For example, there is a significant relationship between a fatalist cultural orientation and attitudes, but as there is not a significant direct relationship between a fatalist orientation and behavioral intention, the Baron and Kenny approach indicates there is no relationship
to mediate (Tikir & Lehmann, 2011). While we cannot infer the strengths of the relationships from this study and it may have missed potential hidden mediators, the study did show that the theory of planned behavior remains an intriguing possible path from cultural orientation to behavioral intention.

These models share the common concept of attitudes toward an object or event that relate to behavioral intention to act (Rundmo et al., 2012). In Tikir and Lehmann’s (2011) study of culture and the theory of planned behavior, they found that people formed their subjective norms and attitudes based on cultural orientation. This finding was grounded in part by cultural theory, when they provided the example that “being an individualist in the sense of the cultural theory one will form negative attitudes and norms towards behaviors which are non-individualistic like the use of public transport. And being an egalitarian will work the other way around” (Tikir & Lehmann, 2011, p. 399).

When one considers the collective works and models, one can see that cultural orientation is relevant to risk behavior, even though it may be irrelevant to risk perception (Rundmo et al., 2012). The present study does not claim to directly link risk perception with willingness to fly. Instead, it builds upon the mosaic of research that may eventually link the constructs and create a comprehensive picture. Cultural theory was put forward as a plausible explanation of some of the differences between nationalities in willingness to fly observed in the body of knowledge because of its association with cultural differences and individuals’ perceptions of unknowns (Tansey & O’Riordan, 1999).

Furthermore, limiting research to an end point of risk perception raises questions about the utility of such work; it may become categorization for categorization’s sake (Mahmadouh, 1999). Rather, risk perception may be yet another mediator on the path
between cultural orientation and behavioral intention. Given the weak relationship between cultural orientation and risk perception, lack of adequate measures of risk perception, and a lack of a theory explaining relationships between risk perception, attitudes, and behavioral intent, we do not include risk perception in the present research. Instead it is an interesting footnote that may help explain relationships between cultural orientation and behavioral intent observed in other works, best investigated specifically in future theory-building work.

**Cultural orientation.** Cultural theory and cultural cognition theory provide two dimensions with which to assess cultural orientation, but other descriptions of cultural orientations have been developed in parallel. Before we conduct research using cultural cognition theory as an explanatory hypothesis, we must address other competing models of cultural orientation and describe the similarities and differences.

Cultural theory defined two axes to explain cultural differences, both in terms of how much a person adheres to social groups (the “group” scale) and how much control social structures exert upon a person’s daily life (the “grid” scale). Douglas and Wildavsky (1982) depicted the two axes as orthogonal and intersecting, thus creating four categories to which a culture may belong: individualism (low group, low grid), fatalism (low group, high grid), egalitarianism (high group, low grid), and hierarchism (high group, high grid) (Kahan, 2012; Tansey & O’Riordan, 1999). Later, a fifth category representing the asocial life, autonomy, was added to the theory (Thompson et al., 1990). As autonomy is defined by the absence of the other cultural orientations, it is not depicted or discussed as regularly in the body of knowledge as the four main orientations.
Here we must point out that cultural theory described these four (and later, five) resultant cultural categories as mutually exclusive categories to describe a culture (Douglas & Wildavsky, 1982; Thompson et al., 1990). They made no claim to quantify the degree of group and grid, nor did they use the group and grid constructs to explain social behavior. Group and grid were instead defined to describe the primary attributes of the categorical cultural orientations (Douglas & Wildavsky, 1982; Thompson et al., 1990).

In early research designed to operationalize the cultural groups for empirical analysis, researchers faced complications with measuring individuals’ relationship with authority. The grid dimension was found to be closely correlated with the hierarchy quadrant (Marris et al., 1998; Sjöberg, 2002a). Further complicating analysis was the fact that true egalitarian societies are rare (Campbell, 2006). Thus, despite the theoretical framework that the worldviews are discrete—cultural theory does not presume group and grid are continuous variables—there were blurred lines in the high-group quadrants.

Hofstede (1980) sought to quantify national cultural dimensions and built upon Douglas’s “grid” dimension by breaking it into two separate scales. Where Douglas saw a single dimension with higher grid values indicating acceptance of social hierarchy and adherence to tradition, Hofstede (1980) separated this into power distance and uncertainty avoidance. He defined power distance as the measure of how much people in a culture accept unequal distribution of power, and uncertainty avoidance as how much people seek to avoid unknown situations and new ideas, instead following tradition and rules (Hofstede, 1980).
Unlike with cultural theory, Hofstede’s (1980) values were quantified and separate, and he did not assign societies to worldview categories. Hofstede’s cultural dimensions and supporting research are useful for making broad cultural classifications at the national level, but one must not conflate cultural values at the national level with values held by individuals (Shavitt, Lalwani, Zhang, & Torelli, 2006). The point may be moot, however, as Hofstede’s survey instrument for measuring national cultural values did not work and exhibited low internal validity when attempting to assess cultural values among individuals (Yoo et al., 2011).

Despite Hofstede’s use of four (and later, six) cultural dimensions, individualism, collectivism, and relationships with power—as with the original cultural theory—remained the focus of the vast majority of research (Shavitt et al., 2011, 2006). Here, Hofstede used the term “individualism” as a direction on a continuum from individualism to collectivism rather than a categorical name as under cultural theory. The concept of individualism represents values of independence, personal freedom, and personal responsibility (Weber & Hsee, 1998). Individualists view the decision to participate in a risky activity a personal decision and believe that risk mitigation is a personal responsibility (Adams, 1995). Perhaps because it is a personal decision, people from individualist nations perceive more risk in a common scenario than those from collectivist nations (Weber & Hsee, 1998). Even so, individualists also were found to be more likely to exhibit risky behavior (Olofsson & Öhman, 2015).

Collectivism represents strong identification with social groups and describes how individuals form interdependent relationships (Weber & Hsee, 1998). Collectivists tend to perceive less risk in a given scenario (Weber & Hsee, 1998), particularly if a person
described the perceived risk as something he or she dreads (Olofsson & Öhman, 2015). Weber and Hsee (1998) suggested that this may because the collectivist nature includes an inbuilt safety net, in which individuals assume the broader group can provide necessary help, and thus potential unfavorable outcomes affect the individual less, if the risk perception is held constant.

The grid axis, emblematic of individual’s relationship with social power and hierarchy, also provides a means to understand how one’s cultural orientation affects behavior. People exhibiting a high group, high grid (high grid meaning a high level of external prescriptions on individuals’ actions) cultural orientation are more willing to accept risks that authorities justify (Yang, 2015). In Japan and China, where there is a high level of power distance (acceptance of inequalities in power structure), individuals respect hierarchical status and yield to authoritative risk decisions (Yang, 2015). Those with high grid or power distance cultural orientations may perceive less risk in a given scenario because they assume authorities have already mitigated the risk; when the risk perception is held constant, however, Chinese decision makers (high grid, high power distance) were especially adverse to selecting high-risk options (Rohrmann & Chen, 1999).

Referring to the definitions of grid and power distance, one can appreciate the explanatory relevance of cultural theory. The high grid cultural orientation means individuals see the target object or event through the lens of a member of a hierarchy, where someone in an authoritative position has managed the risk and there is a social group, leading to reduced risk perception. Those with a high group orientation approach decisions with the understanding that they have a support network in the event of adverse
consequences, leading to a reduced perception of the risk as a function of severity (Sjöberg, 2002b). Thus it makes intuitive sense that collectivist and high grid individuals would simultaneously be more adverse to risk behavior; if the perceived risk rises to a level equal to that which individualists perceive, the social networks integral to their worldview have failed to some degree, and a highly social person is left to face the situation alone.

Singelis, Triandis, and colleagues continued this trend by examining the nature of individualist and collectivist societies, and noticing that individualism was exhibited differently in nations ostensibly grouped together as similarly individualist (Singelis, Triandis, Bhawuk, & Gelfand, 1995; Triandis, 1995). They noted that there is a horizontal and vertical component to individualism and collectivism, which explains how individuals and groups incorporate hierarchy and social status into individualist and collectivist orientations. Triandis and Gelfand (1998) then provided an instrument to measure individualist and collectivist traits at the individual level, including that person’s relationship with power in the horizontal and vertical dimensions. They described and quantified four types of cultural orientations, made up of horizontal individualism, horizontal collectivism, vertical individualism, and vertical collectivism (Triandis & Gelfand, 1998).

Horizontal individualism and horizontal collectivism align with Hofstede’s (1980) individualism and collectivism dimension and Douglas and Wildavsky’s (1982) group dimension, although it is presented as two different scales rather than a continuum. The vertical dimension is different than the other models; vertical individualism and collectivism refer to a person’s ascribed importance and value to social hierarchy.
(Triandis & Gelfand, 1998), Hofstede’s power distance refers to a person’s acceptance of inequality within society (Shavitt et al., 2006), and cultural theory grid refers to how much one’s life is dictated by external actors and social norms (Thompson et al., 1990).

As Triandis and Gelfand (1998) use four different scales, the vertical and horizontal constructs take on a different meaning than in the group and grid typology. Most notably, as four separately quantified constructs, they should not be placed on a two-axis chart as with the group and grid typology, and the orientations do not correspond to those of the group and grid typology. Instead, each category is defined and quantified separately. Horizontal individualists are the people who want to be independent from groups and value self-reliance, vertical individualists are people who compete for and seek personal status, horizontal collectivists are those who value equality and common goals, and vertical collectivists are people who value hierarchical groups and sacrifice personal needs for the greater good of the group (Triandis & Gelfand, 1998).

Differences in the grid, power distance, and verticality concepts are explained best through example. We can consider a prototypical person from the United States in each of the three constructs: one who exhibits the national culture orientations of cultural theory’s individualist quadrant type (low group, low grid), Hofstede’s low power distance values, and high vertical individualism (Douglas & Wildavsky, 1982; Hofstede Insights, 2019; Triandis, 1995). The low grid orientation refers to a lack of external prescriptions on action (Thompson et al., 1990), so the person from the United States perceives his or her actions as functions of his or her own will. With low power distance, the person from the United States believes in an inherent right to be equal for members of society and
does not value the social norms contributing to inequality (Singelis et al., 1995). As a vertical individualist, the person from the United States recognizes the existence and utility of social hierarchy and seeks differentiation through personal status and recognition (Triandis & Gelfand, 1998). Thus, a person with low power distance and high vertical orientations might drive a luxury car to a meeting for a civil rights advocacy group; he or she does not endorse social norms that create inequality but does recognize that inequality exists and still seeks rewards within the system (Singelis et al., 1995).

Because they measure different constructs than those of cultural theory, horizontal and vertical individualism and collectivism scales are suited for assessing different effects than perceived risk. The scale has demonstrated its utility in assessing communication, advertising content, and advertising receptiveness between cultural orientations. People in horizontal individualist nations, such as Australia and Scandinavian countries, are more interested in personal satisfaction deriving from technology than those in other countries—for example, companies market their cars as being fun to drive (Shavitt et al., 2011). People from vertical individualist countries, such as the United States, tend to seek uniqueness personal status and respond to messages about how a product or technology is a status symbol or helps them differentiate themselves (Shavitt et al., 2011). Vertical collectivists are more accepting of technology if they believe it will help them function better in their social support role, such as being a better parent (Shavitt et al., 2011).

Triandis and Gelfand’s (1998) horizontal and vertical individualism and collectivism scale faced challenges with internal validity. While not biased to the extent of Dake’s (1991, 1992) scales, the usefulness was questioned in subsequent analyses.
where questions in the instrument were found to load on unexpected constructs (Li & Aksoy, 2007). Furthermore, horizontal collectivism and vertical collectivism were correlated, while both individualism constructs were distinct (Singelis et al., 1995). This indicated the model may be inadequate in some circumstances.

The advent of cultural cognition theory returned cultural assessment to the original roots of cultural theory with its cultural worldview scale. Instead of using four (or five) nominal categories of cultural orientation, the cultural worldview scale uses two orthogonal continuums of individualism-communitarianism (i.e., group) and hierarchy-egalitarianism (i.e., grid) (Kahan, Braman, Gastil, Slovic, & Mertz, 2007). In short, the cultural cognition approach treated the axes on the group and grid graph as continuous values. Rather than defining cultural orientation as a single category, the cultural worldview scale was designed to allow cultural orientation to be plotted in the two-dimensional “culture space” (Kahan, 2012).

This solved the problems associated with Dake’s (1991, 1992) scales, where, as the scales were assessed individually, an individual could score highly in multiple cultural orientations which were mutually exclusive in cultural theory (Boholm, 1996; Kahan, 2012). In addition, the transition from categorical to interval values of cultural orientation allowed researchers to study correlations with higher statistical power (Kahan, 2012). Thus, cultural cognition theory and the dimensions in the cultural worldview scale represented a marked improvement of the original group and grid dimensions while retaining their original meaning.

**Nationality and culture.** It is important to recognize the distinction between nationality and culture, as imprecise writing or inattentive reading can lead one to
confuse the terms. Culture is the collection of behavioral tendencies and mental models common to a group of people (Hofstede, 1980). A group of any size can exhibit a shared culture, from family to region to nation or larger.

Nationality refers to people within the geo-political boundaries of a given country of origin. Here, nationality works to define who is included within a broad cultural group and provides a convenient label: People from the nation of India tend to belong to an Indian cultural group, though there are a multitude of sub-national groups. Hofstede (1980) developed his cultural dimensions to provide a means to understand cultural groups at the national level, enabling broad conclusions such as that people from India are more collectivist than those from the United States. With these distinctions in mind, one can appreciate the utility of using nationality as a proxy for culture, as nationality serves as a discrete categorization of people’s behavior, quantified and explained through Hofstede’s work.

The dimensions of national culture speak to the broad tendencies of persons in a geographic region, although only by assessing dimensions at the individual level can one determine to what degree individual persons identify with specific cultural values (Triandis & Gelfand, 1998). By assessing dimensions at the individual level, researchers can quantify specific elements of culture as variables, rather than assuming which construct is at work and assuming each individual exhibits a mean value of the macro group.

While useful at the macro level, Hofstede’s (1980) cultural dimensions break down at the individual level. For example, researchers have determined that U.S. and Indian passengers have different attitudes toward riding in autonomous vehicles (Rice et
al., 2014; Winter, Rice, et al., 2015) or allowing family members to do so (Anania, Rice, Winter, et al., 2018), and the researchers cited Hofstede’s finding that the United States is individualist and India is collectivist. Such generalizations confound nationality with culture and miss the fact that the degree individualism and collectivism is only one component of Hofstede’s (1980) cultural dimensions. One therefore does not know that it is the particular mechanism at work, and not one of the other cultural dimensions such as power distance or uncertainty avoidance. In addition, without measuring cultural orientation simultaneously, one cannot know whether differences were due to culture or some aspect of nationality. Studies citing national cultural dimensions must make multi-step deductions and assumptions, rather than measuring correlation: They assume individual participants exhibit the national cultural tendencies (Yoo et al., 2011) and, when effects of nationality are uncovered, deduce that it is culture or a specific cultural dimension at work.

The concept of nationality encompasses more than merely describing cultural tendencies of people within the borders. Other aspects of the nation including governance, regulations, regional media, and history also may affect individuals’ risk perception (Cha, 2000). For example, survey participants from the Republic of Korea and Japan—groups exhibiting similar cultural orientations—perceived the risk of nuclear energy differently, perhaps because the nuclear attacks on Japan in 1945 are uniquely engrained in the nation’s collective memory (Cha, 2000).

Beyond the collective national memory, nationality encompasses differences in daily life as well. People who have experienced more crises or have been exposed to more risk were more likely to engage in behavior considered risky (Olofsson & Öhman,
2015). In sub-Saharan Africa, inhabitants may perceive greater risks of terrorism and war than would people from other countries with similar cultural dimensions because they are more often exposed to such threats (Nordfjærn et al., 2011). Particularly relevant in this case are the unique attitudes—both positive and negative—toward mass transit options among Indians, considering the use and importance of busses and trains (Badami & Haider, 2007), overcrowding of busses in urban centers (Suman, Bolia, & Tiwari, 2017), and rising trend in road traffic accidents (Pal et al., 2019). Those from dense urban areas may be more amenable to autonomous vehicles, seeing them as a potential solution to traffic congestion or other driving considerations (König & Neumayr, 2017). Nationality is thus a broad categorization, worthy of discriminate investigation in future research.

**Autonomous Vehicles**

**Planes, trains, and automobiles.** We discuss the possible relationships between nationality and cultural orientation on behavioral intention because automated passenger vehicles are proliferating throughout the world. Since the first autonomous metro trains were introduced decades ago, the concept of autonomous vehicles has gained the interest of policymakers, leading to planned expansions in technology and urban transportation to include autonomous busses, cars, and small aircraft. Despite advances in technology, public trust, and stated willingness to ride in such vehicles varies in different nations.

First, we must pause to discuss the meaning of autonomous operations as used in the present study. Depending on the application, different regulatory or professional organizations have created standards and definitions of autonomous operations, each typically involving multiple degrees of autonomy. For trains, the International Association of Public Transport (UITP, from its French acronym) uses the term
“unattended train operations,” corresponding to its level 4 “grade of automation” on its scale of 1 to 4, to describe a train which starts, stops, controls doors, and handles disruptions to operations without human input (UITP, 2016). The Society of Automotive Engineers (SAE) International defines levels 0 to 5 to describe levels of automation in automobiles, with levels 4 and 5 corresponding to a vehicle requiring no input from a human once the destination is selected (Favarò, Eurich, & Nader, 2018). The U.S. National Highway Traffic Safety Administration defines automobile autonomy on a scale of 0 to 4, with level 4 being completely automated (Adnan, Nordin, bin Bahruddin, & Ali, 2018). Other models exist that are not tied to specific environments, such as the “level of automation” scale from 1 to 10, with 10 being full automation where the “human is completely out of the control loop and cannot intervene” (Kaber & Endsley, 2004, p. 120). Despite the slightly different definitions in each application, the present study uses the term “autonomous” to simplify the discussion and indicate the highest applicable level of autonomy where the “autonomous systems can function in an open environment under unstructured and dynamic circumstances” (Trentesaux et al., 2018, p. 515).

Partial autonomy in train operations had increased incrementally until 1981, when the first passenger metro train without onboard staff began operation in Kobe, Japan, and was followed in 1985 by the SkyTrain system in Vancouver, British Columbia (Powell, Fraszczyk, Cheong, & Yeung, 2016). Since then, several cities have introduced fully autonomous train operations in individual lines within broader metro systems or throughout the entirety of the system. The pace of automated train adoption has also increased in recent years, reaching 59 train lines over 1,109 kilometers of track in 38
cities worldwide by 2019 (UITP, 2019). Cities have converted existing metro lines to autonomous operation, such as in Nuremberg and Paris, as well as designed and built the system with autonomous operations from the beginning as in Dubai (Botelle, McSheffrey, Zouzoulas, & Burchell, 2012; Fraszczyk, Brown, & Duan, 2015).

Passengers are generally accepting of autonomous trains. In studies comparing the levels of perceived risk, study participants rated autonomous trains as less risky than human-driven automobiles and all other forms of automated transportation (Hulse et al., 2018). Passengers appear to trust the technology as well; one study in Europe found that 93% of females and 72% of males rated their opinions of autonomous trains as “good” or “very good” (Fraszczyk et al., 2015). Survey participants rated technical failure as the biggest concern with autonomous train operations (Fraszczyk et al., 2015)

The high acceptance ratings of autonomous trains may be a result of a few unique factors. First, trains have had varying levels of automation since the 1960s, demonstrating a history of safe operations over several decades and allowing passengers to become familiar with the technology (Trentesaux et al., 2018; Yeomans, 2014). Second, as the majority of accidents are a result of unauthorized access to the tracks, and as metro trains are segregated from other traffic, people may perceive trains as safer (Trentesaux et al., 2018). And third, there is a high alternative cost to train ridership; where a non-autonomous automobile may easily be selected over an autonomous automobile as an alternative means for intra-city transit, the nature of rail infrastructure precludes comparable options. In the case of a city, there is the choice of metro train or automobile and traffic; in an airport, the alternative to an automated train is to walk the length of the terminal.
Autonomous trains have given policymakers useful insights as automobile companies seek to introduce more automation into road vehicles for both public transit and personal use, yet they are entering an uncertain environment without sufficient data to develop certifications and standardizations for the industry (Fagnant & Kockelman, 2015). Before the public will readily use autonomous vehicles in mass transit, policymakers must build the regulatory framework and cultivate public perceptions of usefulness and safety of autonomous vehicles as public transit options (Tennant et al., 2019). Such perceptions and acceptance, however, comes with customer experience and time (Bansal, Kockelman, & Singh, 2016), and can vary between different implementations in different countries (Tennant et al., 2019). Thus, as autonomous automobiles and busses enter their infancy, the public is likely to view them with skepticism until they can establish a history of safe use as have autonomous train systems.

Another complicating factor for adoption of autonomous automobiles and busses is that they are currently expensive to design and mass produce, thereby keeping cost to consumers high and availability low (Fagnant & Kockelman, 2015). It is incumbent on policymakers to use policy and regulations to shape the price structure and environment for autonomous vehicle adoption (Bösch, Becker, Becker, & Axhausen, 2018). But, unfortunately, such policy requires a basis in trial implementations and public acceptance to be effective, creating a circular barrier to entry.

Regardless, technological progress continues to be made as incremental advances in automated process—offloading driver inputs in varying degrees—have already entered production in the automotive industry (Adnan et al., 2018). The gradual transition to fully
autonomous automobiles is already underway (Fu et al., 2019). Even in their beginnings, automated vehicles and mass transit are demonstrating that parking and other infrastructure in urban areas will need to be adapted for new applications (Bösch et al., 2018). Such findings illustrate that not only will the increasing popularity of autonomous road vehicles influence how policymakers and urban planners will determine land use, it will also affect the type of passenger who has access to the vehicles and how such passengers will use the vehicles (Bansal et al., 2016).

As companies test autonomous vehicles at the request of the National Highway Traffic Safety Administration (NHTSA) and policymakers seek more information (Fagnant & Kockelman, 2015), researchers have studied the factors associated with acceptance of autonomous vehicles and the public’s willingness to ride in them. While the studies provide useful information and have advanced understanding of the associated factors, the limited presence of autonomous vehicles—and the public’s lack of familiarity with them—makes such research subject to biases due to the hypothetical nature of the survey instruments (Fu et al., 2019). With this caution in mind, the body of knowledge does show both similarities and differences from the acceptance of automated trains; such comparisons may be useful as autonomous vehicles also begin operations in the skies.

Autonomous automobiles elicit mixed reactions from the public. In general, people regard autonomous automobiles favorability, viewing them as safer than non-autonomous automobiles and recognizing the enhanced mobility they can grant to disabled and disadvantaged populations (Asgari & Jin, 2019; Chan, 2017; Gkartzonikas & Gkritza, 2019; Pettigrew & Cronin, 2019). Yet when someone is told they will be a passenger in a hypothetical autonomous vehicle, they raise concerns about personal
safety, which are negatively correlated with intention to ride in autonomous vehicles (Panagiotopoulos & Dimitrakopoulos, 2018). The largest factors associated with passengers’ hesitance to ride in an automated vehicle were personal safety and system failure (Daziano et al., 2017; Hulse et al., 2018; Panagiotopoulos & Dimitrakopoulos, 2018).

In addition, potential passengers viewed riding in autonomous automobiles as riskier than driving or riding in an autonomous train (Fu et al., 2019; Hulse et al., 2018). Even when participants knew autonomous vehicles had a better safety record, they still indicated they perceived greater risk from autonomous vehicles than from driving (Brell, Philipsen, & Ziefle, 2019). However, the level of perceived risk of automobiles appeared to be different depending on the population, namely different interactions with automobiles and driving (Hulse et al., 2018).

The greater perceived risk with autonomous automobiles may be because the concept is still under initial development. As recently as 2017, survey participants appeared mixed in their beliefs whether autonomous automobiles will be omnipresent in the future (41%) or that the concept is not realistic (44%) (Bansal & Kockelman, 2017). Individuals also are reluctant to give up the familiar role as driver to a new system and raised concerns over the lack of a steering wheel or means to take control of the vehicle (Chan, 2017; Hulse et al., 2018; König & Neumayr, 2017). Given these concerns, survey participants appeared hesitant to pay more for autonomous operation capabilities (Chan, 2017; Fagnant & Kockelman, 2015). A person’s willingness to pay for new features is related to his or her socioeconomic status and environment, but generally, willingness to pay for autonomous capabilities in automobiles is expected to increase as they become
more commonplace (Bansal & Kockelman, 2017). Such willingness to pay is a significant barrier to technology adoption; if the price of autonomous vehicles as compared to traditional vehicles decreases by 15-20% annually, willingness to purchase the autonomous vehicles will increase, and nearly all road vehicles will be autonomous by 2050 (Talebian & Mishra, 2018).

Other autonomous road vehicles elicited similar concerns of risk—people were more supportive of the concept in the abstract than when one has a personal stake. In a study with participants from the European Union, participants were slightly uncomfortable with autonomous trucks and much more uncomfortable with the concept of autonomous cars (Hudson, Orviska, & Hunady, 2019). When asked about sharing the road with automated vehicles while the participant was driving, Americans, Britons, and Australians indicated greater concerns with larger vehicles, such as trucks and busses, than with cars (Hulse et al., 2018). As passengers, participants still were less willing to ride—or allow family members to ride—in autonomous vehicles such as busses, school busses, and ambulances than in their traditional counterparts (Anania, Rice, Winter, et al., 2018; Winter, Keebler, Rice, Mehta, & Baugh, 2018; Winter, Rice, et al., 2018).

The commercial aviation industry is undergoing a similar exploration of autonomous vehicle technology. As the global pilot supply struggles to meet the growing demand for passenger travel and new routes, airlines, aircraft manufacturers, and regulatory bodies are exploring the concept of single pilot operations, in which the typical airliner flight deck compliment of two pilots is halved and supplemented with automation and ground-based remote support networks (Bilimoria et al., 2014; Lim et al., 2017). As with autonomous vehicles, passengers indicated they were less willing to fly in an airliner
with one pilot or no pilots (Mehta et al., 2017). Passenger willingness to fly also differed with population: Indian participants indicated they were more willing to fly in a reduced-crew aircraft than their counterparts from the United States (Mehta et al., 2017; Ragbir et al., 2018). As with ground vehicles, potential passengers reported that they were most concerned with safety and how autonomous systems handle emergency situations and system interruptions (Ragbir et al., 2018; Vance & Malik, 2015).

**Urban air mobility.** As city populations grow, traffic congestion and physical constraints are hindering commuter access; city planners have been investigating the possibilities of using the immediate airspace to bring commuting into the third dimension (Holden & Goel, 2016; Reiche et al., 2019). Urban air mobility is a growing concept in which small aircraft are used to supplement existing transportation infrastructure by transporting people and cargo within a single city or metropolitan area (Reiche et al., 2019). This concept has been pioneered in several cities using piloted helicopters; São Paulo, Brazil, has experienced the largest growth in urban helicopter use and currently has the world’s largest urban air mobility system (Cwerner, 2006). However, modern helicopters and aircraft remain expensive and inaccessible to many would-be commuters (Holden & Goel, 2016; Holmes et al., 2017).

A confluence of new technology and business models is shaping the UAM concept. First, advances in automation have allowed companies to design vehicles and infrastructure with autonomous operations in mind from the outset (Fu et al., 2019; Lineberger et al., 2018). Unlike the incremental introduction of autonomous operations in ground vehicles, the public will not have a lengthy period to become comfortable with UAM vehicles before autonomous passenger operations are introduced.
The future UAM concept includes three primary types of aircraft: small package delivery autonomous aircraft, on-demand “air taxis,” and scheduled “air metro” service (NASA et al., 2018). Eventually, all three categories of aircraft will comprise the UAM systems in metropolitan areas; in the short term, the unmanned package delivery system is closest to implementation (NASA et al., 2018).

The small package delivery aircraft will therefore shape much of the public’s perception of autonomous aircraft and the UAM concept before passenger UAM aircraft are introduced (NASA et al., 2018; Ramadan, Farah, & Mrad, 2017). As with other autonomous vehicles, people expressed concern about safety and system failures of autonomous package delivery aircraft, especially in urban areas, as small aircraft crashes could injure pedestrians or damage other vehicles or infrastructure (Schenkelberg, 2016). Potential passengers of autonomous aircraft also indicated that a long record of safe operations would increase their willingness to ride in autonomous aircraft (NASA et al., 2018; Vance & Malik, 2015). Although passenger operations are still years away, Amazon®, UPS®, and even medical supply companies are testing delivery aircraft capabilities now (Schaper, 2019). Their successful operations and safety record over the next few years may be a major influence of perceptions of UAM passenger aircraft when they are first introduced (NASA et al., 2018).

The second major advance coinciding with UAM development is that of on-demand services and ridesharing applications. These present an opportunity to reduce the cost to consumers, as the cost of individual aircraft likely precludes widespread personal ownership (Fu et al., 2019). Passenger UAM is likely to be fielded initially as an on-demand service, using “technologically advanced aircraft for widespread public use in
transportation of people and distribution of goods, to virtually any destination accessible by air” (Holmes et al., 2017, p. 2). In a UAM market study, NASA called this on-demand use case an “air taxi service,” to differentiate it from an “air metro” concept akin to city metro or bus services that move more people at a time along scheduled routes (NASA et al., 2018).

As with autonomous ground vehicles, we must caution that air taxis are not commonplace, and any research on perceptions of UAM may be biased based on participants’ preconceptions and attitudes toward autonomy or flight in general (Eker et al., 2019; Fu et al., 2019). Still, such research is important to understand and mitigate possible concerns among the public, as people avoid using technology if they doubt the benefits or safety (König & Neumayr, 2017).

It is important to analyze the public’s attitudes and willingness to use UAM specifically, as it is a completely unique and novel form of transportation with key differences from other vehicles. Like trains and airliners, UAM is a form of public transportation of which the majority of the public does not have specialty training to operate the vehicle manually; thus, the passenger concerns about losing the familiar ability to take control of automobiles that König and Neumayr (2017) found may not apply. This may be part of the reason why passengers did not indicate they were more willing to fly when presented with different emergency control options for autonomous air taxis, such as a joystick (Ward et al., 2019).

UAM vehicles may have technology in common with autonomous automobiles (Fu et al., 2019), and as the hypothetical aircraft described in the studies are small, passenger perceptions appear to be related to automobile driving experiences (Eker et al.,
Potential passengers of autonomous air taxis reported they were most concerned about accidents, safety, and how the aircraft handled system failures (Eker et al., 2019; Vance & Malik, 2015). Participants’ concerns varied with socioeconomic status and relationship to urban transportation. People from rural areas were most concerned with in-flight crashes of UAM aircraft, while people with higher incomes were more concerned with system failures (Eker et al., 2019). Younger people and people with more education were more willing to fly in autonomous air taxis (Fu et al., 2019). Concerns about UAM safety also appeared related to a person’s experience with safety features in automobiles they had owned (Eker et al., 2019).

UAM is coming faster than people may think: UAM aircraft may enter the market within the next five or ten years (Eker et al., 2019; Holden & Goel, 2016; Lineberger et al., 2018), though widespread adoption of the air taxi model will probably occur after 2030 (NASA et al., 2018). The introduction of a new mode of transportation within urban centers calls for investigation of consumer choices, public safety, and business models if UAM companies are to thrive (Fu et al., 2019), as UAM business will require constant passenger volume (Holden & Goel, 2016) and passengers must be willing to pay for the service (NASA et al., 2018). The rapidly advancing field still has unanswered engineering, policy, infrastructure, safety, and psychological questions that must be answered for effective UAM system implementation (Lineberger et al., 2018). To contribute to the advancement of UAM, the present study seeks to provide new insights into these categories by exploring how passengers perceive autonomous air taxis and how those perceptions differ between nations and cultures, thereby arming engineers and
policymakers with timely and relevant information to remove barriers to UAM implementation.

**Variables**

**Safety system availability.** In a study of factors relating to passengers’ willingness to fly in autonomous airlines, the top three positive factors were airline characteristics, automation sophistication, and system response to interruptions (Vance & Malik, 2015). Of those factors, both automation sophistication and airline characteristics were constructs evaluating trust rather than safety and were concerned with an established performance record. As the present research is concerned with the characteristics of the autonomous air taxis themselves, rather than the operating company, it is the system response to interruptions construct that proves illuminating. Systems response to interruptions was defined as how the aircraft responded to malfunctions, emergencies, or degraded operations, and was the top vehicle- and safety-related factor of passenger willingness to fly (Vance & Malik, 2015). Customer safety perceptions are also a primary barrier to widespread UAM adoption and proliferation (Fu et al., 2019). In short, people want to know the aircraft they will fly in is safe, even when systems fail.

However, people with different cultural backgrounds perceive risk differently (Weber & Hsee, 1998). And while risk perception is not the same as demand for risk mitigation (Sjöberg, 2003), people with different cultural orientations have different views of how risk should be mitigated (Adams, 1995) and may place different values on safety systems designed to mitigate risk associated with flying.
Research participants perceived the concept of autonomous automobiles as generally safer, with safety perceptions accounting for 82% of autonomous vehicle desirability (Asgari & Jin, 2019; Gkartzonikas & Gkritza, 2019). These attitudes were not limited toward desirability of such vehicles; 84% of research participants listed safety as a benefit of autonomous vehicle adoption, and 75% stated that safety was the best feature of autonomous vehicles (Gkartzonikas & Gkritza, 2019).

Responses differed when research participants were presented with a scenario in which they would ride in autonomous vehicles themselves. Safety concerns about specific vehicles on a personal level, rather than vehicles as a system or concept, negatively correlated with intention to ride in autonomous vehicle; in a technology acceptance modeling approach, safety was weighted the highest among the factors comprising perceived trust of autonomous vehicles, thereby influencing the behavioral intention to use the vehicles (Panagiotopoulos & Dimitrakopoulos, 2018).

At the time this research was conducted, several companies were developing autonomous air taxi systems and vehicles, though none were fully operational and publicly available. Volocopter® and Airbus® published descriptions of their vehicles under development, while Uber Elevate® provided more hypothetical characteristics of aircraft operating within its developing system. The Volocopter® aircraft has an airframe parachute and can be adapted for remote piloting (Volocopter, 2019). In a white paper, Uber Elevate® also discussed airframe parachutes and remote piloting capability as desired safety systems (Holden & Goel, 2016). Airbus® similarly stated that an airframe parachute was available in their autonomous air taxi (Electric VTOL News, 2018). No
company listing an available airframe parachute specified whether it is manually or automatically deployed.

In a prior study of passenger willingness to fly in autonomous air taxis, participants were asked their willingness to fly given the availability of an automatic airframe parachute, manual airframe parachute, remote pilot system, two-way radio communications, a joystick for manual control, and a button to immediately land the aircraft (Ward et al., 2019). While Indian participant willingness to fly was not significantly different from the baseline for any safety system, U.S. participant willingness to fly increased with each system except the joystick, and it increased the most for the automatic airframe parachute availability and remote pilot system availability (Ward et al., 2019). Given these findings and their inclusion in developing systems, the automatic airframe parachute and remote pilot system were selected for further investigation in this current study.

**Automatic airframe parachute availability.** Airframe parachutes, sometimes called ballistic recovery systems, are parachutes attached to the body of an aircraft designed to be deployed during an emergency in which landing the aircraft is impossible or inadvisable (Winter et al., 2014). Small aircraft manufacturers are increasing the prevalence of airframe parachute installations as popularity and system familiarity grow, notably marketing them as systems that can mitigate the effects of “total electrical system failure in electric aircraft, especially for multirotor or [distributed electric propulsion] powered lift configurations in vertical flight modes where autorotation or gliding is not possible” (Courtin & Hansman, 2018, p. 8). It is notable that manufacturers are emphasizing small electric aircraft, as it fits the description of emerging UAM design
concepts, which have indeed advertised airframe parachutes as included systems (Eker et al., 2019; Electric VTOL News, 2018; Holden & Goel, 2016; Volocopter, 2019).

Given the emphasis on autonomous operations in UAM, airframe parachutes that deploy automatically may be an integral component of intelligent emergency handling systems (Alexandrov, 2017). Emergency handling systems will monitor the external environment and vehicle systems to manage system degradation, attempt to reach safe a landing site early in the problem chain, and deploy the parachute if the aircraft cannot land safely (Alexandrov, 2017). While there are many studies discussing the effectiveness and design of airframe parachutes, they are not germane to the present research; here we are concerned with peoples’ perceptions of the technology. Prior research regarding airframe parachutes indicated that pilots made the decision to use such parachutes based upon the flight scenario, concern over damage to the aircraft, and desire to control the aircraft (Winter et al., 2014). Such decisions may be made based on choices “between a sure loss and a risky loss” (Winter et al., 2014, p. 33).

Pilots perceived the systems favorably; in a survey they agreed or strongly agreed that flying an aircraft with an airframe parachute was safer than flying one without a parachute (Winter, Geske, Rice, Fanjoy, & Sperlak, 2015). As small pilotless aircraft are an emerging technology, the body of knowledge lacks insight into how non-pilots perceive and may interact with aircraft systems; previous studies were based on pilot actions and perceptions rather than those of passengers (Winter et al., 2014; Winter, Geske, et al., 2015). In one of the few studies of passenger perceptions of UAM aircraft, study participants responded that they desired safety systems capable of mitigating the effects of in-flight emergencies, and specifically requested airframe parachutes (Shaheen
et al., 2018). In a prior study, survey respondents indicated higher levels of willingness to fly in an autonomous air taxi if it was equipped with an airframe parachute (Ward et al., 2019).

For further insight into potential passengers’ desires, studies about automotive safety features may provide insight. As passengers cannot make such decisions about when and how to use an automatic parachute, a parachute is a form of passive system designed to mitigate consequences of an emergency event rather than an active or preventative safety system. In these regards, automatic airframe parachutes may be comparable to other passive, mitigating safety systems such as airbags in automobiles.

U.S. drivers listed seatbelts, airbags, and other crash mitigating passive safety systems as most important when selecting a new automobile (Kaul, Singh, Rajagopalan, & Coury, 2010; Koppel, Charlton, Fildes, & Fitzharris, 2008). If given a fixed budget to allocate to features in a new automobile, U.S. study participants selected systems that protect the occupant first, indicating they prioritized crash mitigation features (Kaul et al., 2010). While the analogy is not perfect, as a person’s driving experience likely shapes his or her perceptions of autonomous automobiles (Tennant et al., 2019), these studies hint that potential UAM passengers will desire such passive safety systems.

**Remote pilot system availability.** A remote pilot system differs significantly from other systems explicitly intended as safety systems as it is a means of control, not a system designed to prevent or mitigate accidents. Yet in the present research, a remote pilot system is presented to participants as a system which allows a human operator to take control in the event of an emergency. From the perspective of the passenger who has
no means to take control in any situation, it is a passive system intended to mitigate consequences of an emergency event, and therefore, a safety system in this context.

This is not to say one can be careless with use of terms in the present research; this study presents it as a system only available during an emergency, thus distinguishing it from other research and applications of remote pilot systems. This is because human-piloted conditions remain the preferred mode of operation among potential UAM passengers (Shaheen et al., 2018). U.S. and Indian participants indicated that they were less willing to fly in autonomous aircraft and aircraft with remote pilots than aircraft with on-board human pilots, though attitudes toward full autonomy and remote pilots were similar (Rice et al., 2014).

When given the choice between conventionally piloted commercial aircraft and a similar remotely piloted aircraft, passengers again consistently chose the conventionally piloted aircraft (Fu et al., 2019; Lee et al., 2019; Molesworth & Koo, 2016). If flying on the remotely piloted aircraft cost less or if the aircraft exhibited greater on-time performance and on-board service, more passengers were willing to fly (Lee et al., 2019; Shaheen et al., 2018). In this manner, passengers do not appear to be adamant in their preference of onboard pilots over remote pilots.

When removing the option to have an onboard pilot at all, potential passengers exhibited differences in willingness to fly when presented with the option for a fully autonomous aircraft or an autonomous aircraft with a remote pilot capability. Another study found that U.S. passengers exhibited greater willingness to fly in autonomous aircraft if a remote pilot system was available for emergencies (Ward et al., 2019). These findings taken together indicate that while a human pilot is preferred, passengers have
differing levels of willingness to fly in autonomous aircraft and remotely piloted aircraft. This preference may carry forward to the present research emergency remote pilot system, raising willingness to fly in conditions in which the remote pilot system is available at least part of the time.

**Nationality.** In the present study, nationality represents the country of origin and is limited to the United States and India. The United States and India were chosen because they are included in several applicable studies of autonomous vehicles, the population has different cultural orientations, and both have accessible English-speaking populations through the Amazon Mechanical Turk® crowdsourcing platform.

First, the United States and India appear paired in prior studies of willingness to fly in autonomous aircraft. In such studies, Indian participants self-reported more willingness to fly than U.S. participants (Mehta et al., 2017; Rice et al., 2014). Similarly, Indians were more willing to ride, or let family members ride, in other autonomous vehicles (Anania, Rice, Winter, et al., 2018). In a prior study of willingness to fly in autonomous air taxis, Indians again demonstrated a greater willingness to fly in autonomous aircraft, but when presented scenarios with aircraft with different safety systems, Indian participant willingness to fly was unchanged, while U.S. participant willingness increased with the availability of parachutes, remote pilot capabilities, abort options, and communication equipment (Ward et al., 2019).

Second, the United States and India have different national cultural orientations, thereby identifying the nations as candidates for comparing differences in cultural orientations of individuals. Hofstede (1980) found that U.S. national culture was more individualist than Indian national culture and that U.S. national culture also exhibited a
smaller power distance disposition than Indian culture. These findings remain consistent in modern research by Hofstede’s foundation, which found that on a scale from 0 to 100, the United States had an individualism value of 91, and India had an individualism value of 48. The United States exhibited a power distance of 40 compared to India’s 77 (Hofstede Insights, 2019). In the horizontal and vertical individualism and collectivism framework, they still exhibit different orientations as the United States is a vertical individualist nation, and India is a vertical collectivist nation (Singelis et al., 1995).

Third, the United States and India both have an accessible population for survey participation through MTurk®. As both nations have large English-speaking populations (Parshad et al., 2016), the same survey instrument can be used in both nations, thereby avoiding threats to validity and reliability. Amazon® MTurk® currently supports direct electronic payments to bank accounts in the United States and India, paying workers in local currency in compliance with the local tax laws (MTurk, 2018). Furthermore, MTurk® verifies worker bank account, tax, and legal work status of employees in the respective countries upon registration, ensuring that potential international survey participants are not merely accessible, their nationality is verified (MTurk, 2018).

Cultural orientation. The cultural cognition approach using the cultural values scale appears to be the best fit for the current study. First, it quantifies cultural theory approaches rather than relying on categorical groupings. Second, it solves Dake’s (1991, 1992) problems with the four-construct model where an individual could score high in more than one cultural orientation (Boholm, 1996; Kahan, 2012). Third, it employs the same two conceptual axes as cultural theory, which are similar to individualism-collectivism constructs well-represented in a wide body of work. Finally, the cultural
values scale aligns with previous research in cultural theory and cultural cognition theory where there have been demonstrated relationships between cultural orientation and risk perception and behavioral intention (Rundmo et al., 2012; Weber & Hsee, 1998), justifying its use in the present case.

Kahan and colleagues developed and tested a 29-question “cultural worldview scale” based upon the group and grid dimensions, albeit calling the group-type scale “communitarianism-individualism” and the grid-type scale “egalitarianism-hierarchism.” (Kahan, 2012; Kahan et al., 2007, 2010). While Douglas observed that the scales presented an overly American perspective, the cultural worldview scale seemed to address validity problems with Dake’s scales and consistently had values of Cronbach’s alpha greater than .70 (Kahan, 2012). The cultural cognition approach and cultural worldview scale worked well enough in fact that it was possible to abridge the instrument into a 12-item questionnaire with Cronbach’s alpha values of .81 for individualism and .87 for hierarchy (Kahan, 2012; Kahan et al., 2011). The abridged cultural worldview scale was selected for the present research because of its demonstrated reliability and brief nature ideal for a distributed survey instrument.

**Passenger willingness to fly.** The willingness of passengers to fly in autonomous aircraft is of particular interest to the emerging UAM market, as consumers’ willingness to fly directly affects the success and proliferation of UAM (Winter, Rice, et al., 2015, 2018). Until recently, much of the research into acceptance of automated vehicles has involved trust or comfort (Rice & Winter, 2015). Trust is a useful construct to measure as it can influence use of automation, as people tend to avoid systems they do not trust (Parasuraman & Riley, 1997). Yet trust is insufficient to model behavioral intention, as it
is a separate construct (Schwarz, Gaspar, & Brown, 2019). For example, if a user fails to perceive the benefits of an automated system, they are not likely to use it even if they consider it generally trustworthy and reliable (Parasuraman & Riley, 1997). This is especially concerning since UAM is a new concept with its benefits potentially unknown to the public, there may be uncertainty regarding its benefits (Rice & Winter, 2015).

Rather than continue measuring trust and comfort, the willingness to fly scale was developed to study passengers’ intentions and decision-making directly (Rice & Winter, 2015; Winter, Rice, et al., 2018). The scale consists of seven Likert response items on a five-point scale, which record self-assessed ratings of whether a potential passenger is willing to fly, comfortable to fly, happy to fly, feels safe flying, has no fear flying, and has no problem flying (Rice, Mehta, et al., 2015). The willingness to fly scale was created and validated by surveying airline passengers throughout its development (Rice & Winter, 2015; Rice, Winter, Kraemer, Mehta, & Oyman, 2015).

The willingness to fly scale has consistently demonstrated high levels of validity and internal consistency. Validity was demonstrated by strong single-factor loading in a factor analysis (Mehta et al., 2017). The scale and its adaptations achieved values of Cronbach’s alpha between .93 and .98 in several studies (Anania, Rice, Walters, et al., 2018; Anania, Rice, Winter, et al., 2018; Winter, Keebler, et al., 2018; Winter, Rice, Friedenreich, Mehta, & Kaiser, 2017; Winter, Rice, et al., 2018).

Research using the willingness to fly scale has found that potential passengers are less willing to fly in autonomous aircraft than in human-piloted aircraft (Mehta et al., 2017; Rice & Winter, 2015). The scale has also been adapted successfully to assess willingness to ride in automated ground vehicles such as busses (Winter, Rice, et al.,
school busses (Anania, Rice, Winter, et al., 2018), and ambulances (Winter, Keebler, et al., 2018), finding in each case that the scale is reliable and that potential passengers generally prefer human-operated conditions. Given the versatility and reliability of the willingness to fly scale, it was selected to assess the dependent variable in the present research.

**Use of Likert scales.** Likert scales are used as interval values in the cultural orientation and willingness to fly variables. Likert scales are often confused with Likert response formats due to imprecise use of language, particularly centered on varying uses of the word “scale,” which has led to debate in the community whether such scales can be treated as interval data (Carifio & Perla, 2007). A Likert response format consists of ordinal, numeric response options to a question, associated with descriptive adjectives. For example, a five-point Likert response format may appear as 1: Strongly disagree, 2: Disagree, 3: Neither disagree nor agree, 4: Agree, and 5: Strongly agree. One may be tempted to use “scale” in a colloquial manner here to refer to the options of 1, 2, 3, 4, and 5 as a range of numbers; however, that implies a continuum to what is unambiguously ordinal data (Carifio & Perla, 2007).

A Likert scale, in the correct use of the term, is a construct that consists of multiple items that use a Likert response format. Likert scales exhibit new properties not necessarily present at the individual item level, which Carifio and Perla (2007) compared the differences in chemical behavior between molecules and their constituent atoms. Such scales should have at least 6 to 8 constituent items to increase reliability and validity (Carifio & Perla, 2008; Cronbach, Gleser, Nanda, & Rajaratnam, 1972). As opposed to direct measurement in individual items with a Likert response format, a Likert scale
intrinsically contains coding and analysis as a product of the transformation from individual ordinal items to a singular interval scale (Carifio & Perla, 2007, 2008). Due to this distinction, one must take caution to only use the scale variables in analysis, rather than the constituent items.

This is not to say that one can simply group a few Likert response format items and proclaim a Likert scale; component items must support the intended construct and be tested to ensure reliability. When Likert (1932) originally developed his technique, he treated the scale data as interval values—the mean of individual, ordinal items in each group. Likert was careful to ensure each response item only measured a single component attitude of the larger construct, demonstrating intent to use as a whole, and stressed the importance of internally consistent and differentiating questions. He further designed the Likert scale to employ “split-half” reliability by wording questions to prompt the participant—if he or she has a consistent attitude—to respond both positively and negatively to different questions within the scale, thereby ensuring numerical values are correctly applied throughout the range of possible responses (Likert, 1932, p. 48).

Researchers have demonstrated that Likert scale variables can be used in parametric tests under specific conditions (Carifio & Perla, 2007; Glass, Peckham, & Sanders, 1972; Mircioiu & Atkinson, 2017). Should Likert scale data exhibit non-normal distributions, Glass and colleagues (1972) found in a Monte Carlo analysis that the $F$ test was robust to non-normal skewness and kurtosis, as well as heterogeneity of variance, so long as independence of errors is met. Mircioiu and Atkinson (2017) agreed in their comparison of parametric and non-parametric analyses of Likert scales; while survey data do not reflect Gaussian distribution, parametric analyses were sufficiently robust to reach
similar conclusions to non-parametric analyses. Given the robustness of parametric
techniques, Carifio and Perla (2007) argued that there is no need for researchers to limit
themselves solely to non-parametric analyses, and that researchers should make use of
the wealth of parametric analysis techniques so long as Likert scales are constructed
adequately.

**Hypotheses and Support**

The first study investigated the effects of nationality (Hypothesis 1), automatic
airframe parachute availability (Hypothesis 2), and remote pilot capability (Hypothesis 3)
on passenger willingness to fly in an autonomous air taxi. In Hypothesis 1, we
hypothesized that Indians are significantly more willing to fly in an autonomous air taxi
because in previous research, Indian survey participants were more willing to fly in
autonomous airliners and autonomous air taxis than survey participants from the United
States. (Ragbir et al., 2018; Rice et al., 2014; Ward et al., 2019).

In Hypothesis 2, we expected that participants would indicate that they were more
willing to fly if there is an automatic airframe parachute available because pilots
indicated parachutes are a desired feature that makes the aircraft safer (Winter, Geske, et
al., 2015), potential UAM passengers indicated that they desired parachutes (Shaheen et
al., 2018), and a study preceding the present research indicated that passengers had
greater willingness to fly with airframe parachutes available (Ward et al., 2019). As
passengers preferred aircraft with pilots on board over remotely piloted or autonomous
aircraft (Rice et al., 2014), and remotely piloted aircraft over autonomous aircraft (Ward
et al., 2019), we expected this ranked preference to manifest in Hypothesis 3 with study
participants preferring aircraft with remote pilot systems available to those without remote pilot systems.

The two-way (Hypothesis 4) and three-way (Hypothesis 5) interactions represented the first chance to begin separating the effects of nationality and culture. Hofstede (1980) provided insight into how nationality is associated with trends in cultural orientation. Previous studies have shown that collectivist cultures, and India specifically, are more accepting of autonomous vehicles (Mehta et al., 2017; Winter et al., 2017). Once we introduce a safety system—an automatic airframe parachute or remote pilot system—into the analysis, we are reminded of findings from cultural cognition theory whereby a person perceives more risk in something that causes conflict with his or her cultural orientation. In this case, the presence or absence of a safety system was hypothesized to affect an individualist’s underlying preference to control personal risk mitigation and behavior (Adams, 1995). Therefore, in Hypothesis 4, we expected two-way interactions where U.S. participants (individualists) are more willing to fly if either safety system is available, while the differences among Indian participants (collectivists) with and without safety systems available are not as pronounced. This condition manifested in the study preceding the present research, where U.S. participants had greater willingness to fly if an automatic airframe parachute or remote pilot system was available, while Indian participants did not have significantly different willingness to fly in any condition (Ward et al., 2019).

After repeating the first study (Hypotheses 6 through 8), the second study investigated whether and how cultural orientation mediates the relationship between safety system availability and willingness to fly. This mediation analysis allowed the
separation of the effects of nationality and cultural orientation, as each were assessed separately. First, cultural orientation along the individualism-communitarianism continuum from the cultural worldview scale (Kahan et al., 2011) was tested as a mediator. Previous studies of India cited its collectivist national culture as a potential reason for increased acceptance of autonomous vehicles. People with collectivist orientations perceive less risk and exhibited greater willingness to act in a setting with controlled risk, and that willingness varied more between groups of cultural orientation than within groups (Weber & Hsee, 1998). Conversely, individualists tend to form negative opinions toward public transportation, which is contrary to the individualist worldview (Tikir & Lehmann, 2011). And as discussed earlier, individualists may value the inclusions of safety systems more because of their belief that risk acceptance and mitigation is a personal decision (Adams, 1995). For these reasons, in Hypothesis 9, we hypothesized that one’s communitarianism-individualism cultural orientation mediates the relationship between safety system availability and willingness to fly, with the individualism end of the spectrum varying more between conditions.

Similarly, the egalitarianism-hierarchism-continuum of cultural orientation was also tested as a mediator. People from social groups valuing hierarchy are most concerned with risks involving threats to law and order, while egalitarians (high group and low grid in this context) were more concerned with technological and environmental risks (Sjöberg, 2002a). People from highly hierarchical social groups are more likely to yield to risk decisions made by authoritative figures (Yang, 2015); in the case of an operational UAM system, such people may assume that if it is operational, a competent authority will have mitigated that risk. Fatalists (high grid, low group) tend to assume
events are out of their control and refrain from debates about such decisions (Adams, 1995). Thus, in Hypothesis 10, we expected the egalitarianism-hierarchism cultural orientation to mediate the relationship between safety system availability and willingness to fly, with the hierarchical end of the continuum having less of an effect on willingness to fly.

**Summary**

To the best of the author’s knowledge, there is no direct theory relating nationality, culture, and willingness to act that may apply to autonomous aircraft. It is difficult to ascribe the cause of differences between people of different cultures and nations; it requires a multitude of experiments building upon each other from different angles (Hsee & Weber, 1999). Such research is akin to creating a mosaic, where “each constituent tile of the mosaic may not be recognizable in and by itself, but in combination and with a bit of distance the tiles create a clear image” (Hsee & Weber, 1999, p. 176). One chain of relationships, however, hints at a possible mechanism underlying the observed relationship between nationality and willingness to fly in autonomous aircraft.

Several links in the chain between nationality and willingness to fly have been established in the body of knowledge. Nationality generally predicts one’s culture, including the aspects of individualism, collectivism, and the importance of hierarchies and status on a person’s daily life (Hofstede, 1980; Triandis & Gelfand, 1998). A person’s cultural orientation toward the importance of horizontal and vertical relationships affects the individual’s risk perception (Tansey & O’Riordan, 1999). Risk perception has been associated with attitudes and behavioral intention through cultural cognition theory and extensions to the technology acceptance model, theory of planned
behavior, and theory of reasoned action (King & He, 2006; Madden et al., 1992; Tikir & Lehmann, 2011).

The two end points of this chain—nationality and intention to act, or willingness—have been linked in previous research of aircraft with reduced crew sizes or no on-board pilots (Rice et al., 2014; Ward et al., 2019). These studies suggested that cultural dimensions, such as individualism and collectivism, may be a factor in differences in passenger willingness to fly, but stopped short of directly measuring cultural orientations. By assessing cultural orientation, the present study may begin to separate the national and cultural factors in passengers’ perceptions and willingness to fly in autonomous aircraft.
CHAPTER III

METHODOLOGY

This chapter describes the methodology used to answer the research questions. It describes how the research method and design were selected, restates the research questions and hypotheses, and describes the processes used to collect and analyze data so that others may replicate this research. The processes used to identify the required population sample, recruit participants, determine whether participants are eligible, protect participants, and meet ethical standards are described in detail as well.

Research Method Selection

The research employs a quantitative, between-participants survey experiment design in a multi-study format. Quantitative methodology was selected because statistical analyses can evaluate the hypotheses associated with the research questions about causal effects, interactions, and mediation. In addition, the constructs included in the research questions—cultural orientation and willingness to fly—can be measured with quantifiable data from available, validated instruments.

As the intent of the study is to assess behavioral intention of participants best obtained from the participants themselves, which can be assessed in short, self-assessed questions, a survey is the best method for distribution (Vogt, Gardner, & Haefele, 2012). The hypothetical nature of the scenario used in the survey instrument can easily be adjusted as an independent variable, participants can be assigned randomly to the conditions, and the study is intended to demonstrate a causal relationship; therefore, an experimental design is desirable (Alferes, 2013; Vogt et al., 2012). In addition, a survey
experiment can be replicated as other researchers seek to expand this study to other populations or aircraft systems.

A multi-study format is used to enhance the reliability and power of the research. Data from prior research using the same scenario (Ward et al., 2019) can be included along with results from Study 1 and Study 2 to compare the standard effect sizes between surveys using the same scenario, nationalities, safety systems, and willingness to fly scale (McShane & Böckenholt, 2017). Doing so helps the scientific community by ensuring the present research is reliable and replicable (Lynn, 2017). There is typically less uncertainty in estimates of effect sizes when compared between studies, as weighted averages of results are employed, both increasing statistical power and “providing a means of resolution when individual studies yield so-called conflicting results” (McShane & Böckenholt, 2017, p. 1,048). In addition, the effect size observed in each iteration of the study can be used to inform and adjust an a priori power analysis in the subsequent study.

**Research Questions and Hypotheses**

The research questions and hypotheses are restated below. The literature provides reason to suspect directionality of some hypotheses; however, there was a nonzero probability of effects in either direction. Therefore, means comparison hypotheses were evaluated bi-directionally.

RQ1: What is the effect of participant nationality on willingness to fly in autonomous air taxis?

H₁: There is a significant difference in willingness to fly in autonomous air taxis as a function of participant nationality.
H₀₁: There is no significant difference in willingness to fly in autonomous air taxis as a function of participant nationality.

RQ2: What is the effect of automatic airframe parachute availability on willingness to fly in autonomous air taxis?

Hₐ₂: There is a significant difference in willingness to fly in autonomous air taxis as a function of automatic airframe parachute availability.

H₀₂: There is no significant difference in willingness to fly in autonomous air taxis as a function of automatic airframe parachute availability.

RQ3: What is the effect of remote pilot system availability on willingness to fly in autonomous air taxis?

Hₐ₃: There is a significant difference in willingness to fly in autonomous air taxis as a function of remote pilot system availability.

H₀₃: There is no significant difference in willingness to fly in autonomous air taxis as a function of remote pilot system availability.

RQ4: What is the effect of any two-way interaction between nationality, automatic airframe parachute availability, and remote pilot system availability?

Hₐ₄ₐ: There is a two-way interaction between nationality and automatic airframe parachute availability.

H₀₄ₐ: There is no two-way interaction between nationality and automatic airframe parachute availability.

Hₐ₄ₘ: There is a two-way interaction between nationality and remote pilot system availability.

H₀₄ₘ: There is no two-way interaction between nationality and remote pilot system availability.
H₀₄b: There is no two-way interaction between nationality and remote pilot system availability.

Hₐ₄c: There is a two-way interaction between automatic airframe parachute availability and remote pilot system availability.

H₀₄c: There is no two-way interaction between automatic airframe parachute availability and remote pilot system availability.

RQ5: What is the effect of a three-way interaction between participant nationality, automatic airframe parachute availability, and remote pilot system availability on willingness to fly in autonomous air taxis?

Hₐ₅: There is a three-way interaction between nationality, automatic airframe parachute availability, and remote pilot system availability.

H₀₅: There is no three-way interaction between nationality, automatic airframe parachute availability, and remote pilot system availability.

RQ6: What is the effect of participant nationality on willingness to fly in autonomous air taxis?

Hₐ₆: There is a significant difference in willingness to fly in autonomous air taxis as a function of participant nationality.

H₀₆: There is no significant difference in willingness to fly in autonomous air taxis as a function of participant nationality.

RQ7: What is the effect of safety system availability on willingness to fly in autonomous air taxis?

Hₐ₇: There is a significant difference in willingness to fly in autonomous air taxis as a function of aircraft safety system availability.
H₀⁷: There is no significant difference in willingness to fly in autonomous air taxis as a function of aircraft safety system availability.

RQ8: What is the effect of a two-way interaction between nationality and safety system availability?

Hₐ₈: There is a two-way interaction between nationality and aircraft safety system availability.

H₀₈: There is no two-way interaction between nationality and aircraft safety system availability.

RQ9: How does a person’s level of communitarianism-individualism mediate the relationship between safety system availability and willingness to fly?

Hₐ₉ₐ: Overall, communitarianism-individualism significantly mediates the relationship between aircraft safety system availability and willingness to fly in autonomous air taxis.

H₀₉ₐ: Overall, communitarianism-individualism does not significantly mediate the relationship between aircraft safety system availability and willingness to fly in autonomous air taxis.

Hₐ₉₉: Among potential U.S. passengers, communitarianism-individualism significantly mediates the relationship between aircraft safety system availability and willingness to fly in autonomous air taxis.

H₀₉₉: Among potential U.S. passengers, communitarianism-individualism does not significantly mediate the relationship between aircraft safety system availability and willingness to fly in autonomous air taxis.
H_{A9c}: Among potential Indian passengers, communitarianism-individualism significantly mediates the relationship between aircraft safety system availability and willingness to fly in autonomous air taxis.

H_{09c}: Among potential Indian passengers, communitarianism-individualism does not significantly mediate the relationship between aircraft safety system availability and willingness to fly in autonomous air taxis.

RQ10: How does a person’s level of egalitarianism-hierarchism mediate the relationship between safety system availability and willingness to fly?

H_{A10a}: Overall, egalitarianism-hierarchism significantly mediates the relationship between aircraft safety system availability and willingness to fly in autonomous air taxis.

H_{010a}: Overall, egalitarianism-hierarchism does not significantly mediate the relationship between aircraft safety system availability and willingness to fly in autonomous air taxis.

H_{A10b}: Among potential U.S. passengers, egalitarianism-hierarchism significantly mediates the relationship between aircraft safety system availability and willingness to fly in autonomous air taxis.

H_{010b}: Among potential U.S. passengers, egalitarianism-hierarchism does not significantly mediate the relationship between aircraft safety system availability and willingness to fly in autonomous air taxis.

H_{A10c}: Among potential Indian passengers, egalitarianism-hierarchism significantly mediates the relationship between aircraft safety system availability and willingness to fly in autonomous air taxis.
H₀₁₀: Among potential Indian passengers, egalitarianism-hierarchism does not significantly mediate the relationship between aircraft safety system availability and willingness to fly in autonomous air taxis.

Population/Sample

Population and sampling frame. The present study is intended to assess the willingness to fly of potential UAM passengers in the United States and India. As autonomous air taxis are intended to serve the general public, the target population of interest includes all U.S. and Indian residents 18 years of age or older. This population was selected because, at the time this was written, Uber Elevate’s® first planned operations are in Dallas and Los Angeles in the United States, followed by India and four other countries in early expansion plans (Uber Technologies, 2019). Thus, selecting these two countries afforded an opportunity to analyze one of the earliest populations that may participate in autonomous air taxi services. India was selected from among the countries listed because it is a developed nation with several dense urban areas suitable for autonomous air taxis, has a large English-speaking population (Parshad et al., 2016), and Indians have different national-level trends in cultural orientations (Hofstede, 1980) and outlooks toward autonomous vehicles than people from the United States (Rice et al., 2014).

The accessible population from where the sample will be selected was users of the MTurk® crowdsourcing platform, thereby delimiting the sample to English-speaking residents of the United States and India with internet access and MTurk® accounts. While physical access may ensure more of the population is accessed locally, it is impossible to reach the breadth of the U.S. and Indian populations without electronic means and direct
sampling would excessively limit the study. MTurk® provided an opportunity to access a broad sampling of the U.S. and Indian populations and could still provide high-quality data that is not systematically different from lab-based data (Buhrmester et al., 2011; Germine et al., 2012; Rice et al., 2017). Workers on MTurk® presented the same biases and levels of attention as participants in lab studies, while the internet platform avoids experimenter bias (Paolacci, Chandler, & Ipeirotis, 2010). MTurk® is especially suited to cross-cultural research because of the diverse and accessible participant base (Mason & Suri, 2012).

**Sample size.** An a priori power analysis was conducted to determine the required sample size for each study. Conducting the power analysis before data collection is important as it ensures there is sufficient statistical power to answer the research questions, given the research analysis selected, such that if there is a difference between groups it can be detected (Buskirk, 2011; Coffey, 2012). Larger sample sizes are required if stricter limits of Type I error ($\alpha$) or Type II error ($\beta$) are imposed (Acheson, 2012); to remain within the bounds of rigor and feasibility, the present research sets $\alpha = .05$ and power = .80 ($\beta = .20$), as is common practice in social science research (Buskirk, 2011; Noymer, 2011).

G*Power 3.1.9.3 was used to calculate the required sample sizes given desired probability value, power, and discernable effect size. G*Power uses Cohen’s $f$ and $f^2$ as the units of measurement for effect size in ANOVA and multiple regression calculations, respectively (Faul, Erdfelder, Lang, & Buchner, 2007). The commonly accepted definitions of effect sizes for Cohen’s $f$ are $f = .10$ for a small effect, $f = .25$ for a medium effect, and $f = .40$ for a large effect (Aberson, 2019). For $f^2$, we used the definitions of
In a study preceding the present research, the researchers observed that the effect size of nationality on willingness to fly was $\eta^2_{\text{partial}} = .027$ (Ward et al., 2019). The results were analyzed in SPSS®, which does not calculate Cohen’s $f$ directly (IBM, n.d.). Instead, IBM® provided a formula to transform the SPSS® $\eta^2_{\text{partial}}$ output to Cohen’s $f$ (IBM, n.d.):

$$f = \sqrt{\frac{n^2_{\text{partial}}}{1-n^2_{\text{partial}}}}$$

(1)

Using Equation 1, we calculated the effect size from the prior study to be $f = .17$, halfway between a small and medium effect (Aberson, 2019). Selecting the more sensitive approach, this study will seek to collect enough data to detect a small effect.

An a priori power analysis indicated that the three-way factorial ANOVA in Study 1 required 787 participants to detect a small effect size ($\alpha = .05, \beta = .20, f = .1$). With three variables of two categories each, there are eight dichotomous groups (numerator degrees of freedom = 1) which will have a minimum of 99 participants per group. Two-tailed comparisons are presumed in all power analysis here because, even though directionality is hypothesized, no definition or other constraint made it impossible for differences to fall in either direction (Acheson, 2012).

For the portion of Study 2 which replicated Study 1, 787 participants were required for the two-way ANOVA with four dichotomous groups ($\alpha = .05, \beta = .20, f = .1$), according to an a priori power analysis using G*Power. This equates to 197 participants per group. Study 2 required 550 participants for the mediation analysis following ordinary least squares regression assumptions. A regression model with three
predictors (two independent variables and one mediating variable) and a small sample size was used for the power analysis ($\alpha = .05, \beta = .20, f^2 = .02$). Study 2 as a whole therefore also required 787 participants as the minimum sample size, as it was the maximum requirement of the two analyses sharing data.

**Sampling strategy.** Both studies employed a convenience sampling strategy. An Amazon MTurk® task was created for each batch of questionnaires and activated at the same local time of day in both Washington, DC, and New Delhi, India.

MTurk® was chosen as a recruitment and distribution platform as it allows rapid acquisition of many samples of similar quality to lab-based samples (Buhrmester et al., 2011; Rice et al., 2017). Furthermore, internet-based sampling methods have demonstrated convergent validity with lab-collected data, indicating they access similar psychological and social constructs (Germine et al., 2012).

MTurk® uses the term “human intelligence task” (HIT) to denote a task or job listed on their internet platform; this includes internet-based surveys. “Worker” is a person performing a HIT, while a “requester” is the person who posts a HIT and indicates the required number of workers. Amazon® manages the payment accounts for both requesters and workers (MTurk, 2018). A requester must prepare the task, set the payment rate and required number of workers, and electronically transfer the funds in full to his or her Amazon® account to initiate the task. Upon completion of a HIT, Amazon® electronically credits a worker’s account.

Requesters can also set restrictions within HITs to allow only workers with specific qualifications or nationality to participate. MTurk® verifies nationality upon account registration for tax and legal purposes (MTurk, 2018). In this research, the HIT
settings will enforce and limit survey distribution to U.S. and Indian participants. MTurk® also allows requesters to filter workers completing a HIT based upon previous performance (Rice et al., 2017). This study will limit participants to those who have completed at least 100 HITs with at least a 98% approval rate from previous requesters, which excludes low-rated workers who tend to not follow instructions (Peer, Vosgerau, & Acquisti, 2014).

In a prior study, the researchers received 281 responses to a survey about willingness to fly in autonomous aircraft with various safety systems in less than four hours (Ward et al., 2019). Workers were required to have a 95% approval rate and have completed at least 100 tasks. Participants in the United States and India were compensated $0.20 to complete a questionnaire with seven Likert item questions, two short answer questions, and associated demographic questions. The present research has seven Likert item questions in Study 1 and 19 Likert item questions in Study 2, in addition to associated demographic questions. Based on the conduct of the prior study and comparisons to the present research, compensation was set at $0.50 per participant for the present research.

MTurk® and traditional laboratory studies both face threats from participants misrepresenting themselves. Studies should be designed so that falsely reported demographics cannot invalidate the study (Siegel & Navarro, 2019). Explicit screening criteria also increases the likelihood the participants will misrepresent themselves to take part in the study, in one notable example, increasing observed demographic misrepresentation among participants from 4% to 45% (Kan & Drummey, 2018; Wessling et al., 2017). The present study avoids this problem by using the MTurk®
platform to control distribution between the key groups of nationality and therefore does 
not provide the option to represent oneself as a resident of a different country. In 
addition, participants in the present study are compensated for participation regardless of 
completion of the research, and there are no screening criteria other than being older than 
18 years of age, which is already verified by MTurk® when a user creates an account. 

The quality of MTurk® data is not typically affected by the amount of 
compensation; instead only the time required to recruit participants negatively varies with 
compensation rates (Litman et al., 2015; Mason & Suri, 2012). Data quality from Indian 
workers only declines if participants are compensated at a rate below the local minimum 
wage in India, which ranges from $0.28 to $0.50 per hour depending on the locality 
(Litman et al., 2015). As Study 1 was expected to take less than 5 minutes to complete 
and Study 2 was expected to take less than 10 minutes to complete, compensation rates 
exceeded $3.00 to $6.00 per hour, well above the threshold of decreased data quality 
from Indian participants seen in Litman and colleagues’ (2015) study. 

There are eight independent variable groups in Study 1 representing the 2 x 2 x 2 
combinations of nationality, automatic airframe parachute availability, and remote pilot 
system availability. Separate MTurk® HITs were created for the U.S. and Indian 
populations, which allowed them to be activated at the same local time of day and limited 
to the appropriate populations. Participants were given a link to the survey with 
embedded JavaScript® code that randomly assigned participants to one of four survey 
instruments hosted by Google Forms®. The four instruments differed only in describing 
which combination of safety systems was available. Although the MTurk® HIT is
different for U.S. and Indian participants, the HITs directed all participants to the same pool of survey instruments.

The questionnaires for both studies were initially distributed to U.S. and Indian participants in batches of 500 each. As the group assignment was random, there was a roughly 25% planning buffer added to ensure a minimum of 99 participants in each group in Study 1 (four groups per country) and 197 per group in Study 2 (two groups per country). If any group failed to achieve the minimum number of participants, a second batch of questionnaires was to be distributed evenly between U.S. and Indian participants. The difference between 125% of the minimum group size and the number of responses received in the smallest group was multiplied by the number of groups to determine the number of questionnaires to send to each country.

Data Collection Process

The two studies comprising the present research used MTurk® to recruit participants. Embedded script in the MTurk® task web page selected a link to one of the survey instruments at random, thereby randomly assigning each participant independently to an experimental group with a response form containing the group’s unique scenario. A Google Form® was used in both studies to gain informed consent of participants, present the scenarios, and collect responses. Once a participant finished with the survey, MTurk® compensated the person for his or her time.

Experimental scenario. The survey instruments included a hypothetical scenario that described a situation in which the participant will fly in an autonomous air taxi. The general intent was to communicate that the participant will fly in an autonomous vehicle,
with no option for an on-board human pilot, and to keep the description short to minimize introducing confounding variables and keep participants’ attention (see Table 1).

Table 1

*Scenario Statements and Purpose*

<table>
<thead>
<tr>
<th>Statement in Survey Instrument</th>
<th>Purpose of the Statement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Imagine a situation where your work sent you to a large city in another part of your country.</td>
<td>Participant is dissociated from normal transportation routine. Participant remains within home nation. Participant is using the air taxi for business; thus, the employer is involved in the hiring of the air taxi.</td>
</tr>
<tr>
<td>You request a ride from a local air taxi business to fly across the city for a reasonable price.</td>
<td>Establishes that this is not regularly scheduled public transit. A private company operates the aircraft, not the government.</td>
</tr>
<tr>
<td>It will arrive on the roof of a parking garage next to you and will fly you directly to a landing pad next to your destination.</td>
<td>Point-to-point transportation, not multi-modal, confining perceptions to just the air taxi.</td>
</tr>
<tr>
<td>The total time to board, fly, and exit the aircraft will take approximately 30 minutes.</td>
<td>Short-duration trip within the geographic confines of a large city.</td>
</tr>
<tr>
<td>The aircraft that arrives is the size of a small passenger car and has four seats.</td>
<td>Frames UAM to the layperson as something different than the more familiar airliner.</td>
</tr>
<tr>
<td>You are the sole occupant in the aircraft. The aircraft is completely autonomous and will travel by autopilot to your pre-selected destination without further input from you.</td>
<td>There is no human pilot on board.</td>
</tr>
</tbody>
</table>

**Design and procedures.** Both studies followed the same procedures to recruit participants and direct them to the survey instrument. Two HITs were created in Amazon MTurk® to recruit participants. One HIT used a filter to ensure it was only visible to U.S. participants and the other was only visible to Indian participants. Both HITs were restricted to participants who have completed over 100 previous HITs and have a 98% approval rate. The HIT requestor then set the compensation rate at $0.50 USD per response, set the desired number of responses, and transferred the corresponding funds
(plus fee) to MTurk® to activate the task. MTurk® pays Indian workers in local currency, Indian rupees (INR), based upon the exchange rate at the time each user withdraws funds from his or her account. The HIT provided a short description of the activity to the potential participant so he or she could decide whether to participate: “A survey about transportation preferences. Expected completion time is less than 5 minutes.”

The person could then elect to participate in the study by clicking the “Accept and Work” button in the MTurk® web interface. He or she was then be directed to a web page with the instructions to participate:

**IMPORTANT:** Please do the best you can on this. This data is very important to the scientific community.

Instructions for completing the survey:

First, be sure to open the page in a new window/tab so that you won't have difficulty in returning to the MTurk page.

Follow this link:

[Randomly generated link here]

At the end of the survey, there will be a 4-digit code. Each code will be personalized to each participate to ensure compliance. If you're found to be fraudulently submitting to MTurk, you will be blocked from further HITs.

Enter this code here on MTurk once you have completed the survey. This will let us know that you completed it so you can be paid.
If you do not do this, I cannot know that you have completed the survey and you will not be paid.

What was the code?

The link in the center of the page used JavaScript® code to randomly select a link to the survey instrument unique to one of the experimental conditions (see Figure 3, with example links to each condition). The code used the length of the array of web links to
generate a random integer with a uniform distribution from 0 to \( n-1 \), where \( n \) represents the number of links defined. The function generated a pseudo-random number with a uniform distribution, with the random seed created in each implementation (Oracle, 2018)—essentially, the equations used to generate the random number are given different initial states for each user. In this manner, each link had an equal probability of being selected—whether there are four in Study 1 or two in Study 2—ensuring uniform random assignment of participants to experimental groups. The random link was generated within each participant’s web browser using JavaScript® rather than server-side code, thereby ensuring each person’s group assignment was independent of all others.

\[
\begin{align*}
\text{Figure 3. Code to randomly assign participants to experimental groups.}
\end{align*}
\]

Within each country’s population, this study followed a completely randomized design, although the distribution method of the survey instrument to the United States and
India separately introduced stratification into the randomization method when considering the totality of the experiment. Binary stratification based upon nationality was used as opposed to blocking, as block randomization would require equal group sizes (Alferes, 2013). After the initial stratification based on nationality, the random link generation set the probability of assignment to the remaining experimental groups equally, either for the four crossed factorial groups in Study 1 or the two groups remaining in Study 2. Because of the random assignment, the groups may have different sizes. Thus, the present study used a restrictedly random design with a stratified random assignment (Alferes, 2013).

Random assignment of U.S. and Indian participants to experimental conditions was conducted to control potentially confounding variables. There are many differences between participants from the general public and from two different nations; addressing each variable individually would not be feasible. Instead, random assignment served to distribute potential bias and confounding variables approximately equally between groups. Doing so ensured any effects from such variables were also distributed nearly equally, thus constraining differences to the experimentally manipulated variables (Braver, Moser, & Thoemmes, 2012).

The questionnaire began with informed consent statements and verification that the participant is at least 18 years old. It then provided a descriptive scenario in which the user is instructed to assume they will fly in an autonomous air taxi. Each group received the same scenario and instructions, followed by additional information, unique to each experimental condition, describing the presence or absence of the above safety systems.
The participants were then asked to rate their willingness to fly aboard the autonomous air taxi. The participants indicated their willingness to fly in the scenario through responding to seven multiple-choice questions (responses on five-point Likert response items) from the willingness to fly scale (Rice, Mehta, et al., 2015).

In Study 1, the survey concluded with demographic questions immediately following the willingness to fly scale. The participant was directed back to MTurk® and compensated $0.50 for their time. The survey was expected to take less than five minutes to complete.

Study 2 used the same recruiting and compensation methods as Study 1. It also provided the same hypothetical scenario. However, the system or systems used for the independent variable were determined by the results of Study 1.

Study 2 first presented the scenario and described the available aircraft safety systems. The participants were then asked 12 questions from the cultural worldviews scale to assess their cultural orientation. Six questions assess the level of communitarianism or individualism, and six questions assess the level of egalitarianism or hierarchism, all of which were assessed using six-point Likert response items (Kahan et al., 2011).

Next, the questionnaire asked the participant seven questions from the willingness to fly scale (Rice, Mehta, et al., 2015). After all 19 multiple choice questions, the instrument concluded with demographic questions, including nationality, gender, and age. The participant was directed back to MTurk® and compensated $0.50 for their time. The survey was expected to take less than ten minutes to complete.
The data were collected and compiled in Google Forms® and exported in a comma-separated values format. As data for each experimental condition was collected in a separate form, data were downloaded and merged into a single document with additional columns indicating the experimental conditions. The data were then loaded in SPSS® for analysis.

In Study 1, U.S. and Indian participants were randomly assigned to one of four groups, representing each combination of automatic airframe parachute availability and remote pilot system availability. Each condition used the same scenario but presents additional information describing the presence or absence of each of the safety systems. One of each pair of the following statements was appended to the scenario:

1A) The aircraft has a whole-aircraft parachute installed that can be automatically deployed during an emergency.  
1B) The aircraft does not have a whole-aircraft parachute installed.

2A) The aircraft can be remotely flown by a human pilot during an emergency.  
2B) The aircraft cannot be remotely flown by a human pilot.

In Study 2, U.S. and Indian participants were randomly assigned to one of two groups differentiated by whether participants are told the safety system (or combination thereof from Study 1) is available. One of each triplet of the following statements was appended to the scenario:

1A) The aircraft has a whole-aircraft parachute installed that automatically deploys during an emergency.  
1B) The aircraft can be remotely flown by a human pilot during an emergency.  
1C) The aircraft can be remotely flown by a human pilot during an emergency and has a whole-aircraft parachute installed that can be automatically deployed during an emergency.

2A) The aircraft does not have a whole-aircraft parachute installed.  
2B) The aircraft cannot be remotely flown by a human pilot.
2C) The aircraft cannot be remotely flown by a human pilot and does not have a whole-aircraft parachute installed.

Study 2 presented the cultural worldview scale before assessing willingness to fly. Each question was self-assessed in a six-point Likert response format. The Google Form® hosting each survey instrument randomized the order of the questions. Of note, Douglas criticized the cultural worldview scale, stating that it had an overly American perspective (Kahan, 2012). Kahan’s work remained focused on cultural subgroups within the United States, and he had not used the cultural worldview scale to study cultural differences between nations (van der Linden, 2016). Upon inspection of the instrument, one egalitarianism question referenced “whites and people of color” and one hierarchism question referenced “blacks.” Both questioned referenced racial groups that have social histories that may be unique to the United States. The specific races were replaced with generic terms, indicated in brackets below, so the questions were applicable and meaningful to participants from both nations. The 12 items of the cultural worldview scale are listed below with coding instructions and in Appendix B as they appeared to participants. Questions are listed here with the first initial of the cultural orientation assessed: communitarianism, individualism, egalitarianism, or hierarchism. The question letters are also numbered 1 to 3 within the cultural orientation triplets to indicate the variable name. The variable name letter/number combinations were not presented on the questionnaire and therefore were not visible to the survey participant.

People in our society often disagree about how far to let individuals go in making decisions for themselves. How strongly do you agree or disagree with each of these statements?
I1. It’s not the government’s business to try to protect people from themselves.  
I2. The government interferes far too much in our everyday lives.  
I3. The government should stop telling people how to live their lives.  
C1. The government should do more to advance society’s goals, even if that means limiting the freedom and choices of individuals.  
C2. Sometimes government needs to make laws that keep people from hurting themselves.  
C3. Government should put limits on the choices individuals can make so they don’t get in the way of what’s good for society.

People in our society often disagree about issues of equality and discrimination. How strongly do you agree or disagree with each of these statements?  
H1. It seems like [minority ethnic, religious,] and other groups don’t want equal rights, they want special rights just for them.  
H2. We have gone too far in pushing equal rights in this country.  
H3. Society as a whole has become too soft and feminine.  
E1. We need to dramatically reduce inequalities between the rich and the poor, [different ethnic and religious groups], and men and women.  
E2. Our society would be better off if the distribution of wealth was more equal.  
E3. Discrimination against minorities is still a very serious problem in our society.  
(Kahan et al., 2011, p. 173)

Finally, both studies ended with asking the participant the seven questions from the willingness to fly scale (Rice, Mehta, et al., 2015). Each question was self-assessed in a five-point Likert response format. Google Forms® randomized the order of the questions (see Appendix B).

Following the willingness to fly scale, the survey instruments concluded with demographic questions including nationality, gender, and age. Nationality is included as a short answer question for an attention check and to prevent misrepresentation, as nationality is also ensured by the distribution method (MacInnis et al., 2020). Participants
are thanked for their participation and returned to MTurk® for compensation. See Appendix B for the survey instruments associated with each experimental condition.

**Sources of the data.** This research used survey instruments to change the independent variables and to collect the data in both studies. The instruments were hosted in Google Forms® and the links were distributed via Amazon MTurk®. Participants were recruited and compensated through MTurk® for responding to the questionnaire. IBM SPSS® and the PROCESS macro was used to analyze the data. No other sources of data contributed to the analysis.

**Ethical Consideration**

There were no known risks greater than normal daily activities associated with the instrument other than privacy. Participant anonymity was ensured through system design: The Google Forms® comprising the research instruments do not record names or any identifying information, and MTurk® managed all recruiting and compensation of participants through its own internal mechanisms without making personal information available to researchers. There was no way for the researchers to retroactively associate a participant with the information collected. All participants were 18 years of age or older, which was controlled by MTurk® registration and a screening question on the survey instruments. Participants were required to give informed consent before participating, if they desired to participate in the research.

Indian MTurk® workers are more likely than U.S. workers to use the service as their primary source of income (Litman et al., 2015). This raised the ethical consideration that the survey length and estimated completion time must be presented clearly and accurately to participants; workers must have enough information to make an informed
decision to elect to participate in this study, as doing so means forgoing other advertised work. Similarly, compensation was set at a rate comparable to other similar surveys, high enough to recruit participants without being so high as to be coercive (Valerio & Mainieri, 2011).

The Embry-Riddle Aeronautical University (ERAU) Institutional Review Board (IRB) procedures were followed because this research involves human participants. The IRB reviewed the instruments and procedures to ensure there is no risk to participants. No data was collected before IRB approval. See Appendix A for IRB documentation.

**Participant eligibility criteria.** Participant eligibility criteria are the conditions under which a participant is deemed eligible to provide data for the research (Lavrakas, 2011). For the present study, eligible participants were U.S. and Indian residents at least 18 years of age with an MTurk® account indicating at least 100 completed HITs with a 98% approval rating. MTurk® verifies the participant is at least 18 years of age and has met legal requirements to work in the country of residence (MTurk, 2018). In addition, the informed consent document preceding the survey instrument stated that the participant must be at least 18 years of age, and the participant must select a response option in a screening question indicating he or she is at least 18. The informed consent forms and survey instruments were approved by the ERAU IRB before research was conducted.

**Participant protections.** Participant identity was masked by MTurk® and never revealed to the researcher. The only personal information collected about participants was age, gender, nationality, locality postal code, and income; the combinations of any or all these data are insufficient to reconstruct personally identifiable information.
In addition to standard ethical and privacy practices, the present research followed guidelines from the International Code of Marketing and Social Research Practice because it includes a multinational population. As the present research does not involve a protected population or personal health information, the only major additions from ERAU IRB requirements are inclusions in the informed consent statement of a description of potential future uses of data and a “clear statement of the level of confidentiality protection that can be legally and technically assured, recognizing that a zero risk of disclosure is not possible” (de Leeuw, Hox, & Dillman, 2008, p. 85).

**Measurement Instrument**

**Independent variables.** Study 1 used nationality, automatic airframe parachute availability, and remote pilot system availability as independent variables. Study 2 used nationality and safety system availability as independent variables.

**Nationality.** Nationality is a dichotomous, between-participants variable with the values United States (0) or India (1) used in both Study 1 and Study 2. The variable is self-reported on the questionnaire. The instrument was only distributed to those claiming residence in the United States or India as an added measure to ensure no other nationalities are included.

**Automatic Airframe Parachute Available.** A dichotomous, between-participants variable with values of “No” (0) or “Yes” (1) used in Study 1. The variable is manipulated by specifying system availability in the scenario section of each questionnaire form.
Remote Pilot System Available. A dichotomous, between-participants variable with values of “No” (0) or “Yes” (1) used in Study 1. The variable is manipulated by specifying system availability in the scenario section of each questionnaire form.

Safety System Available. Used only in Study 2, this dichotomous, between-participants variable with values of “No” (0) or “Yes” (1) indicates the absence or presence of a safety system. The safety system would be either the automatic airframe parachute, remote pilot system, or combination of the two. The system represented by this variable would be selected based upon which system or systems result in the largest effect size during Study 1. The variable was manipulated by specifying system availability in the scenario section of each questionnaire form.

Mediating variables. The following mediating variables were only tested during Study 2. They were evaluated as potential mediators between safety system availability and willingness to fly.

Communitarianism-Individualism. This potential mediator is an interval variable ranging from 1 to 6 designed to assess cultural values of the participant along the “group” axis from cultural theory. This variable is constructed from six Likert response items: three assess communitarianism and three assess individualism, each of which produce an ordinal value from 1 to 6. The responses are transformed into a single interval variable by calculating the mean of the six responses.

The developers of the cultural worldview scale weighted each response item equally by averaging the six items when calculating the scale’s numeric value (Kahan et al., 2007). When comparing weighted and non-weighted values for communitarianism-
individualism, the differences were statistically significant but trivial. Therefore, the same method of weighting each factor equally is used in the present research.

In prior research, the communitarianism responses are reverse coded (Kahan et al., 2011). Instead, the individualism responses are reverse coded in the present research so that individualistic (low group axis) orientations would be depicted to the left in graphs, matching how cultural orientation is typically depicted in cultural theory and cultural cognition theory.

**Egalitarianism-Hierarchism.** This potential mediator is an interval variable ranging from 1 to 6 designed to assess cultural values of the participant along the “grid” axis from cultural theory. As with the other component of the cultural worldview scale, egalitarianism-hierarchism is constructed from six Likert response items: three assess egalitarianism and three assess hierarchism, each of which produce an ordinal value from 1 to 6. The original scale weighted each response item equally (Kahan et al., 2007). Each of the egalitarianism-hierarchism factors are weighted equally in the present research to create the single scale variable.

Egalitarianism responses are reverse-coded (Kahan et al., 2011). High egalitarian (low grid axis) orientations will be depicted on the lower half of graphs, and high hierarchical (high grid axis) orientations will be on the upper half.

**Dependent variable.** The dependent variable in both studies was the participants’ willingness to fly in an autonomous air taxi.

**Willingness to Fly.** Willingness to fly is an interval variable Likert scale, a mean value of seven self-assessed items that use a five-point Likert response format ranging from 1 (strongly disagree) to 5 (strongly agree) (Rice, Mehta, et al., 2015). Each of the
seven response items were weighed equally in the original willingness to fly scale (Rice, Mehta, et al., 2015). This approach was validated following a factor analysis that found no significant difference between weighted and non-weighted response items comprising the willingness to fly scale. Thus, in the present research, the seven factors are given equal weights.

The scale was developed and validated in a study of potential airline passengers and has demonstrated high internal consistency in multiple studies (Rice, Mehta, et al., 2015). In the present research, the scale was also evaluated for internal consistency using Cronbach’s alpha and for test-retest reliability using Guttman’s split-half test with newly collected data. Values greater than .70 indicate the component questions are measuring the same construct (Trobia, 2011; Vogt et al., 2012).

**Factor weights.** Each mediating and dependent Likert scale variable is calculated from using the average of its component factors, effectively weighting each equally because that is how the scale developers used the variables in their original research (Kahan et al., 2007, 2011; Rice, Mehta, et al., 2015). However, a comparison of weighted values and averaged values was conducted using previously collected data to determine whether equal weights were appropriate. Principal component analyses of the cultural worldview scale and willingness to fly scale were conducted (see validity assessment section), which provided factor loadings and the factor coefficients. The coefficients were used to weight each response item.

A principal component analysis of the cultural worldview scale indicated the factors loaded on to the correct constructs and yielded coefficients for each factor (see Table 2). Values for communitarianism-individualism and egalitarianism-hierarchism
were calculated for each entry of a pilot test of the scale (see validity assessment below) in two ways: one score used the average (equal weights) of all factors, and one score used the coefficients from the principal components extraction to weight each factor. A paired samples t-test was then conducted to determine the mean difference in communitarianism-individualism and egalitarianism-hierarchism scores when the factors were evenly weighted and when they were weighted according by factor analysis coefficient. For communitarianism-individualism, the weighted calculation method resulted in a score that was .051 more communitarian than the method where factors were weighted equally, $t(437) = 5.732, p < .001$, 95% CI [.034, .069]. For egalitarianism-hierarchism, the weighted calculation method resulted in a score that was .050 more egalitarian than the method where factors were weighted equally, $t(437) = -4.916$, $p < .001$, 95% CI [-.069, -.030].

Table 2

<table>
<thead>
<tr>
<th>Component</th>
<th>Communitarianism-Individualism</th>
<th>Egalitarianism-Hierarchism</th>
</tr>
</thead>
<tbody>
<tr>
<td>I1</td>
<td>.211</td>
<td>-.021</td>
</tr>
<tr>
<td>I2</td>
<td>.206</td>
<td>-.023</td>
</tr>
<tr>
<td>I3</td>
<td>.262</td>
<td>.017</td>
</tr>
<tr>
<td>C1</td>
<td>.286</td>
<td>.072</td>
</tr>
<tr>
<td>C2</td>
<td>.214</td>
<td>.010</td>
</tr>
<tr>
<td>C3</td>
<td>.277</td>
<td>.102</td>
</tr>
<tr>
<td>E1</td>
<td>-.031</td>
<td>.189</td>
</tr>
<tr>
<td>E2</td>
<td>-.004</td>
<td>.187</td>
</tr>
<tr>
<td>E3</td>
<td>.033</td>
<td>.206</td>
</tr>
<tr>
<td>H1</td>
<td>.056</td>
<td>.212</td>
</tr>
<tr>
<td>H2</td>
<td>.075</td>
<td>.234</td>
</tr>
<tr>
<td>H3</td>
<td>.009</td>
<td>.199</td>
</tr>
</tbody>
</table>
While the differences in the weighted and non-weighted cultural worldview scale were statistically significant, the differences were trivial (< 1%) within the scale’s range from 1 to 6. Therefore, the previous method of weighting all factors equally was followed to avoid introducing transformations and more sources of error.

Every factor in the willingness to fly scale loaded nearly equally and had similar coefficients (see Table 3). A paired samples t-test was conducted with previously collected data using the same hypothetical scenario to compare results when the scale was weighted by component coefficient and when it was equally weighted. There was no significant difference between the variable constructed with weighted or averaged factors ($N = 487$, $t(486) = -.224$, $p = .823$). Therefore, each factor was weighted equally in the present research.

**Table 3**

*Willingness to Fly Component Coefficients*

<table>
<thead>
<tr>
<th>Component</th>
<th>Willingness to Fly</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comfortable to fly</td>
<td>.158</td>
</tr>
<tr>
<td>Confident to fly</td>
<td>.157</td>
</tr>
<tr>
<td>Safe to fly</td>
<td>.158</td>
</tr>
<tr>
<td>No problem to fly</td>
<td>.155</td>
</tr>
<tr>
<td>Happy to fly</td>
<td>.157</td>
</tr>
<tr>
<td>Willing to fly</td>
<td>.143</td>
</tr>
<tr>
<td>No fear to fly</td>
<td>.151</td>
</tr>
</tbody>
</table>

**Demographic variables.** The demographic variables are not assessed in the primary analysis of the present research. All participants are stratified by nationality and randomly assigned to an experimental condition—the different safety systems available on the hypothetical aircraft. The random assignment of participants serves to distribute
demographics, along with unknown or confounding variables, approximately equally among all conditions, thereby ensuring any differences in the dependent variable are associated with changes in the independent and mediating variables (Braver et al., 2012).

In addition, the inability to control or randomly assign demographic variables does not support the experimental design of the present research (Marchant, 2018). Collecting demographic variables instead provides insight into the participants and informs the generalizability (Dobosh, 2018). The researchers collected the following demographics because the body of knowledge indicated they may still have effects on willingness to fly, although they are not the primary purpose of the present research.

**Gender.** Gender is assessed as a categorical variable with the values of female (0), male (1), or non-binary/prefer not to say (2). Previous work indicates that gender may affect risk perception and willingness to fly (Anania, Rice, Walters, et al., 2018; Anania, Rice, Winter, et al., 2018). Gender differences may only be meaningful within cultures, not between cultures, as gender differences in risk perception are a function of social experiences and pressures unique to each culture (Flynn, Slovic, & Mertz, 1994; Kahan et al., 2007), and gender differences in risk perception may disappear when cultural worldviews are considered (Kahan et al., 2010).

**Age.** Age is a ratio variable self-reported by participants in years. Age was recorded because older participants may be less accepting of autonomous vehicles in general (Charness, Yoon, Souders, Stothart, & Yehnert, 2018), and the study preceding the present research indicated age negatively correlated with willingness to fly in an autonomous air taxi (Ward et al., 2019).
**Household income.** Household income is an ordinal variable self-reported by participants. The demographic variable was selected because of the observation that passengers with higher income rated their concern of autonomous vehicle system failure higher (Eker et al., 2019). The variable consists of five categories representing each approximate quintile of household income in the nation. The values are represented to the participants as values in the local currency, not as percentages. The year 2018 was used as the most recent full year data available for the United States. For U.S. participants, the lower bound of each quintile are: less than $25,000, $25,000, $50,000, $80,000, and $130,000 (United States Census Bureau, 2018). In India, household income is not recorded in government census data, and the most recent applicable independent surveys available were the National Survey of Household Income and Expenditure and India Human Development Survey, both conducted in 2004 and 2005 (Desai et al., 2010). Inflation rates in the intervening years were high and variable, ranging from 3% to over 10% in 2009 (Kundu, 2019). A 167% total inflation rate was used to convert 2005 income reported in the surveys to 2018 values, which were then rounded to the nearest ₹5,000 INR (StatBureau, 2019). There may have been other demographic changes in the years since the survey was conducted to add more error to the quintile estimates, but absent a more recent population survey, these income values remain approximations. For India, the estimated quintile lower bounds used are: less than ₹15,000, ₹15,000, ₹30,000, ₹50,000, and ₹85,000.

**Urban setting.** Urban setting is a dichotomous variable consisting of the values rural (0) and urban (1). The variable is dichotomous because it may be difficult for participants to accurately estimate the population density of their areas, and measures of
degrees of urbanization such as those used by the U.S. Department of Agriculture (Hall, Kaufman, & Ricketts, 2006) may not be meaningful in the present context. This variable is assessed because research has demonstrated differences in perceptions of autonomous vehicles between urban and rural passengers (Eker et al., 2019), and those from urban areas may have different public transportation attitudes (König & Neumayr, 2017). It is defined for participants in simple terms using a question based upon the U.S. Census Bureau definitions of rural and urban (Hall et al., 2006): “Please describe which description best matches the area where you live:” “Urban. I live in a city, metropolitan area, suburb, or town with a population more than 2,500 people,” or “Rural. I live in a farm, town, village, or area with less than 2,500 people.” Participants from the United States and India were also provided a short-answer section where they were asked to fill in their ZIP Code or Postal Index Number (PIN) Code, respectively, thereby providing a value that could later be compared with U.S. and Indian census data for the corresponding postal codes for a more accurate evaluation of the urban setting.

*Use of transportation.* We evaluated the frequency of use of various transportation methods by the number of days in a typical week the participant uses the selected mode of transportation, as familiarity with different modes of transportation may affect willingness to fly. The variable is a ratio variable with integer values ranging from 0 to 7 days per week. The question asks:

During a typical week, how many days do you:
1) Ride a bicycle?
2) Drive a car?
3) Ride as a passenger in a car?
4) Ride in a bus or van?
5) Ride a train, metro, or other vehicle on rails?
6) Ride in an aircraft?
Data Analysis Approach

The following section describes the two-study approach to quantitatively analyze the data. Study 1 used a three-way ANOVA to compare differences between groups. Study 2 used a two-way ANOVA and a mediation analysis with ordinary least squares regression. Both studies used existing validated and reliable survey instruments, although they have not been used together before.

Reliability assessment method. The internal consistency for the willingness to fly scale and the cultural worldview scale was assessed using Cronbach’s alpha to ensure the questions associated with each scale are measuring the same construct (Vogt, Vogt, Gardner, & Haeffele, 2014). As the cultural worldview scale has two dimensions, each should be evaluated separately for internal consistency (Trobia, 2011). Researchers recommend modifying scales exhibiting Cronbach’s alpha values less than .70 as they may not be measuring the same construct (Trobia, 2011; Vogt et al., 2014). The constructs were also evaluated using a Guttman split-half reliability test (also known as $\lambda_4$) to further assess the lower bound to item score reliability (Sijtsma, 2009).

The consistency of the measures could also be assessed by comparing results in a meta-analysis of the same measures from previous research, Study 1, and Study 2 (McShane & Böckenholt, 2017). Each included the same variables of nationality and willingness to fly, allowing for comparison of standard effect size and confidence intervals between iterations.

Validity assessment method. Both the willingness to fly scale and the cultural worldview scale have been tested and found to be valid (Kahan, 2012; Rice, Mehta, et al., 2015). The willingness to fly scale has been used with U.S. and Indian survey
participants in the past, was found to be valid and reliable, and therefore is used without change in the present research (Ragbir et al., 2018). The egalitarianism-hierarchism construct of the cultural worldview scale raised face validity concerns when considering a multi-national population: Two of the six components had terms suspected to elicit different meanings and responses between participants of different nationalities. A licensed clinical psychologist with experience conducting assessments and working with people from multiple countries and cultures was consulted and independently identified that the original terms may be problematic if used in India (V. Ward, personal communication, October 9, 2019). To increase face validity, the specific racial groups from the cultural worldview scale were replaced with general mentions of minority ethnic and religious groups expected to be applicable in both nations.

Validity test of cultural worldview scale. A principal components analysis with varimax rotation was conducted in an unpublished brief analysis to assess whether all items loaded on a single factor, to ensure convergent validity (Field, 2009). Past use of the cultural worldview scale demonstrated that communitarianism and individualism loaded onto the same construct, as did egalitarianism and hierarchism (Kahan, 2012; Kahan et al., 2007, 2011). Therefore, the means of the responses to communitarianism, individualism, egalitarianism, and hierarchism question triplets were treated as coded and reverse-coded items within the communitarianism-individualism and egalitarian-hierarchism constructs, and compared with a modified squared discrepancy procedure to identify and remove potentially invalid data from survey responses (Litman et al., 2015). The squared discrepancy procedure compares pairs of reverse-coded Likert response
items, squares the difference between them, and provides a squared discrepancy score for interpretation (Litman et al., 2015).

For each person, the communitarianism-individualism squared discrepancy ($SD_{CI}$) was calculated as follows. The numbers $C_1$, $C_2$, and $C_3$ represent the ordinal Likert responses, ranging from 1 to 6, for communitarianism (coded so 6 = high communitarianism), and $I_1$, $I_2$, and $I_3$ are the Likert responses for individualism (reverse coded so 1 = high individualism). The means of the communitarianism and individualism responses were calculated separately. Given the 6-point Likert response format, the maximum difference between the means of the reverse-coded items was 5. This difference was squared to maximize discrepancies, thus $SD_{CI}$ ranges from 0 to 25.

$$SD_{CI} = \left( \frac{C_1 + C_2 + C_3}{3} - \frac{I_1 + I_2 + I_3}{3} \right)^2$$

(2)

The squared discrepancy for egalitarianism-hierarchism ($SD_{EH}$) was calculated similarly. The possible values of $SD_{EH}$ also range from 0 to 25.

$$SD_{EH} = \left( \frac{E_1 + E_2 + E_3}{3} - \frac{H_1 + H_2 + H_3}{3} \right)^2$$

(3)

The component scores were then summed (possible values from 0 to 50) and divided by 50 to express the value as a percentage; the percentage was then reversed by subtracting it from 1 to enable an intuitive interpretation where a higher value is considered better. The squared discrepancy score ($SDS$) thus ranges from 0%, which indicates “maximally low performance”, to 100%, which indicates “maximally high performance” (Litman et al., 2015, p. 522). The formula to calculate the squared discrepancy score is as follows:

$$SDS = 1 - \left( \frac{SD_{CI} + SD_{EH}}{50} \right)$$

(4)
The maximum squared discrepancy score can only be achieved if a person lists “strongly agree” or “strongly disagree” for every answer; thus, a more relevant cutoff is needed. In a Monte Carlo study using randomly generated 5-point Likert response items with split-half reverse coding, random responses resulted in a mean squared discrepancy score of 70% ($SD = 7$) (Litman et al., 2015). A squared discrepancy score of 84% represented two standard deviations above the random chance value, indicating a 95% chance the data provided are not random (Litman et al., 2015; Robinson, Rosenzweig, Moss, & Litman, 2019). The more conservative value was selected, thus, response data exhibiting a squared discrepancy score below 84% were filtered out. While the thresholds identified were directly applicable to the specific survey instrument Litman and colleagues (2015) used, it still provided a useful quantifiable threshold for the present study to judge attentiveness.

The squared discrepancy procedure also serves to identify occasions where a participant chooses the same Likert response option for every question, or “clicks through” the survey inattentively. The even number of response options for each question (i.e. no neutral option) will always produce a discrepancy value if the participant chooses the same response across both halves of a reverse-coded scale. With the cultural worldview scale’s six options, the squared differences will be either 1, 9, or 25 for each component scale. In all but one case where a participant chooses the same response across coded and reverse-coded item, the squared discrepancy score is 80% or less (see Table 4). This indicates the procedure is useful for filtering out problematic responses, especially if the 84% threshold set by Litman and colleagues (2015) is used. The only case where it cannot effectively filter out inattentive, identical responses is when the
person chose either “slightly agree” or “slightly disagree” for each response in both subscales.

Table 4

**Possible Squared Discrepancy Scores for Same Response to All Questions**

<table>
<thead>
<tr>
<th>SD_CI</th>
<th>SD_EH</th>
<th>SDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>25</td>
<td>0%</td>
</tr>
<tr>
<td>25</td>
<td>9</td>
<td>32%</td>
</tr>
<tr>
<td>25</td>
<td>1</td>
<td>48%</td>
</tr>
<tr>
<td>9</td>
<td>25</td>
<td>32%</td>
</tr>
<tr>
<td>9</td>
<td>9</td>
<td>64%</td>
</tr>
<tr>
<td>9</td>
<td>1</td>
<td>80%</td>
</tr>
<tr>
<td>1</td>
<td>25</td>
<td>48%</td>
</tr>
<tr>
<td>1</td>
<td>9</td>
<td>80%</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>96%</td>
</tr>
</tbody>
</table>

Finally, a principal component analysis with varimax rotation was conducted using the data from participants with a squared discrepancy score greater than 84%, \( N = 438 \) (252 U.S. participants, 134 Indians, 52 unspecified). Using the squared discrepancy procedure, 19 U.S. participants, 171 Indians, and 39 people from unspecified nations were excluded from analysis. The communitarianism-individualism scores loaded on the correct construct with correlation values from .607 to .761, and the egalitarianism-hierarchism scores loaded on the correct construct with correlation values from .742 to .861 (see Table 5).
Table 5

Cultural Worldview Scale Rotated Component Matrix

<table>
<thead>
<tr>
<th>Question</th>
<th>Communitarianism-Individualism</th>
<th>Egalitarianism-Hierarchism</th>
</tr>
</thead>
<tbody>
<tr>
<td>I1</td>
<td>.625</td>
<td>-.258</td>
</tr>
<tr>
<td>I2</td>
<td>.610</td>
<td>-.261</td>
</tr>
<tr>
<td>I3</td>
<td>.737</td>
<td>-.148</td>
</tr>
<tr>
<td>C1</td>
<td>.761</td>
<td>.048</td>
</tr>
<tr>
<td>C2</td>
<td>.607</td>
<td>-.138</td>
</tr>
<tr>
<td>C3</td>
<td>.710</td>
<td>.174</td>
</tr>
<tr>
<td>E1</td>
<td>-.247</td>
<td>.774</td>
</tr>
<tr>
<td>E2</td>
<td>-.165</td>
<td>.742</td>
</tr>
<tr>
<td>E3</td>
<td>-.074</td>
<td>.785</td>
</tr>
<tr>
<td>H1</td>
<td>-.015</td>
<td>.792</td>
</tr>
<tr>
<td>H2</td>
<td>.021</td>
<td>.861</td>
</tr>
<tr>
<td>H3</td>
<td>-.139</td>
<td>.778</td>
</tr>
</tbody>
</table>

Cronbach’s alpha and Guttman’s split-half coefficient were calculated for the cultural worldview scale ($N = 438$). The values for communitarianism-individualism and egalitarianism-hierarchism indicated acceptable and good reliability, respectively (see Table 6). Cronbach’s alpha was .77 for communitarianism-individualism in the pilot assessment of U.S. and Indian participants, which was similar to past uses of the cultural worldview scale in an exclusively U.S. setting, where it consistently had values of .81 (Kahan, 2012; Kahan et al., 2011). Cronbach’s alpha for egalitarianism-hierarchism in the pilot assessment was also similar to past applications among just U.S. participants: The value was .92 in the present research and .87 in past research among U.S. participants (Kahan, 2012; Kahan et al., 2011).
Table 6

Reliability Assessment of Cultural Worldview Scale

<table>
<thead>
<tr>
<th>Method</th>
<th>Communitarianism-Individualism</th>
<th>Egalitarianism-Hierarchism</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cronbach’s alpha</td>
<td>.773</td>
<td>.886</td>
</tr>
<tr>
<td>Guttman’s Split-Half</td>
<td>.686</td>
<td>.837</td>
</tr>
</tbody>
</table>

These values indicated the cultural worldview scale, in its 2011 abridged format, was sufficiently reliable and internally consistent to use in the present research. However, reliability and internal consistency values failed to meet useful thresholds when the squared discrepancy procedure was not used to filter data. As the reliability and internal consistency values approximated past research when the filter was used, we attributed the difference to participant effort and data quality rather than a failing of the scale itself. Therefore, the scale appeared reliable and internally consistent, although only if the squared discrepancy procedure is used to screen problematic questionnaire response behavior first.

Validity test of willingness to fly scale. A principal component analysis of the willingness to fly scale was conducted to assess whether all components loaded onto the same construct ($N = 487$). The data was collected for a previous study (Ward et al., 2019) and used nearly the same survey scenario in the questionnaire. All seven items loaded on a single construct (see Table 7). Loadings ranged from .860 to .948. All components loaded onto a single factor.
Table 7

*Willingness to Fly Component Matrix*

<table>
<thead>
<tr>
<th>Question</th>
<th>Willingness to Fly</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comfortable to fly</td>
<td>.948</td>
</tr>
<tr>
<td>Confident to fly</td>
<td>.940</td>
</tr>
<tr>
<td>Safe to fly</td>
<td>.948</td>
</tr>
<tr>
<td>No problem to fly</td>
<td>.930</td>
</tr>
<tr>
<td>Happy to fly</td>
<td>.945</td>
</tr>
<tr>
<td>Willing to fly</td>
<td>.860</td>
</tr>
<tr>
<td>No fear to fly</td>
<td>.907</td>
</tr>
</tbody>
</table>

*Validity assessment in present research.* New standards for data collection were added to the preset research to improve data quality because of the high frequency of Indian responses that scored low with the squared discrepancy procedure in the test of the cultural worldview scale. First, participant compensation was raised from $0.20 (compensation in the above test) to $0.50. Past use of the MTurk® platform indicated that participant compensation rates primarily affected the time required to recruit participants. While data quality from U.S. participants did not appear to be affected by compensation, data quality from Indian participants decreased with compensation (Litman et al., 2015). This may partially explain the differences in data quality between U.S. and Indian participants, so compensation was increased for the present study. In addition, the minimum worker approval rating was raised from 95% in the principal components analysis to 98% in the present research.

Next, data were filtered using the squared discrepancy procedure to ensure quality and filter out responses in which a participant is suspected to have inattentively or erroneously responded to the questionnaire (Litman et al., 2015). Cases with a squared discrepancy score below 84% were excluded listwise. The cutoff value ensures most
instances where a person enters the same response to every question—thus indicating opposing cultural orientations within the same spectrum—are excluded.

In the present research, the communitarianism-individualism scale and the egalitarianism-hierarchism scale each were tested for convergent validity. The cultural worldview scale was also tested for discriminant validity to ensure the communitarianism-individualism scale and the egalitarianism-hierarchism scale are not correlated. Cultural cognition theory posits that the two scales are orthogonal (Kahan, 2012); a low correlation coefficient between the scales would indicate the constructs are independent and that the instrument measures them separately (Eid, 2012).

While random sampling is preferred in survey research (Vogt et al., 2012), samples drawn from the MTurk® platform are not random (Rice et al., 2017). Each member of the population does not have an equal chance of being selected, as only MTurk® workers can view the task (Mason & Suri, 2012; Rice et al., 2017). In addition, when creating the MTurk® HIT to request participation, the researcher must specify the number of responses required, thereby limiting availability to the first participants who see and select the survey after it is activated and introducing selection bias (Paolacci & Chandler, 2014). The resulting sample is not representative of the entire population; it approximates the demographic makeup of internet users, including skewing younger and more educated than the general public (Chandler & Shapiro, 2016).

While the selection bias cannot be eliminated, research regarding the MTurk® platform indicates several advantages to mitigate potential bias. The data quality returned does not differ significantly than what could be achieved in a lab study, and the population is much more diverse than traditional university settings (Buhrmester et al.,
Workers pay attention to the questions and exhibit the same biases as those in laboratory experiments (Paolacci et al., 2010). Responses are consistent with high test-retest reliability, and therefore workers likely are truthful (Chandler & Shapiro, 2016). Finally, selection bias can be somewhat reduced by disguising the subject of the survey (other than length and compensation) (Chandler & Shapiro, 2016).

Others found that inattentiveness among workers can be a problem if not properly controlled for: In one study employing attention checks, 46% of an MTurk® sample had to be deleted due to failures of internal controls, where lab samples only had 27% of the data deleted (Aruguete et al., 2019). The authors argued that MTurk’s® benefits of a more diverse sample held, but researchers should incorporate internal validity checks to counter participant carelessness (Aruguete et al., 2019). Third-party add-ons to the MTurk® platform, such as Turk Prime™, can prevent fraudulent participation as well, by ensuring no IP address or verified geolocation address accesses the survey more than once (Strickland & Stoops, 2019). Validation checks used in data analysis, such as using reverse coding, can help overcome the effects of participant carelessness (Wessling et al., 2017), so the squared discrepancy procedure will be used to filter data.

**Data analysis process/hypothesis testing.** Study 1 used a 2 x 2 x 2 between-groups factorial design to evaluate Hypotheses 1 through 5. Study 1 assessed the effects of nationality, automatic airframe parachute availability, and remote pilot system availability on willingness to fly. Study 2 used a 2 x 2 between-groups factorial design to evaluate Hypotheses 6 through 8 when assessing effects of nationality and safety system availability on willingness to fly.
Null hypothesis significance testing is most commonly used in research using randomly assigned experimental groups, such as the present research (Vogt et al., 2014). The ANOVA is a parametric means comparison test used when there is a continuous dependent variable and more than one independent variable that provides the necessary means to compare mean differences with one-, two-, and three-way interactions between the independent variables (Field, 2009; Vogt et al., 2014). Study 1 therefore used a three-way between-groups ANOVA to test hypotheses 1 through 5, and Study 2 used a two-way between-groups ANOVA to test hypotheses 6 through 8.

The ANOVAs make the following assumptions that will be tested after data are collected (Laerd Statistics, 2017a, 2017b):

1. One continuous dependent variable
2. Three independent variables (two in two-way ANOVA) with two or more categorical variables
3. Independent observations
4. No significant outliers
5. Dependent variable is normally distributed in every cell
6. Variance of dependent variable is equal in every cell

The present research design met the assumption of a continuous dependent variable because the willingness to fly scale was designed to be interpreted with a single interval value between 1 and 5 (Rice, Mehta, et al., 2015). Similarly, the independent variables were categorical by definition; nationality was limited to two nations, and safety system availability was defined as available or not available. The data collection process ensured independent observations by requiring each participant to independently access the survey instrument and by randomly assigning each participant to a single experimental condition.
Outliers may affect analysis between groups and the generalizability of the study and must be addressed before further analysis (Laerd Statistics, 2017a, 2017b). Depending on the outlier frequency and effect on distribution and variance in each experimental condition, outliers may be deleted, transformed, or retained.

The normality assumption was tested using a Kolmogorov-Smirnov test of normality for each experimental condition. The ANOVA is typically considered robust to violations of normality if the violations are not extreme (Carifio & Perla, 2008; Laerd Statistics, 2017a, 2017b). Analysis may be able to proceed with acknowledging such violations or transforming the data appropriately.

For Hypotheses 9 and 10, Study 2 employed a mediation design to assess if and how communitarianism-individualism and egalitarianism-hierarchism mediate safety system availability and willingness to fly. “Mediation analysis is used to quantify and examine the direct and indirect pathways through which an antecedent variable X transmits its effect on a consequent variable Y through one or more intermediary or mediator variables” (Hayes, 2018, p. 10).

Mediation, rather than moderation, was analyzed in the current research. In mediation relationships, the indirect effect operates through the mediator variable (Hayes, 2018). Moderators affect the sign or strength of the relationship between the independent and dependent variables but are not claimed to be affected by the independent variable (Hayes, 2018). A person’s cultural orientation has been shown to depend on the situational context, thereby justifying the relationship between the independent variables and cultural orientation in the mediation models and ruling out cultural orientation as simply a moderator. Additionally, one’s cultural orientation is not deterministic; cultural
orientation is an influence in decision making (Tansey, 2004). As cultural orientation is a factor in decision making—such as one’s intention or willingness to fly—it logically follows that the relationship between safety system availability (the context) and willingness to fly (the decision) may be modeled best as working through a mediating variable (cultural orientation).

Several mediation analysis techniques have evolved over the years, of which Baron and Kenny’s method was particularly popular (Hayes, 2018). However, Hayes’s method includes notable differences. Hayes’s method discards the “causal steps approach,” deemed integral to prior mediation techniques including—and at times synonymous with—Baron and Kenny’s method (Hayes, 2018). The causal steps approach had staying power in earlier research perhaps because it makes intuitive sense: First one must identify a significant relationship between the independent variable and dependent variable, then between the independent variable and mediator, and finally between the mediator and dependent variable, thereby building the model one step at a time. If any step produces a non-significant result, analysis stops at that point, and the model is said to have no mediation. If the direct relationship is closer to zero than the mediated relationship, the model is said to be completely mediated. Otherwise the model is called partially mediated.

Hayes (2018) approached the problem differently; rather than presenting a yes/no/partial mediation option, his approach quantifies the mediation if present. The benefits of this approach over the causal steps approach are that it quantifies the claim of mediation, relies on fewer statistical tests, and communicates uncertainty to the reader (Hayes, 2018).
The Hayes method using ordinary least squares regression bears some similarity to structural equation modeling. When output from ordinary least squares regression and structural equation modeling was compared in a simple mediation experiment, the results were equal (Hayes, 2018). Structural equation modeling does provide some advantages, such as modeling observed and latent variables simultaneously, although it introduces complexity by requiring additional software and analysis. Given that the results are equivalent for simple mediation models and that the scales used herein have already been tested, ordinary least squares regression grants the benefit of simplicity and ease of use (Hayes, 2018). As the mediation analysis uses ordinary least squares regression already available in SPSS software, a simple, free macro can be added to SPSS to accomplish mediation analysis (Hayes, 2019).

Study 2 used Hayes’s (2018) model 4 with two parallel mediating variables to assess whether cultural orientation—communitarianism-individualism in Hypothesis 9 and egalitarianism-hierarchism in Hypothesis 10—mediates the relationship between safety system availability and willingness to fly. For Hypothesis 9a, communitarianism-individualism was assessed as a mediator among all study participants (see Figure 4). Next, the mediating effects of communitarianism-individualism was assessed separately for U.S. participants (Hypothesis 9b, see Figure 5) and Indians (Hypothesis 9c, see Figure 6).
Figure 4. Communitarianism-individualism mediator, all participants, Hypothesis 9a.

Figure 5. Communitarianism-individualism mediator, U.S. participants, Hypothesis 9b.

Figure 6. Communitarianism-individualism mediator, Indians, Hypothesis 9c.
For Hypothesis 10, egalitarianism-hierarchism was assessed as a mediator among all study participants (see Figure 7). The mediating effects of egalitarianism-hierarchism were then assessed separately for U.S. participants (Hypothesis 10b, see Figure 8) and Indian participants (Hypothesis 10c, see Figure 9).

Figure 7. Egalitarianism-hierarchism mediator, all participants, Hypothesis 10a.

Figure 8. Egalitarianism-hierarchism mediator, U.S. participants, Hypothesis 10b.
Each mediator requires a separate formula, where $S$ represents the safety system availability, $CI$ represents communitarianism-individualism, $EH$ represents egalitarianism-hierarchism, and $WTF$ is willingness to fly. The $e$ terms represent estimation error, the $a$ terms represent the effect of safety system availability and nationality on each mediator, the $b$ terms represent the effect of the mediators on willingness to fly, and $c'$ represents the direct effect of safety system availability on willingness to fly.

The above diagram can be represented in statistical equations. The $i$ terms in the following equations represent the regression constant.

$$CI = i_{CI} + a_{CI}S + e_{CI} \quad (5)$$

$$EH = i_{EH} + a_{EH}S + e_{EH} \quad (6)$$

$$WTF = i_{WTF} + c'S + b_{CI}CI + b_{EH}EH + e_{WTF} \quad (7)$$

Using ordinary least squares regression to assess mediation provides the notable benefit of communicating the strength of the relationships and uncertainty to the reader, while Baron and Kenny’s causal steps approach does not. Each of the mediation analyses provide regression coefficients and confidence intervals, which then could be used to
compare differences in mediation between all participants, U.S. participants, and Indian participants.

The regression assumptions were assessed before using the PROCESS macro for SPSS® (Hayes, 2019) to conduct the mediation analyses. Hayes’s mediation analysis uses similar assumptions as ordinary least squares regression (Hayes, 2018; Laerd Statistics, 2015a): Notably, the mediation assumptions differ by not requiring normal distributions, as the PROCESS operation uses bootstrapping to produce confidence intervals and does not rely upon the normal theory approach (Hayes, 2018). In addition, the linearity assumption is not required, as the mediation analysis does not use the causal steps approach, and no significant relationships involving the mediating variable are required to produce an estimate of the indirect effect.

1. One continuous dependent variable
2. Two or more independent variables
3. Independent observations
4. Equal error variances
5. No significant outliers

Summary

This chapter described the methods and analysis required to address the research questions and evaluate the hypotheses. The present research uses extant scales to assess passenger willingness to fly and cultural orientation, although combining them in a new way. Previous work previously inferred cultural orientation from participants’ nationality; the scales and analysis methods used here allow the researchers to directly measure two aspects of cultural orientation and begin to understand how nationality and culture each affect willingness to fly in autonomous aircraft.
This was accomplished by recruiting participants for a survey experiment using the MTurk® crowdsourcing platform, collecting data in two studies distributed to two countries, and compensating participants through MTurk®. The scales were assessed for validity and reliability before further analysis. A three-way ANOVA, two-way ANOVA, and mediation analysis with ordinary least squares regression were used to analyze the data and evaluate the hypotheses.
CHAPTER IV

RESULTS

This chapter describes the data and analysis gathered from conducting the studies according to the methodology outlined in the previous chapter. Details about the data collection process and demographics for Study 1 and Study 2 are presented, followed by the results of each study. The study results include descriptive statistics, reliability and validity testing, and hypothesis testing. Finally, the hypotheses are restated and summarized with the results.

General Data Collection

Data collection for Study 1 began when the MTurk® task restricted to Indian participants was published at approximately 7:00 AM India Standard Time on January 22, 2020. The MTurk® task restricted to U.S. participants was published 10.5 hours later at 7:00 AM Eastern Standard Time. Data collection was complete within 12 hours.

Study 1 data collection yielded 1,021 completed surveys (484 U.S. participants, 527 Indian participants). Participants from each nation were randomly assigned to an experimental condition. The random assignment resulted in an approximately even distribution between the eight experimental groups.

Study 2 data collection began after finding in Study 1 that the safety system or combination with the greatest effect size was the automatic airframe parachute alone. The questionnaire forms were adjusted to include automatic airframe parachute availability or non-availability as the sole difference in hypothetical scenarios. Data collection for Study 2 was conducted on January 29, 2020, and followed the same process of opening the MTurk® tasks to U.S. and Indian participants at their respective local time of 4:00
PM. The first batch of responses were collected within 12 hours, with 973 participants (468 U.S. participants, 505 Indian participants).

After collecting the data, the squared discrepancy procedure was used to identify inattentive participants. Litman and colleagues (2015) recommended that researchers use the procedure to check MTurk® participant truthfulness in scales employing reverse-coded items. Among U.S. participants, 419 (90%) met the screening criteria. The U.S. group with an automatic airframe parachute available ($N = 211$) and without ($N = 208$) both met the required sample size of 197 per group. No more data were collected from U.S. participants.

Among Indian participants, the data returned indicated a large number of participants were not attentive. Only 264 (52%) of initial participants passed the screening criteria. Data collection continued for just Indian participants for another 24 hours.

Ultimately, 1,516 survey responses were returned for Study 2 (468 U.S. participants, 1,048 Indian participants). Participants from each nation were randomly assigned to an experimental condition. The random assignment resulted in an approximately uniform distribution between the two experimental groups within each stratification of nationality.

**Study 1 Results**

**Study 1 results introduction.** The results of data analysis and hypothesis testing for Study 1 are presented below. First, descriptive statistics are analyzed to infer information about the sample and population. Next, descriptive statistics provide insight about the frequencies, distributions, and variances of the data in each of the eight
experimental conditions. The descriptive statistics were analyzed, and assumptions were tested. The hypotheses were tested using a three-way ANOVA with willingness to fly as the dependent variable and nationality, automatic airframe parachute availability, and remote pilot system availability as the independent variables. Analysis revealed two significant main effects of nationality and automatic airframe parachute availability on willingness to fly. Finally, a brief post hoc analysis determined the ANOVA was sufficiently robust to assumption violations and the hypothesis testing was valid.

**Demographic statistics.** Demographics from Study 1 are presented separately for U.S. participants (see Table 8) and Indians (see Table 9). Annual household income quintiles are presented in Table 10.

There were more male U.S. participants (58.5%) than would be expected of the general public, which is approximately 49% male (United States Census Bureau, 2010). Among U.S. participants, the median age of 37 was close to the median age of the general U.S. population of 37.2 (United States Census Bureau, 2010). Most U.S. participants were from the second (31.8%) and third (30.8%) quintiles of household income (see Table 10)—which would be expected to be approximately 20% each in the general public—while few participants were from the top quintile (6.5%). Of U.S. participants, 84.2% claimed to live in urban areas, close to the 80.7% the U.S. Census Bureau reported for the general population (United States Census Bureau, 2010).
Table 8

**Study 1 Demographics, U.S. Participants**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>288</td>
<td>(58.4%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>204</td>
<td>(41.4%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-binary</td>
<td>1</td>
<td>(0.2%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>492</td>
<td>39.87 (11.74)</td>
<td>37</td>
<td>35</td>
<td>20</td>
<td>82</td>
</tr>
<tr>
<td>Income Quintile</td>
<td>493</td>
<td>2.74 (1.10)</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Urban Setting</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urban</td>
<td>416</td>
<td>(84.2%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rural</td>
<td>78</td>
<td>(15.8%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transportation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>frequency</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ride a bicycle</td>
<td>492</td>
<td>1.26 (2.01)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>Drive a car</td>
<td>494</td>
<td>4.86 (2.23)</td>
<td>5</td>
<td>7</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>Ride in a car</td>
<td>494</td>
<td>2.15 (1.98)</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>Ride a bus</td>
<td>493</td>
<td>1.13 (1.92)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>Ride a train</td>
<td>493</td>
<td>1.07 (2.01)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>Ride in aircraft</td>
<td>491</td>
<td>.77 (1.82)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>7</td>
</tr>
</tbody>
</table>

More Indian males responded (67.5%) than would be expected of the general population (52.6%) (National Institution for Transforming India Aayog, 2015). However, the median age of participants (28) was very close to that of the Indian population (28.1) (U.S. Central Intelligence Agency, 2019). The bottom household income quintile was underrepresented (10%) among Indian participants, the second quintile appeared overrepresented (28%), and the top three were represented proportionally (20%, 22%, and 19%, respectively). While 34.5% of the Indian population lives in urban areas, 79.5% of Indian participants claimed to live in urban areas (U.S. Central Intelligence Agency, 2019).
Table 9

*Study 1 Demographics, Indian Participants*

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>354</td>
<td>(67.6%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>170</td>
<td>(32.4%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-binary</td>
<td>0</td>
<td>(0%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>520</td>
<td>29.81 (6.52)</td>
<td>28</td>
<td>25</td>
<td>18</td>
<td>68</td>
</tr>
<tr>
<td>Income Quintile</td>
<td>524</td>
<td>3.11 (1.30)</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Urban Setting</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urban</td>
<td>409</td>
<td>(79.4%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rural</td>
<td>106</td>
<td>(20.6%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transportation frequency</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ride a bicycle</td>
<td>525</td>
<td>3.07 (2.26)</td>
<td>3</td>
<td>2</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>Drive a car</td>
<td>525</td>
<td>3.02 (2.09)</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>Ride in a car</td>
<td>526</td>
<td>2.62 (1.96)</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>Ride a bus</td>
<td>525</td>
<td>2.99 (2.09)</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>Ride a train</td>
<td>525</td>
<td>2.28 (2.17)</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>Ride in aircraft</td>
<td>524</td>
<td>1.77 (2.25)</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>7</td>
</tr>
</tbody>
</table>

Table 10

*Study 1 Household Income Quintiles*

<table>
<thead>
<tr>
<th>Nation</th>
<th>Quintile</th>
<th>$N$</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S.</td>
<td>1</td>
<td>63 (12.8%)</td>
</tr>
<tr>
<td>U.S.</td>
<td>2</td>
<td>157 (31.8%)</td>
</tr>
<tr>
<td>U.S.</td>
<td>3</td>
<td>152 (30.8%)</td>
</tr>
<tr>
<td>U.S.</td>
<td>4</td>
<td>89 (18.0%)</td>
</tr>
<tr>
<td>U.S.</td>
<td>5</td>
<td>32 (6.5%)</td>
</tr>
<tr>
<td>India</td>
<td>1</td>
<td>55 (10.5%)</td>
</tr>
<tr>
<td>India</td>
<td>2</td>
<td>147 (28.0%)</td>
</tr>
<tr>
<td>India</td>
<td>3</td>
<td>105 (20.0%)</td>
</tr>
<tr>
<td>India</td>
<td>4</td>
<td>117 (22.3%)</td>
</tr>
<tr>
<td>India</td>
<td>5</td>
<td>100 (19.0%)</td>
</tr>
</tbody>
</table>

In summary, U.S. participants approximated the U.S. population in age and urban or rural setting, but the sample had lower income distribution and more male representation than the general public. Indian participants approximated the general
population in age and income but skewed more male and more urban than the general public.

**Descriptive statistics.** Analysis of the descriptive statistics revealed that each group had more than the 99 required from the a priori power analysis. The smallest group had 105 valid entries, and the largest had 146 (1.39 times the size of the smallest group). The standard deviations appeared greater among U.S. participants than among Indian participants. The results were not overly skewed, but negative kurtosis among U.S. participants indicated a lower peak in the histogram and more uniform distribution than among Indian participants. See Table 11.

Table 11

*Study 1 Descriptive Statistics for Willingness to Fly*

<table>
<thead>
<tr>
<th>Nationality</th>
<th>AAP</th>
<th>RPS</th>
<th>N</th>
<th>Min.</th>
<th>Max.</th>
<th>M</th>
<th>SD</th>
<th>Skewness</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S.</td>
<td>No</td>
<td>No</td>
<td>131</td>
<td>1.00</td>
<td>5.00</td>
<td>2.57</td>
<td>.24</td>
<td>.276</td>
<td>-1.337</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>136</td>
<td>1.00</td>
<td>5.00</td>
<td>2.47</td>
<td>1.20</td>
<td>.446</td>
<td>-1.065</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>122</td>
<td>1.00</td>
<td>5.00</td>
<td>2.81</td>
<td>1.28</td>
<td>.125</td>
<td>-1.321</td>
<td></td>
</tr>
<tr>
<td>India</td>
<td>No</td>
<td>No</td>
<td>146</td>
<td>1.00</td>
<td>4.86</td>
<td>3.34</td>
<td>1.03</td>
<td>-.745</td>
<td>-.551</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>129</td>
<td>1.00</td>
<td>5.00</td>
<td>3.69</td>
<td>.80</td>
<td>-.903</td>
<td>.550</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>134</td>
<td>1.00</td>
<td>5.00</td>
<td>3.62</td>
<td>.94</td>
<td>-1.136</td>
<td>.661</td>
<td></td>
</tr>
</tbody>
</table>

*Note.* AAP = Automatic Airframe Parachute Available; RPS = Remote Pilot System Available.

**Reliability and validity testing results.** Cronbach’s alpha and Guttman’s split half reliability were calculated for the willingness to fly scale. Cronbach’s alpha was calculated to be .96, exceeding the minimum acceptable value of .70 that indicates the component questions are measuring the same construct (Trobia, 2011; Vogt et al., 2012). This result was similar to other uses of the willingness to fly scale in which values ranged
from .93 and .98 (Anania, Rice, Walters, et al., 2018; Anania, Rice, Winter, et al., 2018; Winter, Keebler, et al., 2018; Winter et al., 2017; Winter, Rice, et al., 2018). Guttman’s split half was .94 for the willingness to fly scale, also an acceptable indicator of test-retest reliability.

Validity was not explicitly tested in Study 1 because the present research used the willingness to fly scale, developed and validated through factor analysis in a previous study (Rice, Mehta, et al., 2015). In addition to using a previously validated scale, a principal components analysis of the willingness to fly scale was conducted in the present research that found all component items loaded on the same construct (see Table 7), which indicated good construct validity.

**Initial data analysis and assumption testing.** The data were prepared and the ANOVA assumptions were tested before hypothesis testing began. First, missing data was either imputed or cases were excluded. Next, the ANOVA assumptions of no extreme outliers, normality, and homoscedasticity were tested.

**Missing data.** As the willingness to fly scale is calculated from the average value of seven components, the willingness to fly score cannot be calculated if one or more of those component responses are blank. In cases where any of the component response answers are missing, the willingness to fly value remains blank and is treated as a missing value. Of the 1,021 responses returned, one response left all seven items blank and the case was excluded. Twenty participants left a single response item blank in the willingness to fly scale; there was no observed pattern among missing items. The willingness to fly value was calculated for these by using the “all-available” imputation process (Hair, Black, Babin, & Anderson, 2013) because the scale components had equal
weights and the scale had previously demonstrated high internal consistency. Willingness to fly was calculated from the average of six components rather than the usual seven, and the data were retained.

**Outliers.** Next, boxplots were created for each of the eight experimental conditions and inspected for outliers (see Figure 10). There were 11 outliers spread between three groups, none of which was identified as extreme. All data entries corresponding to the outliers were inspected closely. Two entries listed zeroes for all transportation options in addition to listing “strongly disagree” for every response, potentially indicating an inattentive participant. Responses with those two outliers were excluded listwise. Inspection of the other nine outlier responses revealed no reason to suspect the data were entered or recorded erroneously, and they were retained. Enough responses remained to meet the minimum sample size of 99 participants per group (see Table 12).

*Figure 10.* Distribution of willingness to fly by condition.
Normality. Next, a series of Kolmogorov-Smirnov tests revealed the willingness to fly values were not normally distributed in any cell ($p < .001$). Visual inspection confirmed the data were not normally distributed (see Figure 11). If such violations of normality are not extreme, the ANOVA is typically considered robust to violations of normality (Carifio & Perla, 2008; Laerd Statistics, 2017a, 2017b). For this reason, data analysis proceeded with the three-way ANOVA. However, as an “extreme violation” is not well-defined, the robustness of the ANOVA to non-normally distributed data was evaluated after testing hypotheses to validate the findings.

![Figure 11. Histograms of Study 1 conditions.](image)

Homogeneity of variance. A Levene’s test of equality of error variance revealed the assumption of homoscedasticity was also violated ($p < .001$). While this can be problematic, the ANOVA is also considered robust to heterogeneity of variance if the group sizes are approximately equal, defined as the largest group being no more than three times the size of the smaller group (Blanca, Alarcón, Arnau, Bono, & Bendayan,
The largest group \((N = 141)\) was only 1.4 times the size of the smallest group \((N = 101)\), and the group sizes were judged sufficiently comparable (Blanca et al., 2018).

Additionally, Glass and colleagues (1972) found that the \(F\) test was robust to heterogeneity of variance so long errors are independent; the design of the present research ensured independence of observations.

**Assessing effects of normality violation.** A Monte Carlo analysis was conducted to test whether the ANOVA in Study 1 was robust to the normality assumption violation in the data collected. The willingness to fly results were simulated with normal distributions in each of the eight conditions. The mean and standard deviation from each group in the actual results (Table 11) were used with the “NORM.INV” formula in Microsoft Excel® to produce random values with a normal distribution. The group sizes in the simulation were the same as the actual data. Of note, the simulated data were not constrained to the 1 to 5 range of the actual data so that they could follow a normal distribution and use the same standard deviation as the actual results.

Next, the mean of each simulated group was recorded and compared to the mean of the actual data. All data points for each group were added to or subtracted by the difference in actual and simulated means to ensure the final simulated data had the same mean as the actual data.

Comparison of the descriptive data for actual willingness to fly and simulated values revealed the means were identical and the standard deviations were similar. Also, of note, skewness and kurtosis of the simulated data approached 0 indicating it more closely followed a normal curve (see Table 12).
Table 12

Actual and Simulated Willingness to Fly Data

<table>
<thead>
<tr>
<th>Nat.</th>
<th>AAP</th>
<th>RPS</th>
<th>Data</th>
<th>N</th>
<th>Min.</th>
<th>Max.</th>
<th>M</th>
<th>SD</th>
<th>Skewness</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S.</td>
<td>No</td>
<td>No</td>
<td>WTF</td>
<td>131</td>
<td>1.00</td>
<td>5.00</td>
<td>2.57</td>
<td>1.24</td>
<td>.276</td>
<td>-1.337</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Sim</td>
<td>131</td>
<td>.58</td>
<td>5.81</td>
<td>2.57</td>
<td>1.15</td>
<td>.121</td>
<td>-.017</td>
</tr>
<tr>
<td>Yes</td>
<td></td>
<td></td>
<td>WTF</td>
<td>136</td>
<td>1.00</td>
<td>5.00</td>
<td>2.47</td>
<td>1.20</td>
<td>.446</td>
<td>-1.065</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Sim</td>
<td>136</td>
<td>.19</td>
<td>5.32</td>
<td>2.47</td>
<td>1.09</td>
<td>.380</td>
<td>-.322</td>
</tr>
<tr>
<td>Yes</td>
<td>No</td>
<td></td>
<td>WTF</td>
<td>122</td>
<td>1.00</td>
<td>5.00</td>
<td>2.81</td>
<td>1.28</td>
<td>.125</td>
<td>-1.321</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Sim</td>
<td>122</td>
<td>.06</td>
<td>6.10</td>
<td>2.81</td>
<td>1.34</td>
<td>-.012</td>
<td>-.281</td>
</tr>
<tr>
<td>Yes</td>
<td></td>
<td></td>
<td>WTF</td>
<td>105</td>
<td>1.00</td>
<td>5.00</td>
<td>2.89</td>
<td>1.28</td>
<td>-.215</td>
<td>-1.475</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Sim</td>
<td>105</td>
<td>.08</td>
<td>5.15</td>
<td>2.89</td>
<td>1.10</td>
<td>-.017</td>
<td>-.229</td>
</tr>
<tr>
<td>India</td>
<td>No</td>
<td>No</td>
<td>WTF</td>
<td>146</td>
<td>1.00</td>
<td>4.86</td>
<td>3.34</td>
<td>1.03</td>
<td>-.745</td>
<td>-.551</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Sim</td>
<td>146</td>
<td>1.06</td>
<td>5.34</td>
<td>3.34</td>
<td>.93</td>
<td>.004</td>
<td>-.377</td>
</tr>
<tr>
<td>Yes</td>
<td></td>
<td></td>
<td>WTF</td>
<td>129</td>
<td>1.00</td>
<td>5.00</td>
<td>3.69</td>
<td>.80</td>
<td>-.903</td>
<td>.550</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Sim</td>
<td>129</td>
<td>1.87</td>
<td>5.62</td>
<td>3.69</td>
<td>.77</td>
<td>-.060</td>
<td>-.319</td>
</tr>
<tr>
<td>Yes</td>
<td>No</td>
<td></td>
<td>WTF</td>
<td>134</td>
<td>1.00</td>
<td>5.00</td>
<td>3.62</td>
<td>.94</td>
<td>-.928</td>
<td>.175</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Sim</td>
<td>134</td>
<td>1.37</td>
<td>5.99</td>
<td>3.62</td>
<td>.91</td>
<td>.103</td>
<td>-.002</td>
</tr>
<tr>
<td>Yes</td>
<td></td>
<td></td>
<td>WTF</td>
<td>115</td>
<td>1.00</td>
<td>5.00</td>
<td>3.63</td>
<td>.99</td>
<td>-1.136</td>
<td>.661</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Sim</td>
<td>115</td>
<td>.57</td>
<td>5.96</td>
<td>3.63</td>
<td>1.02</td>
<td>-.381</td>
<td>.063</td>
</tr>
</tbody>
</table>

Note. AAP = Automatic Airframe Parachute Available; RPS = Remote Pilot System Available; WTF = Actual Willingness to Fly Data; Sim = Simulated Data.

A series of Kolmogorov-Smirnov tests indicated all simulated groups achieved normality ($p > .200$) except for two: the group with U.S. participants, no automatic airframe parachute, and a remote pilot system available had $p = .048$, and the group with Indian participants, an automatic airframe parachute available, and a remote pilot system available had $p = .031$. Visual inspection of the histograms and Q-Q plots indicated the groups had approximately normal distributions. Combined with the fact they were created randomly using a normal distribution function, the distributions were deemed acceptably normal to continue.

The simulated data were then used to conduct a three-way ANOVA. The results were compared to the results using actual data from hypothesis testing (see Table 13).
### Table 13

**ANOVA Results from Actual and Simulated Data**

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Results, Actual Data</th>
<th>Results, Simulated Data</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>$F$</td>
<td>$p$</td>
</tr>
<tr>
<td>Corrected Model</td>
<td>7</td>
<td>26.51</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Intercept</td>
<td>1</td>
<td>8136.585</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>NAT</td>
<td>1</td>
<td>162.19</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>AAP</td>
<td>1</td>
<td>9.814</td>
<td>.002</td>
</tr>
<tr>
<td>RPS</td>
<td>1</td>
<td>1.457</td>
<td>.228</td>
</tr>
<tr>
<td>NAT*AAP</td>
<td>1</td>
<td>2.346</td>
<td>.126</td>
</tr>
<tr>
<td>NAT*RPS</td>
<td>1</td>
<td>1.88</td>
<td>.171</td>
</tr>
<tr>
<td>AAP*RPS</td>
<td>1</td>
<td>.319</td>
<td>.572</td>
</tr>
<tr>
<td>NAT<em>AAP</em>RPS</td>
<td>1</td>
<td>3.38</td>
<td>.066</td>
</tr>
<tr>
<td>Error</td>
<td>1010</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1018</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>1017</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note.* NAT = Nationality; AAP = Automatic Airframe Parachute Available; RPS = Remote Pilot System Available; WTF = Willingness to Fly; Sim = Simulated Data.

There were no significant three-way interactions in either the actual or simulated data. The $p$ value for the three-way interaction differed by .013, and effect size differed by .001 between actual and simulated data, indicating the ANOVA was robust to the normality assumption violation for the three-way analysis in Study 1. There were no significant two-way interactions in either the actual or simulated data. The three $p$ value differences (.018, .017, and .023) and effect size differences (all < .001) were small between actual and simulated data, indicating the ANOVA was robust to the normality assumption violation for the two-way analysis.

For the main effects of nationality and automatic airframe parachute availability, the $p$ value differed by less than .001 between actual and simulated results. The $p$ value
varied by .024 for remote pilot system availability, and the result was not statistically significant in either analysis. Effect size differed by .013 for nationality, .001 for automatic airframe parachute availability, and .001 for remote pilot system availability. Thus, the ANOVA in Study 1 was considered robust to the normality assumption violation for the main effects as well.

In summary, differences in p values and effect sizes were small between actual data and simulated data, meeting the normal distribution assumption using the same means and standard deviations. In all cases, significance or non-significance of differences was the same between actual and simulated data. Therefore, the ANOVA was assumed to be valid for Study 1, and analysis of inferential statistics proceeded with the three-way ANOVA despite the violations of normality.

**Inferential statistics and hypothesis testing.** A three-way ANOVA was conducted to test for main effects, two-way interactions, and three-way interactions (see Table 14). There were two significant main effects (see Figure 12). There were no significant three-way or two-way interactions (see Figure 13). These findings are all associated with Hypotheses 1 through 5 and are interpreted below.
Table 14

Tests of Between-Participants Effects

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>p</th>
<th>$\eta^2_{\text{partial}}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected Model</td>
<td>224.963</td>
<td>7</td>
<td>32.138</td>
<td>26.510</td>
<td>&lt; .001</td>
<td>.155</td>
</tr>
<tr>
<td>Intercept</td>
<td>9863.857</td>
<td>1</td>
<td>9863.857</td>
<td>8136.585</td>
<td>&lt; .001</td>
<td>.890</td>
</tr>
<tr>
<td>NAT</td>
<td>196.620</td>
<td>1</td>
<td>196.620</td>
<td>162.190</td>
<td>&lt; .001</td>
<td>.138</td>
</tr>
<tr>
<td>AAP</td>
<td>11.897</td>
<td>1</td>
<td>11.897</td>
<td>9.814</td>
<td>.002</td>
<td>.010</td>
</tr>
<tr>
<td>RPS</td>
<td>1.766</td>
<td>1</td>
<td>1.766</td>
<td>1.457</td>
<td>.228</td>
<td>.001</td>
</tr>
<tr>
<td>NAT*AAP</td>
<td>2.844</td>
<td>1</td>
<td>2.844</td>
<td>2.346</td>
<td>.126</td>
<td>.002</td>
</tr>
<tr>
<td>NAT*RPS</td>
<td>2.280</td>
<td>1</td>
<td>2.280</td>
<td>1.880</td>
<td>.171</td>
<td>.002</td>
</tr>
<tr>
<td>AAP*RPS</td>
<td>.387</td>
<td>1</td>
<td>.387</td>
<td>.319</td>
<td>.572</td>
<td>.000</td>
</tr>
<tr>
<td>NAT<em>AAP</em>RPS</td>
<td>4.098</td>
<td>1</td>
<td>4.098</td>
<td>3.380</td>
<td>.066</td>
<td>.003</td>
</tr>
<tr>
<td>Error</td>
<td>1224.408</td>
<td>1010</td>
<td>1.212</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>11415.730</td>
<td>1018</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>1449.370</td>
<td>1017</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. NAT = Nationality; AAP = Automatic Airframe Parachute Available; RPS = Remote Pilot System Available; WTF = Willingness to Fly.

Figure 12. Main effects and standard error.
Hypothesis 1. Hypothesis 1 is that there is a significant difference in willingness to fly in autonomous air taxis as a function of nationality. Indian participants \((M = 3.56, SD = 1.25)\) were significantly more willing to fly than U.S. participants \((M = 2.67, SD = .95)\), \(F(1, 1010) = 162.190, p < .001, \eta^2_{\text{partial}} = .138\). The effect size was medium to large (Aberson, 2019). Null Hypothesis 1 was rejected.

Hypothesis 2. Hypothesis 2 is that there is a significant difference in willingness to fly in autonomous air taxis as a function of automatic airframe parachute availability. Participants were significantly more willing to fly with an automatic airframe parachute available \((M = 3.25, SD = 1.19)\) than without one available \((M = 3.02, SD = 1.19)\), \(F(1, 1010) = 9.814, p = .002, \eta^2_{\text{partial}} = .010\). The effect size was medium (Aberson, 2019). Null Hypothesis 2 was rejected.
**Hypothesis 3.** Hypothesis 3 is there is a significant difference in willingness to fly in autonomous air taxis as a function of remote pilot system availability. There was no significant difference of willingness to fly between groups with a remote pilot system available ($M = 3.16, SD = 1.19$) and without a remote pilot system available ($M = 3.10, SD = 1.19$), $F(1, 1010) = 1.452, p = .228, \eta^2_{\text{partial}} < .001$. Null Hypothesis 3 failed to be rejected.

**Hypothesis 4a.** Hypothesis 4a is that there is a two-way interaction between nationality and automatic airframe parachute availability. There was no significant two-way interaction of nationality and automatic airframe parachute availability, $F(1, 1010) = 2.346, p = .126, \eta^2_{\text{partial}} = .003$. Null Hypothesis 4a failed to be rejected.

**Hypothesis 4b.** Hypothesis 4b is that there is a two-way interaction between nationality and remote pilot system availability. There was no statistically significant two-way interaction of nationality and remote pilot system availability, $F(1, 1010) = 1.880, p = .171, \eta^2_{\text{partial}} = .002$. Null Hypothesis 4b failed to be rejected.

**Hypothesis 4c.** Hypothesis 4c is that there is a two-way interaction between automatic airframe parachute availability and remote pilot system availability. There was no statistically significant two-way interaction of automatic airframe parachute availability and remote pilot system availability, $F(1, 1010) = .319, p = .572, \eta^2_{\text{partial}} < .001$. Null Hypothesis 4c failed to be rejected.

**Hypothesis 5.** Hypothesis 5 is there is a three-way interaction between nationality, automatic airframe parachute availability, and remote pilot system availability. There was no statistically significant three-way interaction between nationality, automatic airframe
parachute availability, and remote pilot system availability, $F(1, 1010) = 3.380, p = .066$, $\eta^2_{\text{partial}} = .003$. Hypothesis 5 failed to be rejected.

**Study 1 Results Summary.** Study 1 met a priori sample size requirements with more than 100 participants in each group. The participants were close in age to the general population and had more male participants than expected.

The survey responses did not conform to normal distributions and had heterogeneous variance, although the ANOVA was reportedly robust to both assumption violations. The results were compared to simulated data with the same mean and standard deviation and a normal distribution. The comparison indicated the ANOVA was robust to the assumption variations as similar results were attained in both cases.

There were two significant main effects: Nationality and automatic airframe parachute availability both affected willingness to fly. There were no other significant main effects, two-way interactions, or three-way interactions. Therefore, the safety system or combination with the greatest effect was the automatic airframe parachute, which was used as the independent variable for Study 2.

**Study 2 Results**

**Study 2 results introduction.** Study 2 tested the favored condition from Study 1 that resulted in the largest change in willingness to fly. The results above indicated that automatic airframe parachute availability had the largest effect of safety systems and was used for the safety system variable in scenario in Study 2. This section describes the results of Study 2 and tests Hypotheses 6 through 10. Hypotheses 6 through 8 were tested using a two-way ANOVA with willingness to fly as the dependent variable and nationality and automatic airframe parachute availability as the independent variables.
Hypotheses 9 and 10 were tested with mediation analyses using ordinary least squares regression.

**Data preparation.** Because the cultural worldview scale used in Study 2 had reverse-coded items, the squared discrepancy procedure could be used to screen out inattentive participants. Initial analysis of squared discrepancy scores was conducted to identify and exclude inattentive participants before proceeding with data analysis. Only responses with squared discrepancy scores equal to or greater than .84 were included. Of U.S. participants, 468 surveys were returned, and 419 (90%) met the screening criteria. Indian participants appeared more inattentive: Of 1,048 survey responses, 440 (42%) met the screening criteria and were included.

Other survey results were screened for incomplete responses. One participant indicated he or she did not agree to the informed consent; the case was excluded listwise. One participant did not answer five of the six egalitarian-hierarchism questions, and the response was excluded listwise. Three Indian participants entered values greater than 10,000 for age; the age values were deleted and treated as missing data, and the remainders of each case was kept. After initial screening, 859 cases remained (419 U.S. participants, 440 Indian participants).

**Demographic statistics.** Demographics from Study 2 are presented separately for U.S. participants (see Table 15) and Indian participants (see Table 16). Annual household income quintiles are presented in Table 17.

There were more male U.S. participants (53.7%) than female participants, skewing toward more males than the 49% in the general population (United States Census Bureau, 2010). Among U.S. participants, the median age of 35 was close to the
median age of the general U.S. population of 37.2 (United States Census Bureau, 2010).

As with Study 1, most U.S. participants were from the second (35.0%) and third (27.1%) quintiles of household income (see Table 17) and few were from the top quintile (4.6%).

Of U.S. participants, 81.8% claimed to live in urban areas, close to the 80.7% the U.S. Census Bureau reported for the general population (United States Census Bureau, 2010).

Table 15

*Study 2 Demographics, U.S. Participants*

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>225</td>
<td>(53.7%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>194</td>
<td>(46.3%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-binary</td>
<td>0</td>
<td>(0%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>418</td>
<td>37.50 (11.21)</td>
<td>35</td>
<td>35</td>
<td>19</td>
<td>73</td>
</tr>
<tr>
<td>Income Quintile</td>
<td>417</td>
<td>2.55 (1.09)</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Urban Setting</td>
<td>Urban</td>
<td>341</td>
<td>(81.8%)</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Rural</td>
<td>76</td>
<td>(18.2%)</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Transportation frequency</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ride a bicycle</td>
<td>419</td>
<td>.46 (1.16)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>Drive a car</td>
<td>417</td>
<td>4.22 (2.48)</td>
<td>5</td>
<td>7</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>Ride in a car</td>
<td>418</td>
<td>1.80 (1.77)</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>Ride a bus</td>
<td>416</td>
<td>.42 (1.24)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>Ride a train</td>
<td>418</td>
<td>.41 (1.26)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>Ride in aircraft</td>
<td>418</td>
<td>.11 (.65)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>6</td>
</tr>
</tbody>
</table>

As before, more Indian males responded (72.0%) than would be expected of the general population (52.6%) (National Institution for Transforming India Aayog, 2015). However, the median age of participants (29) was close to that of the Indian population (28.1) (U.S. Central Intelligence Agency, 2019). Most participants (38%) were from the second quintile of annual household income, while the first and fourth quintiles were underrepresented (10.5% and 9.5%, respectively). Of Indian participants, 77.7% claimed
to live in urban areas, compared to 34.5% of the general Indian population (U.S. Central Intelligence Agency, 2019).

Table 16

Study 2 Demographics, Indian Participants

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>317</td>
<td>(72.0%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>123</td>
<td>(28.0%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-binary</td>
<td>0</td>
<td>(0%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>434</td>
<td>30.35 (6.61)</td>
<td>29</td>
<td>25</td>
<td>18</td>
<td>62</td>
</tr>
<tr>
<td>Income Quintile</td>
<td>440</td>
<td>2.88 (1.27)</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Urban Setting</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urban</td>
<td>338</td>
<td>(77.7%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rural</td>
<td>97</td>
<td>(22.3%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transportation frequency</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ride a bicycle</td>
<td>438</td>
<td>3.08 (2.16)</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>Drive a car</td>
<td>437</td>
<td>2.95 (2.00)</td>
<td>3</td>
<td>5</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>Ride in a car</td>
<td>439</td>
<td>2.72 (1.82)</td>
<td>3</td>
<td>4</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>Ride a bus</td>
<td>437</td>
<td>3.06 (1.97)</td>
<td>3</td>
<td>5</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>Ride a train</td>
<td>440</td>
<td>2.54 (2.02)</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>Ride in aircraft</td>
<td>437</td>
<td>1.78 (2.10)</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>7</td>
</tr>
</tbody>
</table>

Table 17

Study 2 Household Income Quintiles

<table>
<thead>
<tr>
<th>Nation</th>
<th>Quintile</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S.</td>
<td>1</td>
<td>73 (17.51%)</td>
</tr>
<tr>
<td>U.S.</td>
<td>2</td>
<td>146 (35.01%)</td>
</tr>
<tr>
<td>U.S.</td>
<td>3</td>
<td>113 (27.1%)</td>
</tr>
<tr>
<td>U.S.</td>
<td>4</td>
<td>66 (15.83%)</td>
</tr>
<tr>
<td>U.S.</td>
<td>5</td>
<td>19 (4.56%)</td>
</tr>
<tr>
<td>India</td>
<td>1</td>
<td>46 (10.45%)</td>
</tr>
<tr>
<td>India</td>
<td>2</td>
<td>167 (37.95%)</td>
</tr>
<tr>
<td>India</td>
<td>3</td>
<td>104 (23.64%)</td>
</tr>
<tr>
<td>India</td>
<td>4</td>
<td>42 (9.55%)</td>
</tr>
<tr>
<td>India</td>
<td>5</td>
<td>81 (18.41%)</td>
</tr>
</tbody>
</table>
As with Study 1, U.S. participants in Study 2 approximated the U.S. population in age and urban or rural setting, but the sample had lower income distribution and more male representation than the general public. Indian participants approximated the general population in age, but skewed more male, more urban, and had more representation among lower income people than the general public.

**Descriptive statistics.**

Analysis of the descriptive statistics revealed that each group had more than the 197 required from the a priori power analysis. The smallest group had 198 valid entries, and the largest had 242 (1.22 times the size of the smallest group).

The descriptive statistics for willingness to fly appeared similar to those in Study 1. As before, the standard deviations appeared greater among U.S. participants than among Indian participants, and there was more negative kurtosis among U.S. participants. Kurtosis among Indians was higher than in Study 1 (see Table 18). Kurtosis values for Indian participants also were higher than with U.S. participants in the communitarianism-individualism scale (see Table 19) and the egalitarianism-hierarchism scale (see Table 20).

### Table 18

**Study 2 Descriptive Statistics for Willingness to Fly**

<table>
<thead>
<tr>
<th>Nationality</th>
<th>AAP</th>
<th>N</th>
<th>Min.</th>
<th>Max.</th>
<th>M</th>
<th>SD</th>
<th>Skewness</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td></td>
<td>208</td>
<td>1.00</td>
<td>5.00</td>
<td>2.38</td>
<td>1.164</td>
<td>.564</td>
<td>-.829</td>
</tr>
<tr>
<td>Yes</td>
<td></td>
<td>211</td>
<td>1.00</td>
<td>5.00</td>
<td>2.79</td>
<td>1.284</td>
<td>.010</td>
<td>-1.346</td>
</tr>
<tr>
<td>India</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td></td>
<td>242</td>
<td>1.00</td>
<td>5.00</td>
<td>3.38</td>
<td>.807</td>
<td>-1.157</td>
<td>1.120</td>
</tr>
<tr>
<td>Yes</td>
<td></td>
<td>198</td>
<td>1.00</td>
<td>5.00</td>
<td>3.49</td>
<td>.675</td>
<td>-1.155</td>
<td>2.920</td>
</tr>
</tbody>
</table>

*Note.* AAP = Automatic Airframe Parachute Available.
Table 19

Study 2 Descriptive Statistics for Communitarianism-Individualism

<table>
<thead>
<tr>
<th>Nationality</th>
<th>AAP</th>
<th>N</th>
<th>Min.</th>
<th>Max.</th>
<th>M</th>
<th>SD</th>
<th>Skewness</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S.</td>
<td>No</td>
<td>208</td>
<td>1.00</td>
<td>6.00</td>
<td>3.23</td>
<td>1.069</td>
<td>-.028</td>
<td>-.141</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>211</td>
<td>1.00</td>
<td>6.00</td>
<td>3.25</td>
<td>1.136</td>
<td>.089</td>
<td>-.411</td>
</tr>
<tr>
<td>India</td>
<td>No</td>
<td>242</td>
<td>1.50</td>
<td>5.67</td>
<td>3.62</td>
<td>.595</td>
<td>-.405</td>
<td>1.961</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>198</td>
<td>1.17</td>
<td>5.67</td>
<td>3.58</td>
<td>.547</td>
<td>-.059</td>
<td>2.729</td>
</tr>
</tbody>
</table>

Note. AAP = Automatic Airframe Parachute Available.

Table 20

Study 2 Descriptive Statistics for Egalitarianism-Hierarchism

<table>
<thead>
<tr>
<th>Nationality</th>
<th>AAP</th>
<th>N</th>
<th>Min.</th>
<th>Max.</th>
<th>M</th>
<th>SD</th>
<th>Skewness</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S.</td>
<td>No</td>
<td>208</td>
<td>1.00</td>
<td>6.00</td>
<td>2.49</td>
<td>1.369</td>
<td>.636</td>
<td>-.642</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>211</td>
<td>1.00</td>
<td>6.00</td>
<td>2.32</td>
<td>1.339</td>
<td>.871</td>
<td>-.229</td>
</tr>
<tr>
<td>India</td>
<td>No</td>
<td>242</td>
<td>4.83</td>
<td>3.29</td>
<td>.625</td>
<td>-1.399</td>
<td>2.504</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>198</td>
<td>4.67</td>
<td>3.34</td>
<td>.502</td>
<td>-1.012</td>
<td>2.425</td>
<td></td>
</tr>
</tbody>
</table>

Note. AAP = Automatic Airframe Parachute Available.

Reliability and validity testing results. The squared discrepancy procedure was used to assess validity of responses. By assessing the squared difference of the means of each set of reverse-coded items, the procedure was used to identify inattentive responses. For example, the lowest possible squared discrepancy score results from a participant choosing “strongly agree” to questions from both ends of either the communitarianism-individualism or egalitarianism-hierarchism subscales. As the question orders are randomized and nothing identifies the questions as measuring different constructs to the participants, the procedure serves to screen out careless, inattentive, and contradictory responses. Ninety percent of U.S. participants achieved satisfactory squared discrepancy scores, while only 42% of Indian participants achieved satisfactory scores.
Cronbach’s alpha and Guttman’s split-half were calculated for the willingness to fly scale. A value of .96 for Cronbach’s alpha indicated the component questions were measuring the same construct and the value exceeded the minimum acceptable value of .70. This was similar to findings from other studies using the willingness to fly scale (Anania, Rice, Walters, et al., 2018; Anania, Rice, Winter, et al., 2018; Winter, Keebler, et al., 2018; Winter et al., 2017; Winter, Rice, et al., 2018). Guttman’s split-half was .94, indicating an acceptable level of test-retest reliability.

The validity and reliability of each subscale of the cultural worldview scale were assessed separately. Cronbach’s alpha for communitarianism-individualism was .76, indicating that the component questions were measuring the same construct. The value exceeded the minimum acceptable value of .70 and was similar to findings from other studies using the cultural worldview scale that had a Cronbach’s alpha score of .81 (Kahan, 2012; Kahan et al., 2011). Guttman’s split-half was .63, indicating there may be problems with test-retest reliability. However, if the six questions were split in different triplets, Guttman’s split half reached as high as .80, indicating an acceptable level of test-retest reliability. As the questions are in random order, this was deemed acceptable.

Cronbach’s alpha for egalitarianism-hierarchism was .86, indicating that the component questions were measuring the same construct. The value exceeded the minimum acceptable value of .70 and was also similar to findings from other studies using the cultural worldview scale, which had a value of .87 (Kahan, 2012; Kahan et al., 2011). Guttman’s split-half was .80, indicating an acceptable level of test-retest reliability.
The cultural worldview scale was developed in previous research involving factor analysis, which determined the scale had construct validity in the two subscales of communitarianism-individualism and egalitarianism-hierarchism (Kahan et al., 2007). In addition, a principal components analysis conducted in the present research indicated that communitarianism and individualism loaded on the same construct, as did egalitarianism and hierarchism, indicating each had good convergent validity (see Table 5). After a varimax rotation, both subscales also indicated they were divergent from each other.

Initial data analysis and assumption testing. Before hypothesis testing began, the ANOVA and regression assumptions were tested. First, missing data was either imputed or cases were excluded. Next, the ANOVA assumptions of no extreme outliers, normality, and homoscedasticity were tested. Finally, the additional assumptions for regression will be tested: a relationship between each independent variable and dependent variable, a collective relationship between independent variables and dependent variables, no multicollinearity, and normal distribution of residuals.

Missing data. Twenty cases had a single missing response for a component of the willingness to fly scale. Willingness to fly value for these cases was imputed using the “all-available” method, which averaged the remaining six entries (Hair et al., 2013). No cases were missing more than one component.

Ten cases were missing a single response among the communitarianism-individualism scale. As with the willingness to fly scale, the communitarianism-individualism value was calculated from the mean of the remaining responses. Ten cases were also missing a single response from the egalitarianism-hierarchism scale. The
egalitarianism-hierarchism value was computed from the mean of the remaining responses.

One case was missing two values for both the communitarianism-individualism and egalitarianism-hierarchism responses. As one third of the data were missing, the values were not imputed, and both the communitarianism-individualism and egalitarianism-hierarchism values were treated as missing data. The case still had valid experimental condition and willingness to fly values, so it was not excluded from further analysis.

**Outliers.** Willingness to fly data were analyzed in each of the four experimental conditions to identify outliers in willingness to fly (see Figure 14). There were no outliers among U.S. participants. There were 13 outliers in the group with Indian participants and no automatic airframe parachute available, and 17 outliers in the group with Indian participants and an automatic airframe parachute available. Five outliers were identified as “extreme” by SPSS®, all in the group with Indian participants and an automatic airframe parachute available.
Each outlier case was subsequently inspected. None appeared to be the result of data entry. All five outliers were the lowest possible scores on the willingness to fly scale, but it is impossible to determine whether the person intentionally rated willingness so low or if it was inattentiveness. Three of the outliers had very high squared discrepancy scores—indicating they had consistently answered randomly ordered questions with reverse scoring included—suggesting that the outliers were valid data. As a result, all outliers were retained for further analysis.

For communitarianism-individualism, there were no outliers in either group of U.S. participants (see Figure 15). There were nine outliers in the Indian participant group with an automatic airframe parachute available and 11 in the group without one available (two extreme outliers). All were examined and found to have acceptable to high squared
discrepancy scores and no indications of erroneous or inattentive data entry. All were retained.

*Figure 15. Distribution of communitarianism-individualism by condition.*

For egalitarianism-hierarchism, there were again no outliers in either group of U.S. participants (see Figure 16). There were eight outliers in the Indian participant group with an automatic airframe parachute available and nine in the group without one available (one extreme outlier). All were examined and found to have acceptable to high squared discrepancy scores and no indications of erroneous or inattentive data entry. In fact, the extreme outlier had the lowest possible egalitarianism-hierarchism score, which was achieved by purposefully selecting different responses on reverse-coded items in a random order. All were retained.
Figure 16. Distribution of egalitarianism-hierarchism by condition.

**Normality.** Normally distributed data is an assumption for both the two-way ANOVA and linear regression. A series of Kolmogorov-Smirnov tests revealed the willingness to fly values were not normally distributed in any cell ($p < .001$) (see Figure 17). Communitarianism-individualism values were normally distributed in the group of U.S. participants with an automatic airframe parachute available, although they were not normally distributed for the remainder of U.S. participants ($p = .019$) or either group of Indian participants ($p < .001$) (see Figure 18). Egalitarianism-hierarchism was not normally distributed in any group ($p < .001$) (see Figure 19).
As mentioned before, the ANOVA is typically considered robust to violations of normality if the violations are not extreme (Carifio & Perla, 2008; Laerd Statistics, 2017a, 2017b). Visual inspection of the willingness to fly indicated it was distributed similarly to that of Study 1, which had demonstrated its robustness to the normality violation. Analysis continued, and the robustness of the ANOVA to non-normally distributed data was again evaluated after testing hypotheses to validate the findings.
For the linear regression used to test Hypotheses 9 and 10, normality is “one of the least important” assumptions and is rarely met by scales bounded by upper and lower limits (Hayes, 2018, p. 70). For these reasons, Hayes’s (2018) mediation analysis with linear regression uses bootstrapping with replacement to produce 95% confidence intervals. The bootstrapping process eliminates the need to use the normal theory approach and eliminates the assumption of normality. Therefore, normality of the communitarianism-individualism scale and egalitarianism-hierarchism scale are not further analyzed.

**Homogeneity of variance.** A Levene’s test of equality of error variance revealed the assumption of homoscedasticity was also violated ($p < .001$) for willingness to fly. However, the ANOVA is also considered robust to heterogeneity of variance if the largest group size is not more than three times larger than the smallest group size (Blanca et al., 2018). The largest group ($N = 242$) was only 1.2 times the size of the smallest group ($N = 198$). Additionally, an ANOVA is robust to heterogeneity of variance when errors are independent, as is the design in the present research (1972). Therefore, analysis continued after acknowledging these assumption violations.

For the regression analysis, homogeneity of variance was assessed by comparing the regression standardized residuals with regression standardized predicted values on a scatterplot. For there to be homoscedasticity, the points should appear randomly distributed (Laerd Statistics, 2015b). In the relationship between automatic airframe parachute availability and communitarianism-individualism, there was homoscedasticity (see Figure 20). In the relationship between communitarianism-individualism and willingness to fly, there was homoscedasticity (see Figure 21). In the relationship
between automatic airframe parachute availability and egalitarianism-hierarchism, there was homoscedasticity (see Figure 22). In the relationship between egalitarianism-hierarchism and willingness to fly, there was homoscedasticity (see Figure 23).

Figure 20. Residuals, communitarianism-individualism as dependent variable.
Figure 21. Residuals, communitarianism-individualism as independent variable.

Figure 22. Residuals, communitarianism-individualism as dependent variable.
Assessing effects of normality violation. The same Monte Carlo procedure as in Study 1 was used to compare results of the two-way ANOVA in Study 2 using actual data to results using simulated data with the same mean and standard deviation but normal distribution (see Tables 21 and 22). The group sizes in the simulation were the same as the actual data. A series of Kolmogorov-Smirnov tests found the data were distributed normally in all groups for each variable ($p > .05$).

As before, simulated willingness to fly values were not constrained to the 1 to 5 range of the actual values to allow for a normal distribution. The actual and simulated data produced very similar $p$ values, only differing by at most .006 (see Table 22). Effect sizes differed by at most $\eta^2_{\text{partial}} = .002$. Therefore, the ANOVA in Study 2 was considered robust to the violation of normality, and the results from hypothesis tests were assumed to be valid.

**Figure 23.** Residuals, communitarianism-individualism as dependent variable.
Table 21

*Actual and Simulated Willingness to Fly Data*

<table>
<thead>
<tr>
<th>Nat.</th>
<th>AAP</th>
<th>Data</th>
<th>N</th>
<th>Min.</th>
<th>Max.</th>
<th>M</th>
<th>SD</th>
<th>Skewness</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S.</td>
<td>No</td>
<td>WTF</td>
<td>208</td>
<td>1.00</td>
<td>5.00</td>
<td>2.38</td>
<td>1.16</td>
<td>.564</td>
<td>-.829</td>
</tr>
<tr>
<td></td>
<td>Sim</td>
<td></td>
<td>208</td>
<td>-1.13</td>
<td>5.12</td>
<td>2.38</td>
<td>1.18</td>
<td>-.333</td>
<td>-.343</td>
</tr>
<tr>
<td>Yes</td>
<td>WTF</td>
<td></td>
<td>211</td>
<td>1.00</td>
<td>5.00</td>
<td>2.79</td>
<td>1.28</td>
<td>.010</td>
<td>-1.346</td>
</tr>
<tr>
<td></td>
<td>Sim</td>
<td></td>
<td>211</td>
<td>-1.66</td>
<td>5.73</td>
<td>2.79</td>
<td>1.27</td>
<td>-.314</td>
<td>.105</td>
</tr>
<tr>
<td>India</td>
<td>No</td>
<td>WTF</td>
<td>242</td>
<td>1.00</td>
<td>5.00</td>
<td>3.38</td>
<td>.81</td>
<td>-1.157</td>
<td>1.120</td>
</tr>
<tr>
<td></td>
<td>Sim</td>
<td></td>
<td>242</td>
<td>.97</td>
<td>5.26</td>
<td>3.38</td>
<td>.76</td>
<td>-.270</td>
<td>.041</td>
</tr>
<tr>
<td>Yes</td>
<td>WTF</td>
<td></td>
<td>198</td>
<td>1.00</td>
<td>5.00</td>
<td>3.49</td>
<td>.68</td>
<td>-1.155</td>
<td>2.920</td>
</tr>
<tr>
<td></td>
<td>Sim</td>
<td></td>
<td>198</td>
<td>1.45</td>
<td>5.79</td>
<td>3.49</td>
<td>.68</td>
<td>-.059</td>
<td>.680</td>
</tr>
</tbody>
</table>

*Note.* AAP = Automatic Airframe Parachute Available; WTF = Actual Willingness to Fly Data; Sim = Simulated Data

Table 22

*ANOVA Results from Actual and Simulated Data*

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Results, Actual Data</th>
<th>Results, Simulated Data</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>F</td>
<td>p</td>
</tr>
<tr>
<td>Corrected Model</td>
<td>3</td>
<td>56.12</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Intercept</td>
<td>1</td>
<td>7568.83</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>NAT</td>
<td>1</td>
<td>151.019</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>AAP</td>
<td>1</td>
<td>14.231</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>NAT*AAP</td>
<td>1</td>
<td>5.083</td>
<td>.024</td>
</tr>
<tr>
<td>Error</td>
<td>855</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>859</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>858</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note.* NAT = Nationality; AAP = Automatic Airframe Parachute Available.

**Inferential statistics and hypothesis testing.** A two-way ANOVA was conducted to test for main effects and two-way interactions of nationality and automatic airframe parachute availability (see Table 23). Both nationality and automatic airframe parachute availability significantly affected willingness to fly. There was also a two-way interaction in which U.S. participants increased in willingness to fly if an automatic
airframe parachute was available, but Indian participants did not (see Figure 24). Finally, mediation analyses using ordinary least squares regression to assess whether communitarianism-individualism and egalitarianism-hierarchism mediated the relationship between automatic airframe parachute availability and willingness to fly. No significant mediation relationships were found.

Table 23

*Tests of Between-Participants Effects*

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>p</th>
<th>η²partial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected Model</td>
<td>171.998</td>
<td>3</td>
<td>57.333</td>
<td>56.120</td>
<td>&lt; .001</td>
<td>.165</td>
</tr>
<tr>
<td>Intercept</td>
<td>7732.395</td>
<td>1</td>
<td>7732.395</td>
<td>7568.839</td>
<td>&lt; .001</td>
<td>.899</td>
</tr>
<tr>
<td>NAT</td>
<td>154.283</td>
<td>1</td>
<td>154.283</td>
<td>151.019</td>
<td>&lt; .001</td>
<td>.150</td>
</tr>
<tr>
<td>AAP</td>
<td>14.539</td>
<td>1</td>
<td>14.539</td>
<td>14.231</td>
<td>&lt; .001</td>
<td>.016</td>
</tr>
<tr>
<td>NAT*AAP</td>
<td>5.193</td>
<td>1</td>
<td>5.193</td>
<td>5.083</td>
<td>.024</td>
<td>.006</td>
</tr>
<tr>
<td>Error</td>
<td>873.476</td>
<td>855</td>
<td>1.022</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>8864.442</td>
<td>859</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>1045.474</td>
<td>858</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note.* NAT = Nationality; AAP = Automatic Airframe Parachute Available; WTF = Willingness to Fly.
Hypothesis 6. Hypothesis 6 is that there is a significant difference in willingness to fly in autonomous air taxis as a function of participant nationality. Indian participants ($M = 3.43$, $SD = .752$) were significantly more willing to fly than U.S. participants ($M = 2.59$, $SD = 1.242$), $F(1, 855) = 151.019, p < .001$, $\eta^2_{\text{partial}} = .150$. The effect size was large (Aberson, 2019). Null Hypothesis 6 was rejected.

Hypothesis 7. Hypothesis 7 is that there is a significant difference in willingness to fly in autonomous air taxis as a function of automatic airframe parachute availability. Participants were significantly more willing to fly with an automatic airframe parachute available ($M = 3.13$, $SD = 1.090$) than without one available ($M = 2.92$, $SD = 1.107$), $F(1, 855) = 14.231, p < .001$, $\eta^2_{\text{partial}} = .016$. The effect size was small (Aberson, 2019). Null Hypothesis 7 was rejected.
**Hypothesis 8.** Hypothesis 8 is that there is a two-way interaction between nationality and automatic airframe parachute availability. There was a statistically significant two-way interaction between nationality and willingness to fly, $F(1, 855) = 5.083, \ p = .024$, partial $\eta^2_{\text{partial}} = .006$. The simple main effect of automatic airframe parachute availability on willingness to fly among U.S. participants was statistically significant, $F(1, 855) = 17.815, \ p < .001$. The simple main effect of automatic airframe parachute availability on willingness to fly among Indian participants was not statistically significant, $F(1, 855) = 1.175, \ p = .279$. Null Hypothesis 8 was rejected.

**Hypothesis 9a.** Hypothesis 9a is that overall, communitarianism-individualism significantly mediates the relationship between automatic airframe parachute availability and willingness to fly in autonomous air taxis. A simple mediation analysis using ordinary least squares regression found that automatic airframe parachute availability did not predict communitarianism-individualism ($a = -.027$), and communitarianism-individualism did predict willingness to fly ($b = .089$) (see Table 24). Hayes (2018) recommended against referencing significance values in the $a$ and $b$ relationships, as they could be not statistically significant but still influence the indirect effect ($ab$). A bootstrap confidence interval for the indirect effect ($ab = -.002$) based on 10,000 bootstrapped samples included zero (.016 to .010), indicating there was no significant indirect effect. The direct effect ($c’ = .215$) confidence interval was entirely above zero (.068 to .362), indicating there was a significant direct effect, as was found in Hypotheses 2 and 7. As the analysis found no significant indirect effect, communitarianism-individualism did not appear to mediate the relationship between automatic airframe parachute availability and willingness to fly. Null Hypothesis 9a failed to be rejected.
Table 24

Mediation Analysis of Communitarianism-Individualism, All Participants

<table>
<thead>
<tr>
<th>Antecedent</th>
<th>Coeff.</th>
<th>SE</th>
<th>p</th>
<th>Consequent</th>
<th>Coeff.</th>
<th>SE</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAP</td>
<td>(a_{CI})</td>
<td>-.027</td>
<td>.061</td>
<td>.657</td>
<td>(c')</td>
<td>.215</td>
<td>.075</td>
</tr>
<tr>
<td>C-I</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>(b_{CI})</td>
<td>.089</td>
<td>.042</td>
<td>.034</td>
</tr>
<tr>
<td>Constant</td>
<td>(i_{CI})</td>
<td>3.440</td>
<td>.042</td>
<td>&lt;.001</td>
<td>(i_{WTF})</td>
<td>2.609</td>
<td>.154</td>
</tr>
</tbody>
</table>

\[F(1, 856) = .197, p = .657\] \[F(2, 855) = 6.259, p = .002\]

Note. AAP = Automatic Airframe Parachute Available; C-I = Communitarianism-Hierarchism.

**Hypothesis 9b.** Hypothesis 9b is that among potential U.S. passengers, communitarianism-individualism significantly mediates the relationship between automatic airframe parachute availability and willingness to fly in autonomous air taxis. The same mediation analysis as in Hypothesis 9a was conducted with only U.S. cases used. Automatic airframe parachute availability did not predict communitarianism-individualism \((a = .025)\), and communitarianism-individualism did not predict willingness to fly \((b = .490)\) (see Table 25). A bootstrap confidence interval for the indirect effect \((ab = .001)\) based on 10,000 bootstrapped samples included zero \((-0.015 \text{ to } 0.019)\), indicating there was no significant indirect effect. The direct effect \((c' = .416)\) confidence interval was entirely above zero \((0.180 \text{ to } 0.652)\), indicating there was a significant direct effect. As the analysis found no significant indirect effect, communitarianism-individualism did not appear to mediate the relationship between automatic airframe parachute availability and willingness to fly among U.S. participants. Null Hypothesis 9b failed to be rejected.
Table 25

*Mediation Analysis of Communitarianism-Individualism, U.S. Participants*

<table>
<thead>
<tr>
<th>Antecedent</th>
<th>Communitarianism-Individualism</th>
<th>Consequent</th>
<th>Willingness to Fly</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coeff.</td>
<td>SE</td>
<td>p</td>
</tr>
<tr>
<td>AAP</td>
<td>.025</td>
<td>.108</td>
<td>.816</td>
</tr>
<tr>
<td>C-I</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Constant</td>
<td>3.227</td>
<td>.077</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>

$R^2 = .0001$  
$F(1, 417) = .054, p = .816$  
$R^2 = .0293$  
$F(2, 416) = 6.287, p = .002$

*Note.* AAP = Automatic Airframe Parachute Available; C-I = Communitarianism-Hierarchism.

**Hypothesis 9c.** Hypothesis 9c is that among potential Indian passengers, communitarianism-individualism significantly mediates the relationship between automatic airframe parachute availability and willingness to fly in autonomous air taxis. Among Indians, automatic airframe parachute availability did not predict communitarianism-individualism ($a = -.038$), and communitarianism-individualism did predict willingness to fly ($b = -.184$) (see Table 26). A bootstrap confidence interval for the indirect effect ($ab = .007$) based on 10,000 bootstrapped samples included zero (-.012 to .037), indicating there was no significant indirect effect. The direct effect ($c' = .101$) confidence interval also included zero (-.039 to .241), indicating there was no significant direct effect. As the analysis found no significant indirect effect, communitarianism-individualism did not appear to mediate the relationship between automatic airframe parachute availability and willingness to fly among Indians. Null Hypothesis 9c failed to be rejected.
Hypothesis 10a. Hypothesis 10a is that overall, egalitarianism-hierarchism significantly mediates the relationship between automatic airframe parachute availability and willingness to fly in autonomous air taxis. A mediation analysis using ordinary least squares regression found that automatic airframe parachute availability did not predict egalitarianism-hierarchism ($a = -0.027$), and egalitarianism-hierarchism did predict willingness to fly ($b = 0.210$) (see Table 27). A bootstrap confidence interval for the indirect effect ($ab = -0.024$) based on 10,000 bootstrapped samples included zero (-0.060 to 0.007), indicating there was no significant indirect effect. The direct effect ($c’ = 0.237$) confidence interval was entirely above zero (0.092 to 0.381), indicating there was a significant direct effect, as was found in Hypotheses 2 and 7. As the analysis found no significant indirect effect, egalitarianism-hierarchism did not appear to mediate the relationship between automatic airframe parachute availability and willingness to fly. Null Hypothesis 10a failed to be rejected.
Table 27

*Meditation Analysis of Egalitarianism-Hierarchism, All Participants*

<table>
<thead>
<tr>
<th>Antecedent</th>
<th>Egalitarianism-Hierarchism</th>
<th>Willingness to Fly</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coeff.</td>
<td>SE</td>
</tr>
<tr>
<td>AAP</td>
<td>$a_{EH}$</td>
<td>-.115</td>
</tr>
<tr>
<td>E-H</td>
<td>$b_{EH}$</td>
<td>.210</td>
</tr>
<tr>
<td>Constant</td>
<td>$i_{EH}$</td>
<td>2.925</td>
</tr>
</tbody>
</table>

$R^2 = .0026$  
$F(1, 856) = 2.242, p = .135$  
$R^2 = .0549$  
$F(2, 855) = 24.81, p < .001$

*Note.* AAP = Automatic Airframe Parachute Available; E-H = Egalitarianism-Hierarchism.

**Hypothesis 10b.** Hypothesis 10b is that among potential U.S. passengers, egalitarianism-hierarchism significantly mediates the relationship between automatic airframe parachute availability and willingness to fly in autonomous air taxis. Among U.S. participants, automatic airframe parachute availability did not predict egalitarianism-hierarchism ($a = -.179$), and egalitarianism-hierarchism did not predict willingness to fly ($b = .025$) (see Table 28). A bootstrap confidence interval for the indirect effect ($ab = -.005$) based on 10,000 bootstrapped samples included zero (-.029 to .015), indicating there was no significant indirect effect. The direct effect ($c' = .421$) confidence interval was entirely above zero (.185 to .658), indicating there was a significant direct effect. As the analysis found no significant indirect effect, egalitarianism-hierarchism did not appear to mediate the relationship between automatic airframe parachute availability and willingness to fly among U.S. participants. Null Hypothesis 10b failed to be rejected.
Table 28

Mediation Analysis of Egalitarianism-Hierarchism, U.S. Participants

<table>
<thead>
<tr>
<th>Antecedent</th>
<th>Egalitarianism-Hierarchism</th>
<th>Willingness to Fly</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coeff.</td>
<td>SE</td>
</tr>
<tr>
<td>AAP</td>
<td>(-.179)</td>
<td>(.132)</td>
</tr>
<tr>
<td>E-H</td>
<td>(-)</td>
<td>(-)</td>
</tr>
<tr>
<td>Constant</td>
<td>(.498)</td>
<td>(.094)</td>
</tr>
</tbody>
</table>

\[ R^2 = .0044 \quad R^2 = .029 \]

\[
F(1, 417) = 1.836, p = .176 \quad F(2, 416) = 6.206, p = .002
\]

Note. AAP = Automatic Airframe Parachute Available; E-H = Egalitarianism-Hierarchism.

**Hypothesis 10c.** Hypothesis 10c is that among potential Indian passengers, egalitarianism-hierarchism significantly mediates the relationship between automatic airframe parachute availability and willingness to fly in autonomous air taxis. Among Indians, automatic airframe parachute availability did not predict egalitarianism-hierarchism \((a = .044)\), and egalitarianism-hierarchism did predict willingness to fly \((b = .324)\) (see Table 29). A bootstrap confidence interval for the indirect effect \((ab = .014)\) based on 10,000 bootstrapped samples included zero (-.021 to .054), indicating there was no significant indirect effect. The direct effect \((c' = .094)\) confidence interval included zero (-.044 to .232), indicating there was no significant direct effect. As the analysis found no significant indirect effect, egalitarianism-hierarchism did not appear to mediate the relationship between automatic airframe parachute availability and willingness to fly among Indians. Null Hypothesis 10c failed to be rejected.
Table 29

Mediation Analysis of Egalitarianism-Hierarchism, Indians

<table>
<thead>
<tr>
<th>Antecedent</th>
<th>Egalitarianism-Hierarchism</th>
<th>Willingness to Fly</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coeff.</td>
<td>SE</td>
</tr>
<tr>
<td>AAP</td>
<td>$a_{EH}$</td>
<td>.044</td>
</tr>
<tr>
<td>E-H</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Constant</td>
<td>$i_{EH}$</td>
<td>3.293</td>
</tr>
</tbody>
</table>

$R^2 = .0014$

$F(1, 437) = .634, p = .426$

$F(2, 436) = 15.367, p = < .001$

Note. AAP = Automatic Airframe Parachute Available; E-H = Egalitarianism-Hierarchism.

**Study 2 results summary.** Study 2 met a priori sample size requirements with more than the 197 participants in each group. As with Study 1, the participants were close in age to the general population and had more male participants than expected.

The data did not meet the ANOVA assumption of normal distribution, but a Monte Carlo simulation revealed the ANOVA was robust to the assumption violation. The mediation analyses did not require normal data. The data for the ANOVA did not have equal variance, but group sizes were close enough that the ANOVA was robust to the assumption violation. Analysis proceeded after acknowledging these caveats.

Study 2 repeated Study 1 and found that Indian participants were more willing to fly in autonomous air taxis than U.S. participants and that people were more willing to fly if the aircraft had an automatic airframe parachute available. There was also a two-way interaction, which found that U.S. participants increased their willingness to fly if an automatic airframe parachute was available, while the parachute did not significantly affect Indian participants’ willingness to fly.
A mediation analysis found that communitarianism-individualism and egalitarianism-hierarchism did not mediate the relationship between automatic airframe parachute availability and willingness to fly. While there was a direct relationship in most cases, there were no significant indirect relationship. However, we note that the relationships between both cultural orientation scales to willingness to fly were significant. Communitarianism-individualism explained 1.4% of variations in willingness to fly \( (R^2 = .0144) \), and egalitarianism-hierarchism explained 5.5% of variations in willingness to fly \( (R^2 = .0549) \). Thus, while cultural orientation did not mediate the relationship between automatic airframe parachute availability and willingness to fly, it may still be an important variable worth exploring in a different model.

**Comparison of Studies**

Study 1 and Study 2 both found that nationality significantly affected willingness to fly. Both studies had a medium effect size \( (\eta^2_{\text{partial}} = .138, \eta^2_{\text{partial}} = .150) \). These findings replicated earlier studies that also found Indian participants were more willing to fly in autonomous aircraft than U.S. participants, with medium effects \( \eta^2_{\text{partial}} = .10 \) (Rice et al., 2014), \( \eta^2_{\text{partial}} = .097 \), (Mehta et al., 2017). One study also found Indians had greater willingness to fly but had a small effect, \( \eta^2_{\text{partial}} = .01 \) (Winter, Rice, et al., 2015).

Both studies in the present research also found that people were more willing to fly in an autonomous air taxi when an automatic airframe parachute was available. There was a medium effect (.010) in Study 1 and in Study 2 \( (\eta^2_{\text{partial}} = .016) \).

Two-way interactions differed between the studies. In Study 1, the two-way interaction of nationality and automatic airframe parachute availability was not
significant \((p = .126, \eta^2_{\text{partial}} = .003)\). In Study 2, there was a significant two-way interaction with a small effect size \((p = .024, \text{partial } \eta^2_{\text{partial}} = .006)\).

**Interpreting Demographic Effects**

Demographic data were collected for both studies. A series of analyses were conducted to compare demographic effects to past research. As only Study 2 included the cultural worldview scale in the survey and the demographics appeared similar, only the data from Study 2 was used for analysis.

Study 2 afforded the opportunity to assess cultural orientation tendencies between the two nations. Indian participants \((M = 3.60, SD = .57)\) were more communitarian than U.S. participants \((M = 3.24, SD = 1.10)\), \(t(856) = -6.048, p < .001\). Indian participants \((M = 3.31, SD = .57)\) were more hierarchical than U.S. participants \((M = 2.41, SD = 1.36)\), \(t(856) = -12.624, p < .001\). These findings met expectations because at the national level, India is more collectivist and the United States is more individualist (Hofstede Insights, 2019). In addition, the United States rated lower power distance than India (Hofstede Insights, 2019), and India is a vertical collectivist nation (Singelis et al., 1995), together suggesting a tendency toward hierarchism.

Older people tend to be less accepting of autonomous vehicles (Charness et al., 2018). As expected, age appeared to be negatively correlated with willingness to fly \((p < .001)\). A simple linear regression revealed that for every year of age, willingness to fly decreased by .028 from the intercept of 3.965 at the axis of age = 0. The \(R^2\) value was .062, indicating age explained 6.2% of the variation in willingness to fly.

There were gender differences in willingness to fly, as had been found in previous research of willingness to fly in autonomous aircraft among people from the United
States and India (Anania, Rice, Walters, et al., 2018; Anania, Rice, Winter, et al., 2018). Data from the two nations were analyzed separately because gender differences may only be meaningful within cultures, as gender differences are a function of social experiences unique to each nation (Flynn et al., 1994; Kahan et al., 2007). U.S. males ($M = 2.83$, $SD = 1.20$) were more willing to fly than U.S. females ($M = 2.30$, $SD = 1.23$), $t(404.721) = -4.51$, $p < .001$. Indian males ($M = 3.42$, $SD = .78$) and females ($M = 3.44$, $SD = .66$) did not significantly differ in willingness to fly $t(260.948) = .221$, $p = .825$.

Finally, scatterplots of the remaining demographic variables were created. Urban setting and transportation frequencies did not appear to be correlated with willingness to fly.

**Summary**

This chapter described the demographics, descriptive statistics, and inferential statistics used to test the hypotheses and answer the research questions. This was accomplished in two studies. The first study evaluated whether a safety system affected passengers’ willingness to fly in autonomous air taxis, and the second study assessed whether and how cultural orientation mediated that relationship.

Study 1 found significant main effects of nationality and automatic airframe parachute on passenger willingness to fly. Remote pilot system availability did not significantly affect willingness to fly. There were no significant two- or three-way interactions found.

Study 2 also found nationality and automatic airframe parachute availability affected passenger willingness to fly. In addition, Study 2 revealed different effects based on nationality. Finally, communitarianism-individualism and egalitarianism-hierarchism
were not found to mediate the relationship between safety system availability and willingness to fly. The next chapter discusses these findings and their implications.
CHAPTER V

DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS

This chapter interprets the results of the statistical analyses presented in the previous chapter. The research questions are revisited, and answers are presented. The theoretical and practical significance of the findings are discussed, and avenues for future research are identified.

Discussion

Nationality. Research Questions 1 and 6 asked “what is the effect of participant nationality on willingness to fly in autonomous air taxis?” Study 1 and Study 2 found that Indian participants were more willing to fly in autonomous air taxis than U.S. participants. The findings replicated those of other researchers and who found similar small to medium effects (Ragbir et al., 2018; Rice et al., 2014; Ward et al., 2019).

This first step established that there are clear differences in perceptions and willingness to fly between people of different nationalities. Factors such as local media, perceptions and use of local public transportation systems, and one’s daily exposure to risk differ between nations and may be related to the differences (Cha, 2000; Olofsson & Öhman, 2015). Because of random assignment, those differences are distributed evenly between experimental groups and cannot be determined in the present study. Future studies may be able to explore these other components in depth.

When exploring national differences, one should consider how the environment within the nation affects perceptions. For example, people exposed to more risk in their lives were more likely to engage in risky behavior (Olofsson & Öhman, 2015). People also perceive more risk with if they do not have confidence in their local regulatory
agencies (Wong, 2018). Likewise, those living in urban areas may perceive public transportation solutions such as UAM differently (König & Neumayr, 2017). Using a narrower population, such as that of individual cities rather than nations, may help isolate such effects for future analysis.

**Automatic airframe parachute availability.** Research Questions 2 and 7 asked “what is the effect of automatic airframe parachute availability on willingness to fly in autonomous air taxis?” Both studies found that potential passengers were more willing to fly if the aircraft was equipped with an automatic airframe parachute. The findings conformed to expectations given that previous studies found that UAM passengers desired parachutes (Shaheen et al., 2018), people were concerned about safety in autonomous aircraft (Vance & Malik, 2015), and pilots believed airframe parachutes made an aircraft safer (Winter, Geske, et al., 2015). The effects were not as pronounced as with nationality.

One factor complicating deeper analysis is that people generally conceive of autonomous ground vehicles as safer than vehicles driven by a human operator (Gkartzonikas & Gkritza, 2019). If a participant had a preconception that an autonomous air taxi was a safe option, it may have mitigated effects from the presence or absence of safety systems.

In addition, the present study introduced two concepts simultaneously: autonomy and urban air mobility. Therefore, it is unclear to which concept or concepts participants considered when deciding whether they were willing to fly. Future studies may benefit by isolating autonomous operations as a separate variable when considering safety-related decisions and willingness to fly.
Remote pilot system availability. Research Question 3 asked “what is the effect of remote pilot system availability on willingness to fly in autonomous air taxis?” Study 1 found that remote pilot system availability did not significantly affect willingness to fly. This result was surprising in part because in a previous study with a similar population and hypothetical scenario, there was a significant difference in willingness to fly between when an aircraft was equipped with a remote pilot system and when it was not (Ward et al., 2019).

Previous works do not indicate a clear three-way ranked comparison between preferences for human piloted aircraft, remote piloted aircraft, and fully autonomous aircraft. There is clear preference for human pilots over autonomous aircraft (Fu et al., 2019; Lee et al., 2019; Molesworth & Koo, 2016; Shaheen et al., 2018). If all three conditions were options, potential passengers still preferred on-board human pilots and rated autonomous aircraft and remotely piloted aircraft low (Rice et al., 2014). It is unclear how the scenario in the present study in which there is no on-board pilot option compares.

The scenario used in the present study framed the remote pilot system as an emergency system and not a normal operating condition. This distinction might have led participants to view the hypothetical air taxi as entirely autonomous and respond the same way in both conditions. If so, this may align with Rice and colleagues’ (2014) findings where passengers had similar attitudes toward autonomous operation and remotely piloted operation.

Nationality and two-way interactions. Research Questions 4, 5, and 8 asked about the effects of any two-way or three-way interactions between the independent
variables. There was a two-way interaction nationality and automatic airframe parachute availability in Study 2. Study 1 did not find a significant two-way interaction, although the probability value was closer to significance than the other interactions tested, and participants may have been affected by also seeing a statement about remote pilot system availability or non-availability in the survey scenario.

The two-way interaction meant that U.S. participants increased their willingness to fly in an autonomous air taxi if an automatic airframe parachute was available, but Indian participants did not. This difference in response must logically be a component of national differences because the random assignment of participants to the experimental groups ensured equal distribution of the associated factors. The finding also set up the mediation analysis that followed; cultural orientation was hypothesized to be a component of national differences that mediated the relationship between nationality and willingness to fly.

In addition, there was a potential two-way interaction between nationality and gender where U.S. females were less willing to fly than U.S. males, but there was no difference between Indian females and males. A two-way interaction between gender and nationality was not unexpected because gender differences are a function of social experiences (Flynn et al., 1994; Kahan et al., 2007). Nonetheless, by not knowing the reason India does not have the gender differences that the United States has, more unexplored components of national differences remain.

**Cultural orientation as a mediator.** Research Questions 9 and 10 asked how one’s level of communitarianism-individualism and egalitarianism-hierarchism mediate the relationship between safety system availability and willingness to fly. The indirect
effects of safety system availability on willingness to fly through either cultural orientation were insignificant, and there was no detectable mediation.

There were limited direct effects of communitarianism-individualism and egalitarianism-hierarchism on willingness to fly, but they explained only between 1.4% and 5.4% of the variance. The direct effect of cultural orientation was most prominent among Indians in the egalitarianism-hierarchism scale. These small direct effects of cultural orientation appeared similar to previous findings where cultural orientation explained approximately 10% of variance in risk perception (Sjöberg, 2000, 2002a). Thus, communitarianism-individualism and egalitarianism-hierarchism are not mediators as assessed in the present study, and they may only be marginally relevant to understanding differences in nationality in future research. One possible explanation of the lack of mediation is that willingness to fly is not consistently associated with risk as defined in cultural theory—such as a threat to one’s way of life (Dake, 1991). An individualist may perceive risk in the experimental scenario as a personal decision and view a safety system as the decision criteria. A hierarchist, however, may be most concerned with social risks associated with the scenario (Marris et al., 1998). Thus, to test effects of cultural differences, a different scenario or variable may be required to isolate specific concerns.

Cultural theory and cultural cognition theory exclusively use the group and grid axes (and the associated categorical quadrants) to describe cultural orientation (Douglas & Wildavsky, 1982; Kahan, 2012). Other cultural dimensions, such as masculinity-femininity, uncertainty avoidance (Hofstede, 1980), and horizontal and vertical individualism and collectivism (Singelis et al., 1995) have been shown to affect behavior.
Each may be worthy of exploration in relation to the variables in the present study, as applicable to their unique applications. However, as cultural theory and cultural cognition theory do not incorporate cultural dimensions outside the group and grid typology, the theory could not be used to explain the interactions.

Eliminating communitarianism-individualism and egalitarianism-hierarchism as factors to explain cultural differences opens new doors to exploring national differences in willingness to fly. Most prominently, we can reject cultural cognition theory as a means to understand differences in willingness to fly between U.S. participants and Indian participants. The two-way interaction revealed that there is some factor mediating the relationship, but given the lack of indirect effects of cultural orientation, even among analysis of each nation individually, it is not likely to be cultural orientation. Therefore, there is likely another mediator buried within the broad category of nationality.

**Conclusions**

The present research found that passengers in autonomous air taxis would be more willing to fly if the aircraft were equipped with an automatic airframe parachute. This finding was expected given that safety and response to system failures were listed among passengers’ top concerns about flying in autonomous aircraft (Vance & Malik, 2015). More interesting, however, was the finding that automatic airframe parachute availability only increased U.S. participants’ willingness to fly, suggesting that the effect was based upon not only the airframe parachute, but also nationality as Indian participants were equally willing to fly with or without the airframe parachute.

Previous works suggested that Indians were more willing to fly because people from India tend to be more culturally collectivist than people from the United States, and
people from collectivist countries are more accepting of autonomous vehicles (Rice et al., 2014; Winter, Rice, et al., 2015). In addition, as people from the United States are individualists, they may desire to directly manage their personal risk, and their willingness to fly would be more affected by the availability of a safety system (Adams, 1995).

The findings agreed with past hypotheses in that U.S. participants reported that they would be less willing to fly in autonomous aircraft than Indians (Ragbir et al., 2018; Rice et al., 2014; Ward et al., 2019). In addition, demographic analysis revealed that Indian participants did tend to be more communitarian than U.S. participants in the present research. However, the mediation analysis revealed that cultural orientation did not explain the group differences between nationalities as had been suggested.

Eliminating cultural orientation as a mediating variable does not invalidate previous findings, rather, it amplifies the call for new areas of exploration. The differences between India and the United States are myriad and encompass factors such as policies, regulations, population density, perceptions toward public transit and air travel, and perceptions of the need for an alternative to ground transportation. Eliminating cultural orientation as a factor in willingness to fly allows researchers to focus on other differences.

**Theoretical contributions.** The present research contributes to the growing body of work indicating people from India are more accepting of autonomous vehicles and aircraft than people from the United States. The finding was replicated twice in the present research. In addition, by comparing effects among multiple samples of the U.S.
and Indian populations, it contributes to a growing sample and improves the
generalizability of associated research (Mehta et al., 2019).

The present research also answers questions raised in previous studies of
passengers’ willingness to fly. Researchers had hypothesized, but not tested, that people
from India were more willing to fly than people from the United States because of their
more collectivist cultural orientation. The present research agreed that people from India
were more willing to fly in autonomous aircraft than people from the United States but
rejected cultural orientation as an explanatory factor. As cultural cognition theory linked
cultural orientation to risk perception, risk perception stands as an early opportunity for
future exploration.

**Practical contributions.** UAM system operators need information about
passenger preferences, barriers, and willingness to fly to sustain business operations and
expand the industry (Fu et al., 2019; Shaheen et al., 2018; Tennant et al., 2019). The most
immediately applicable contribution is the finding that, in general, passengers are more
willing to fly if an automatic airframe parachute is available, although this effect seems
most pronounced with people from the United States. Aircraft designers may wish to
renew consideration of including such systems when developing autonomous air taxis,
and system operators may wish to weight aircraft with airframe parachutes more
favorably when selecting aircraft for their UAM operations.

In addition, the finding that automatic airframe parachutes did not significantly
affect Indian passengers’ willingness to fly may help with marketing and public
awareness campaigns. In the United States, companies may gain more ridership by
emphasizing the safety systems on board autonomous aircraft. In India, there may be
more to gain by emphasizing other factors associated with the aircraft or UAM in general. However, the present study did not identify what factors would be most relevant to Indian passengers.

More generally, the results also indicated that communicating information describing features of an aircraft to a passenger could affect willingness to fly. Given this finding, companies can adjust advertising strategies by emphasizing vehicle features, as is done with the personal automobile industry, to increase favorable attitudes towards their aircraft. If UAM companies can find such ways to increase willingness to fly, they can increase their paying passenger base.

The systems explored in the present research were limited to two safety features designed to mitigate the effects of an emergency, however, there are other approaches to safety that UAM companies are exploring. The aviation industry prizes high reliability and system redundancy as key safety features, but it is unclear whether passengers may seek such features or respond favorably to advertising strategies emphasizing them. UAM companies and aircraft designers can employ the concept and methodology from the present research to conduct further market research to determine how aircraft features and safety strategies affect willingness to fly in their aircraft.

Governments also need such information to craft policies and regulations to integrate autonomous aircraft into urban areas and national airspace systems (Clothier et al., 2015). Given that passengers were more willing to fly in aircraft with automatic airframe parachutes, companies may subsequently favor such aircraft in UAM applications. Indeed, both the Volocopter® and Airbus® UAM aircraft that are in development have airframe parachutes, and Uber Elevate® listed an airframe parachute as
a desired safety systems for its vehicles (Electric VTOL News, 2018; Holden & Goel, 2016; Volocopter, 2019). These findings and developments lend focus to policymakers’ efforts: For example, now policymakers may wish to consider developing regulations and policies governing airframe parachute deployments over urban environments.

**Limitations of the Findings**

The most obvious limitation of the present study is its hypothetical nature. There were no active autonomous air taxi services in the world at the time the questionnaires were completed. The survey responses relied upon each individual’s internal conceptualization of UAM and autonomous aircraft and thus may not represent actual willingness to fly once such aircraft become commonplace. In addition, the scientific community has not reached consensus—when no real-world option exists—on how to correct for the difference between survey participants replying they are willing to undertake a hypothetical activity and participants actively engaging in the activity (Loomis, 2014). Thus, one must incorporate the hypothetical nature of the results in interpretation and decisions that follow this study. For example, Indians were more willing to fly in autonomous aircraft, given the layperson’s concept of the industry as it exists today. Actual events may change these attitudes over time.

Next, one must consider carefully the decision to reject cultural orientation as a potential mediator. The current research was limited to two dimensions of cultural orientation, but dozens of other cultural orientation scales exist, such as uncertainty avoidance, masculinity-femininity, horizontal and vertical individualism, and collectivism (Hofstede, 1980; Singelis et al., 1995). Although cultural cognition theory pointed to the horizontal and vertical scales contained in the cultural worldview scale, it
was only those two scales that were found to not mediate willingness to fly. Researchers may still wish to consider alternatives to the cultural worldview scale or consider scales associated with a different theory of cultural orientations.

The data collection process also limited the study. Although MTurk® was the best-known option to reach a broad sample of the U.S. and Indian populations, it was not without limitation. First, the sampling method introduced selection bias as every participant must choose the survey from a list of all available tasks in order to participate. The bias was somewhat mitigated by not including any description of the topic or content of the survey before people participated, but there was still bias at the very least toward people who desire to participate in surveys for compensation (Litman et al., 2015). Past research found MTurk® data to be comparable to data from lab-based studies (Buhrmester et al., 2011; Germine et al., 2012; Rice et al., 2017) and that MTurk® workers paid the same amount of attention as participants in lab studies (Paolacci et al., 2010). However, the large proportion of responses from Indian participants failing the response consistency screening did raise concerns. The most obvious limitation is that while India has a large English-speaking population, the internet-based nature of MTurk® prevented including a screening procedure in which we could verify each participant spoke and understood English sufficiently.

The distribution method also limited the generalizability of the study. MTurk® participants are typically not representative of the general population as they skew younger, more educated, and more closely approximate demographics of internet users (Chandler & Shapiro, 2016). However, our demographic results found that the median age of participants was very close to that of each nation. More male participants and
participants from urban areas participated in the study than would be generalizable to the population as a whole.

**Recommendations**

**Recommendations for the UAM industry.** The UAM industry should strive to communicate its safe operations to the public. Potential autonomous aircraft passengers listed safety and response to system failures as top concerns (Vance & Malik, 2015). In addition, acceptance of autonomous vehicles and trains gradually increased after each demonstrated years of safe operations. Together, one can appreciate that managing passengers’ perceptions of safety will be important to any UAM business model.

As the UAM industry is not yet in operation and therefore cannot demonstrate a safety record, another approach must be taken to ensure safety. Aircraft designers can incorporate passive safety systems, such as airframe parachutes, into their platforms to address passengers’ concerns about safe responses to system failures. The present study demonstrated that method’s effectiveness by finding that passengers increased their willingness to fly when an aircraft had such a system.

The industry must also consider other forms of safety as well, given that people list responses to system failure as a top concern. Further research is needed into exactly what types of responses to failure may affect willingness to fly. The present research focused on passive safety features designed to mitigate effects of emergencies; it is unclear whether systems designed to prevent emergencies from occurring would similarly affect passenger willingness to fly.

The UAM organizations should also recognize they will need to tailor aircraft, operations, and communication to the countries in which they operate. They will also
need to understand the desires of the target populations. The present study found that U.S. participants’ willingness to fly significantly increased with an automatic airframe parachute availability, but Indian participants’ willingness to fly did not. UAM companies should consider conducting more in-depth studies of customer desires to see if another aircraft feature or operating concept influences willingness to fly among Indians.

**Recommendations for future research.** Future researchers should explore the component differences between participants from the United States and India that are related to passengers’ willingness to fly in autonomous aircraft. The present study found that communitarianism-individualism and egalitarianism-hierarchism cultural orientations did not mediate the relationship between safety system availability and willingness to fly. The significant two-way interaction indicated that there may be a different mediator of interest. In this case, cultural orientation’s non-significance as a mediating variable, and its small direct effect, help to guide future research down a path to uncover other mediators of interest. It may be more useful scientifically to discard cultural orientation from such research and seek other components of national differences that may be more useful, or even controllable, in practical applications.

There are at least two ways to explore national differences. First, the literature review found several factors that may influence perceptions of autonomous vehicles. In particular, local media narratives, perceptions of local public transit, local population density, and trust in government or organizations to provide safe operations may be different between people of different nationalities. Each may be worth exploring. However, each factor also varies at the local level. UAM researchers may need to consider the unique urban environment of each UAM application as inseparable from the
opinions of the passengers who will be flying in that environment. Thus targeted, regional or city level research may be the most productive path forward.

A second way to approach future research into national differences is to approach the problem from another construct and model. A model such as the technology acceptance model, and therefore assessing acceptance rather than willingness, may illuminate links to other theories and constructs that can be used to identify and quantify differences in passenger perceptions. Modeling may be less immediately applicable for practical applications, but would provide a unique opportunity to identify additional variables to study the differences in willingness to fly in different nations and regions. Such modeling can then provide feedback for more direct research on passenger attitudes.

Summary

The present study investigated whether nationality and safety system availability in autonomous air taxis affected passengers’ willingness to fly and whether their cultural orientation mediated the relationship. Two survey experiments revealed that, in general, people from India were more willing to fly than people from the United States and that passengers were more willing to fly with an automatic airframe parachute available. There was a two-way interaction in which U.S. participants increased their willingness to fly if an automatic airframe parachute was available, but Indian participants did not. Cultural orientation, assessed as the levels of communitarianism-individualism and egalitarianism-hierarchism, did not mediate the relationship. Further research is needed to understand what factors associated with nationality influence the differences between people from the United States and India.
REFERENCES


Schenkelberg, F. (2016, January). *How reliable does a delivery drone have to be?* Paper presented at the IEEE Annual Reliability and Maintainability Symposium (RAMS), Tuscon, AZ. https://doi.org/10.1109/RAMS.2016.7448054


APPENDIX A

Permission to Conduct Research

This appendix includes the informed consent forms for both Study 1 and Study 2.

An Institutional Review Board approval form for the pilot study of the cultural worldview scale and for Study 1 and 2 follows.

Study 1 Consent Informed Form

INFORMED CONSENT FORM
Willingness to Fly in an Autonomous Air Taxi

Purpose of this research: I am asking you to take part in a research project for the purpose of assessing your willingness to fly in autonomous aircraft. During this study, you will be asked to complete an online survey. You will be presented a hypothetical scenario in which you are flying in a small aircraft in an urban area, and you will be presented 7 statements about your willingness to fly. You will be asked to rate how strongly you agree or disagree with the statements. The survey then closes with a brief section of demographic questions. The completion of the survey is expected to take less than five minutes. Your anonymous responses will be used in multiple analyses to understand air passenger preferences.

Eligibility: To be in this study, you must understand written English, be a resident of the United States or India, a registered user of Amazon Mechanical Turk® with 100 completed tasks and a 98% approval rate, and be at least 18 years of age.

Risks or discomforts: It is anticipated that this study will pose no greater risk than you would experience through normal daily activities.

Benefits: There are no known benefits to your participation other than knowing you have contributed to the advancement of scientific knowledge by helping to improve assessments of cultural orientations.

Confidentiality of records: The data collected during this study will be anonymous and confidential. MTurk does not share any information about your account or identity with us, and we have no way of learning your identity. MTurk may use your IP address to verify your country of origin for eligibility purposes but will not otherwise record the address. The researchers note that by using MTurk, as with any site hosting user information, there is always a small risk of a data breach.
**Compensation:** You will be compensated 50 cents for your time via Amazon’s Mechanical Turk.

**Contact:** If you have any questions about this research project, you can contact Kenneth Ward, principal investigator, at wardk1@my.erau.edu, or the faculty member overseeing this project, Dr. Scott Winter, winte25e@erau.edu. For any concerns or questions as a participant in this research, contact the Institutional Review Board (IRB) at 386-226-7179 or via email at teri.gabriel@erau.edu.

**Voluntary participation:** Your participation in this study is completely voluntary. You may discontinue your participation at any time without penalty or loss of benefits to which you are otherwise entitled. Should you wish to discontinue the research at any time, no information collected will be used.

**CONSENT.** By checking AGREE below, I certify that I am a resident of the United States or India, understand the information on this form, and voluntarily agree to participate in the study.

If you do **not** wish to participate in the study, simply close the browser or check DISAGREE which will direct you out of the study.

Please print a copy of this form for your records. A copy of this form can also be requested from Kenneth Ward, wardk1@my.erau.edu.

0 AGREE
0 DISAGREE
Study 2 Informed Consent Form

INFORMED CONSENT FORM

Cultural Worldview and Willingness to Fly in an Autonomous Air Taxi

**Purpose of this research:** I am asking you to take part in a research project for the purpose of assessing how your cultural worldview influences your willingness to fly in autonomous aircraft. During this study, you will be asked to complete an online survey. You will be presented a hypothetical scenario in which you are flying in a small aircraft in an urban area. You will then be presented 12 statements about your cultural worldview and 7 statements about your willingness to fly. You will be asked to rate how strongly you agree or disagree with the statements. The survey then closes with a brief section of demographic questions. The completion of the survey is expected to take less than ten minutes. Your anonymous responses will be used in multiple analyses to understand air passenger preferences.

**Eligibility:** To be in this study, you must understand written English, be a resident of the United States or India, a registered user of Amazon Mechanical Turk® with 100 completed tasks and a 98% approval rate, and be at least 18 years of age.

**Risks or discomforts:** It is anticipated that this study will pose no greater risk than you would experience through normal daily activities.

**Benefits:** There are no known benefits to your participation other than knowing you have contributed to the advancement of scientific knowledge by helping to improve assessments of cultural orientations.

**Confidentiality of records:** The data collected during this study will be anonymous and confidential. MTurk does not share any information about your account or identity with us, and we have no way of learning your identity. MTurk may use your IP address to verify your country of origin for eligibility purposes but will not otherwise record the address. The researchers note that by using MTurk, as with any site hosting user information, there is always a small risk of a data breach.

**Compensation:** You will be compensated 50 cents for your time via Amazon’s Mechanical Turk.

**Contact:** If you have any questions about this research project, you can contact Kenneth Ward, principal investigator, at wardk1@my.erau.edu, or the faculty member overseeing this project, Dr. Scott Winter, winte25e@erau.edu. For any concerns or questions as a participant in this research, contact the Institutional Review Board (IRB) at 386-226-7179 or via email at teri.gabriel@erau.edu.

**Voluntary participation:** Your participation in this study is completely voluntary. You may discontinue your participation at any time without penalty or loss of benefits to which you are
otherwise entitled. Should you wish to discontinue the research at any time, no information collected will be used.

**CONSENT.** By checking AGREE below, I certify that I am a resident of the United States or India, understand the information on this form, and voluntarily agree to participate in the study.

If you do **not** wish to participate in the study, simply close the browser or check DISAGREE which will direct you out of the study.

Please print a copy of this form for your records. A copy of this form can also be requested from Kenneth Ward, wardk1@my.eru.edu.

0 AGREE
0 DISAGREE
Permission for Pilot Assessment of Cultural Worldview Scale

Embry-Riddle Aeronautical University
Application for IRB Approval
EXEMPT Determination Form

Principal Investigator: Kenneth Ward
Other Investigators: Scott Winter

Role: Student
Campus: Worldwide
College: Aviation/Aeronautics

Project Title: Principal Components Analysis of Cultural Worldview Scale

Review Board Use Only

Initial Reviewer: Teri Gabriel Date: 10/21/2019 Approval #: 20-044
Determination: Exempt

Dr. Michael Wiggins
IRB Chair Signature: Michael E. Wiggins, Ed.D.
Date: 10/24/2019

Brief Description:

The purpose of this research is to assess the validity and internal consistency of a survey instrument and associated scale to test the Cultural Worldview Scale when used in the international setting. The survey will be uploaded to Google Forms, and participants will be solicited from Amazon's Mechanical Turk (MTurk).

This research falls under the EXEMPT category as per 45 CFR 46.104:

☑ (2) Research that only includes interactions involving educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior (including visual or auditory recording) if at least one of the following criteria is met: (Applies to Subpart B [Pregnant Women, Human Fetuses and Neonates] and does not apply for Subpart C [Prisoners] except for research aimed at involving a broader subject population that only incidentally includes prisoners.)
Permission for Study 1 and Study 2

Embry-Riddle Aeronautical University
Application for IRB Approval
EXEMPT Determination Form

Principal Investigator: Kenneth Ward
Other Investigators: Scott Winter

Role: Student  Campus: Daytona Beach  College: Aviation/Aeronautics

Project Title: Safety Systems, Culture, and Passengers' Willingness to Fly in Autonomous Air Taxis: A Multi-Study and Mediation Analysis

Review Board Use Only

Initial Reviewer: Teri Gabriel  Date: 01/08/2020  Approval #: 20-071
Determination: Exempt

Dr. Michael Wiggins  Michael E. Wiggins, Ed.D.
IRB Chair Signature:  Digitally signed by Michael E. Wiggins, Ed.D.  Date: 01/13/2020

Brief Description:
The purpose of this research is to assess how cultural worldviews influence a participant’s willingness to fly in an autonomous aircraft. An online survey will be used in this study.

This research falls under the EXEMPT category as per 45 CFR 46.104:

✔️ (2) Research that only includes interactions involving educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior (including visual or auditory recording) if at least one of the following criteria is met: (Applies to Subpart B [Pregnant Women, Human Fetuses and Neonates] and does not apply for Subpart C [Prisoners] except for research aimed at involving a broader subject population that only incidentally includes prisoners.)
APPENDIX B

Data Collection Device

Study 1

Study 1 consists of eight survey instruments. They are presented in the subsequent pages in the following order of experimental conditions of nationality (United States = 0, India = 1), automatic airframe parachute availability (not available = 0, available = 1), and remote pilot system availability:

<table>
<thead>
<tr>
<th>Nationality</th>
<th>Automatic airframe parachute</th>
<th>Remote pilot system</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>
Condition 0 x 0 x 0

Survey Study

Purpose of this research: I am asking you to take part in a research project for the purpose of assessing your willingness to fly in autonomous aircraft. During this study, you will be asked to complete an online survey. You will be presented a hypothetical scenario in which you are flying in a small aircraft in an urban area, and you will be presented 7 statements about your willingness to fly. You will be asked to rate how strongly you agree or disagree with the statements. The survey then closes with a brief section of demographic questions. The completion of the survey is expected to take less than five minutes. Your anonymous responses will be used in multiple analyses to understand air passenger preferences.

Eligibility: To be in this study, you must understand written English, be a resident of the United States or India, a registered user of Amazon Mechanical Turk® with 100 completed tasks and a 98% approval rate, and be at least 18 years of age.

Risks or discomforts: It is anticipated that this study will pose no greater risk than you would experience through normal daily activities.

Benefits: There are no known benefits to your participation other than knowing you have contributed to the advancement of scientific knowledge by helping to improve assessments of cultural orientations.

Confidentiality of records: The data collected during this study will be anonymous and confidential. MTurk does not share any information about your account or identity with us, and we have no way of learning your identity. MTurk may use your IP address to verify your country of origin for eligibility purposes but will not otherwise record the address. The researchers note that by using MTurk, as with any site hosting user information, there is always a small risk of a data breach.

Compensation: You will be compensated 50 cents for your time via Amazon’s Mechanical Turk.

Contact: If you have any questions about this research project, you can contact Kenneth Ward, principal investigator, at wardk1@my.erau.edu, or the faculty member overseeing this project, Dr. Scott Winter, winter5e@erau.edu. For any concerns or questions as a participant in this research, contact the Institutional Review Board (IRB) at 386-226-7179 or via email at test.gabriol@erau.edu.

Voluntary participation: Your participation in this study is completely voluntary. You may discontinue your participation at any time without penalty or loss of benefits to which you are otherwise entitled. Should you wish to discontinue the research at any time, no information collected will be used.

CONSENT. By checking AGREE below, I certify that I am a resident of the United States or India, understand the information on this form, and voluntarily agree to participate in the study.

If you do not wish to participate in the study, simply close the browser or check DISAGREE which will direct you out of the study.

Please print a copy of this form for your records. A copy of this form can also be requested from Kenneth Ward, wardk1@my.erau.edu.

* Required

1. By selecting AGREE, I certify that I am a resident of the United States or India, 18 years or older, understand the information on this form, and voluntarily agree to participate in the study. *

Mark only one oval.

☐ AGREE

☐ DISAGREE  Skip to “I’m sorry, but you must be 18 years of age and provide informed consent in order to participate. Thank you for your time.”

https://docs.google.com/forms/d/1NXSymPtxoGdSFR7dqNv7PUk8Mb2CIDAxgJtZK_m0/edit
Scenario
Imagine a situation where your work sent you to a large city in another part of your country. You request a ride from a local air taxi business to fly across the city for a reasonable price.

It will arrive on the roof of a parking garage next to you and will fly you directly to a landing pad next to your destination. The total time to board, fly, and exit the aircraft will take approximately 30 minutes. The aircraft that arrives is the size of a small passenger car and has four seats.

You are the sole occupant in the aircraft. The aircraft is completely autonomous and will travel by autopilot to your pre-selected destination without further input from you.

The aircraft does not have a whole-aircraft parachute installed.
The aircraft cannot be remotely flown by a human pilot.

2. Please state your level of agreement with the following statements:
   *Mark only one oval per row.*

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neither agree nor disagree</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I would be happy to fly in this situation.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I have no fear of flying in this situation.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I would have no problem flying in this situation.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I would feel safe flying in this situation.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I feel confident flying in this situation.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I would be comfortable flying in this situation.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I would be willing to fly in this situation.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Demographics

3. What is your ZIP code?

4. What is your Age?

5. What is your estimated annual household income?
   *Mark only one oval.*

- $25,000 or less
- $25,001 - $50,000
- $50,001 - $80,000
- $80,001 - $130,000
- $130,001 or more

https://docs.google.com/forms/d/1XS5ym9PExGiDSSFR7dcN7PUkM3bz2cTJ3ArGiBZK_m0/edit
6. During a typical week, how many days do you
   Mark only one oval per row.

   0 days  1 day  2 days  3 days  4 days  5 days  6 days  7 days
   Ride a bicycle?  
   Drive a car?  
   Ride as a passenger in a car?  
   Ride in a bus or van?  
   Ride a train, metro, or other vehicle on rails?  
   Ride in an aircraft?  

7. Please describe which description best matches the area where you live
   Mark only one oval.
   ☐ Urban. I live in a city, metropolitan area, suburb, or town with a population more than 2,500 people.
   ☐ Rural. I live in a farm, town, village, or area with less than 2,500 people.

8. Are you male or female?
   Mark only one oval.
   ☐ Female
   ☐ Male
   ☐ Other:

Thank you for completing our survey! You are done now.

9. Please input your initials followed by your age.
   For example, if your name is John Smith and you are 23 years old, then you would put: JS23

Please return to MTurk and enter this code into the appropriate place so that you can be paid for your time.

Stop filling out this form.

I'm sorry, but you must be 18 years of age and provide informed consent in order to participate. Thank you for your time.
Condition 0 x 0 x 1

Survey Study

Purpose of this research: I am asking you to take part in a research project for the purpose of assessing your willingness to fly in autonomous aircraft. During this study, you will be asked to complete an online survey. You will be presented a hypothetical scenario in which you are flying in a small aircraft in an urban area, and you will be presented 7 statements about your willingness to fly. You will be asked to rate how strongly you agree or disagree with the statements. The survey then closes with a brief section of demographic questions. The completion of the survey is expected to take less than five minutes. Your anonymous responses will be used in multiple analyses to understand air passenger preferences.

Eligibility: To be in this study, you must understand written English, be a resident of the United States or India, a registered user of Amazon Mechanical Turk® with 100 completed tasks and a 98% approval rate, and be at least 18 years of age.

Risks or discomforts: It is anticipated that this study will pose no greater risk than you would experience through normal daily activities.

Benefits: There are no known benefits to your participation other than knowing you have contributed to the advancement of scientific knowledge by helping to improve assessments of cultural orientations.

Confidentiality of records: The data collected during this study will be anonymous and confidential. MTurk does not share any information about your account or identity with us, and we have no way of learning your identity. MTurk may use your IP address to verify your country of origin for eligibility purposes but will not otherwise record the address. The researchers note that by using MTurk, as with any site hosting user information, there is always a small risk of a data breach.

Compensation: You will be compensated 50 cents for your time via Amazon’s Mechanical Turk.

Contact: If you have any questions about this research project, you can contact Kenneth Ward, principal investigator, at wardk1@my.erau.edu, or the faculty member overseeing this project, Dr. Scott Winter, winterse@erau.edu. For any concerns or questions as a participant in this research, contact the Institutional Review Board (IRB) at 386-225-7179 or via email at tech.patriot@erau.edu.

Voluntary participation: Your participation in this study is completely voluntary. You may discontinue your participation at any time without penalty or loss of benefits to which you are otherwise entitled. Should you wish to discontinue the research at any time, no information collected will be used.

CONSENT. By checking AGREE below, I certify that I am a resident of the United States or India, understand the information on this form, and voluntarily agree to participate in the study.

If you do not wish to participate in the study, simply close the browser or check DISAGREE which will direct you out of the study.

Please print a copy of this form for your records. A copy of this form can also be requested from Kenneth Ward, wardk1@my.erau.edu.

* Required

1. By selecting AGREE, I certify that I am a resident of the United States or India, 18 years or older, understand the information on this form, and voluntarily agree to participate in the study.*
   Mark only one oval.
   - [ ] AGREE
   - [ ] DISAGREE Skip to "I'm sorry, but you must be 18 years of age and provide informed consent in order to participate. Thank you for your time. ."
Scenario
Imagine a situation where your work sent you to a large city in another part of your country. You request a ride from a local air taxi business to fly across the city for a reasonable price.

It will arrive on the roof of a parking garage next to you and will fly you directly to a landing pad next to your destination. The total time to board, fly, and exit the aircraft will take approximately 30 minutes. The aircraft that arrives is the size of a small passenger car and has four seats.

You are the sole occupant in the aircraft. The aircraft is completely autonomous and will travel by autopilot to your pre-selected destination without further input from you.

The aircraft does not have a whole-aircraft parachute installed.
The aircraft can be remotely flown by a human pilot during an emergency.

2. Please state your level of agreement with the following statements:
   *Mark only one oval per row.*

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neither Agree nor Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I would be happy to fly in this situation.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I have no fear of flying in this situation.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I would have no problem flying in this situation.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I would feel safe flying in this situation.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I feel confident flying in this situation.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I would be comfortable flying in this situation.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I would be willing to fly in this situation.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Demographics

3. What is your ZIP code?

4. What is your Age?

5. What is your estimated annual household income?
   *Mark only one oval.*

   - $25,000 or less
   - $25,001 - $50,000
   - $50,001 - $80,000
   - $80,001 - $130,000
   - $130,001 or more
Survey Study

Purpose of this research: I am asking you to take part in a research project for the purpose of assessing your willingness to fly in autonomous aircraft. During this study, you will be asked to complete an online survey. You will be presented a hypothetical scenario in which you are flying in a small aircraft in an urban area, and you will be presented 7 statements about your willingness to fly. You will be asked to rate how strongly you agree or disagree with the statements. The survey then closes with a brief section of demographic questions. The completion of the survey is expected to take less than five minutes. Your anonymous responses will be used in multiple analyses to understand air passenger preferences.

Eligibility: To be in this study, you must understand written English, be a resident of the United States or India, a registered user of Amazon Mechanical Turk® with 100 completed tasks and a 98% approval rate, and be at least 18 years of age.

Risks or discomforts: It is anticipated that this study will pose no greater risk than you would experience through normal daily activities.

Benefits: There are no known benefits to your participation other than knowing you have contributed to the advancement of scientific knowledge by helping to improve assessments of cultural orientations.

Confidentiality of records: The data collected during this study will be anonymous and confidential. MTurk does not share any information about your account or identity with us, and we have no way of learning your identity. MTurk may use your IP address to verify your country of origin for eligibility purposes but will not otherwise record the address. The researchers note that by using MTurk, as with any site hosting user information, there is always a small risk of a data breach.

Compensation: You will be compensated 50 cents for your time via Amazon’s Mechanical Turk.

Contact: If you have any questions about this research project, you can contact Kenneth Ward, principal investigator, at wardk1@my.erau.edu, or the faculty member overseeing this project, Dr. Scott Winter, winter55e@erau.edu. For any concerns or questions as a participant in this research, contact the Institutional Review Board (IRB) at 386-226-7179 or via email at tri.ohio@erau.edu.

Voluntary participation: Your participation in this study is completely voluntary. You may discontinue your participation at any time without penalty or loss of benefits to which you are otherwise entitled. Should you wish to discontinue the research at any time, no information collected will be used.

CONSENT. By checking AGREE below, I certify that I am a resident of the United States or India, understand the information on this form, and voluntarily agree to participate in the study.

If you do not wish to participate in the study, simply close the browser or check DISAGREE which will direct you out of the study.

Please print a copy of this form for your records. A copy of this form can also be requested from Kenneth Ward, wardk1@my.erau.edu.

* Required

1. By selecting AGREE, I certify that I am a resident of the United States or India, 18 years or older, understand the information on this form, and voluntarily agree to participate in the study. *

   Mark only one oval.

   ☐ AGREE

   ☐ DISAGREE  Skip to "I'm sorry, but you must be 18 years of age and provide informed consent in order to participate. Thank you for your time. . . ."

https://docs.google.com/forms/d/1YE9F30tqK-7GIDMIKEdF7_ykz88XWmlkdE68ybW694O86/edit

1/3
Scenario
Imagine a situation where your work sent you to a large city in another part of your country. You request a ride from a local air taxi business to fly across the city for a reasonable price.

It will arrive on the roof of a parking garage next to you and will fly you directly to a landing pad next to your destination. The total time to board, fly, and exit the aircraft will take approximately 30 minutes. The aircraft that arrives is the size of a small passenger car and has four seats.

You are the sole occupant in the aircraft. The aircraft is completely autonomous and will travel by autopilot to your pre-selected destination without further input from you.

The aircraft has a whole-aircraft parachute installed that can be automatically deployed during an emergency. The aircraft cannot be remotely flown by a human pilot.

2. Please state your level of agreement with the following statements:
   Mark only one oval per row.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neither agree nor disagree</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I would be happy to fly in this situation.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I have no fear of flying in this situation.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I would have no problem flying in this situation.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I would feel safe flying in this situation.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I feel confident flying in this situation.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I would be comfortable flying in this situation.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I would be willing to fly in this situation.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Demographics

3. What is your ZIP code?

   

4. What is your Age?

   

5. What is your estimated annual household income?
   Mark only one oval.

<table>
<thead>
<tr>
<th>Income Range</th>
<th>Oval</th>
</tr>
</thead>
<tbody>
<tr>
<td>$25,000 or less</td>
<td></td>
</tr>
<tr>
<td>$25,001 - $50,000</td>
<td></td>
</tr>
<tr>
<td>$50,001 - $80,000</td>
<td></td>
</tr>
<tr>
<td>$80,001 - $130,000</td>
<td></td>
</tr>
<tr>
<td>$130,001 or more</td>
<td></td>
</tr>
</tbody>
</table>
6. During a typical week, how many days do you
   Mark only one oval per row.
   
   Ride a bicycle?
   0 days 1 day 2 days 3 days 4 days 5 days 6 days 7 days
   Drive a car?
   Ride as a passenger in a car?
   Ride in a bus or van?
   Ride a train, metro, or other vehicle on rails?
   Ride in an aircraft?

7. Please describe which description best matches the area where you live
   Mark only one oval.
   
   ☐ Urban. I live in a city, metropolitan area, suburb, or town with a population more than 2,500 people.
   ☐ Rural. I live in a farm, town, village, or area with less than 2,500 people.

8. Are you male or female?
   Mark only one oval.
   
   ☐ Female
   ☐ Male
   ☐ Other:

Thank you for completing our survey! You are done now.

9. Please input your initials followed by your age.
   For example, if your name is John Smith and you are 23 years old, then you would put: JSM23

Please return to MTurk and enter this code into the appropriate place so that you can be paid for your time.

Stop filling out this form.

I'm sorry, but you must be 18 years of age and provide informed consent in order to participate. Thank you for your time.
Condition 0 x 1 x 1

Survey Study

Purpose of this research: I am asking you to take part in a research project for the purpose of assessing your willingness to fly in an autonomous aircraft. During this study, you will be asked to complete an online survey. You will be presented a hypothetical scenario in which you are flying in a small aircraft in an urban area, and you will be presented 7 statements about your willingness to fly. You will be asked to rate how strongly you agree or disagree with the statements. The survey then closes with a brief section of demographic questions. The completion of the survey is expected to take less than five minutes. Your anonymous responses will be used in multiple analyses to understand air passenger preferences.

Eligibility: To be in this study, you must understand written English, be a resident of the United States or India, a registered user of Amazon Mechanical Turk® with 100 completed tasks and a 96% approval rate, and be at least 18 years of age.

Risks or discomforts: It is anticipated that this study will pose no greater risk than you would experience through normal daily activities.

Benefits: There are no known benefits to your participation other than knowing you have contributed to the advancement of scientific knowledge by helping to improve assessments of cultural orientations.

Confidentiality of records: The data collected during this study will be anonymous and confidential. MTurk does not share any information about your account or identity with us, and we have no way of learning your identity. MTurk may use your IP address to verify your country of origin for eligibility purposes but will not otherwise record the address. The researchers note that by using MTurk, as with any site hosting user information, there is always a small risk of a data breach.

Compensation: You will be compensated 50 cents for your time via Amazon's Mechanical Turk.

Contact: If you have any questions about this research project, you can contact Kenneth Ward, principal investigator, at wardk1@my.erau.edu, or the faculty member overseeing this project, Dr. Scott Winter, winter25e@erau.edu. For any concerns or questions as a participant in this research, contact the Institutional Review Board (IRB) at 386-226-7179 or via email at terr.gabriel@erau.edu.

Voluntary participation: Your participation in this study is completely voluntary. You may discontinue your participation at any time without penalty or loss of benefits to which you are otherwise entitled. Should you wish to discontinue the research at any time, no information collected will be used.

CONSENT. By checking AGREE below, I certify that I am a resident of the United States or India, understand the information on this form, and voluntarily agree to participate in the study.

If you do not wish to participate in the study, simply close the browser or check DISAGREE which will direct you out of the study.

Please print a copy of this form for your records. A copy of this form can also be requested from Kenneth Ward, wardk1@my.erau.edu.

* Required

1. By selecting AGREE, I certify that I am a resident of the United States or India, 18 years or older, understand the information on this form, and voluntarily agree to participate in the study.*

Mark only one oval.

☐ AGREE

☐ DISAGREE Skip to "I'm sorry, but you must be 18 years of age and provide informed consent in order to participate. Thank you for your time. ."
Scenario
Imagine a situation where your work sent you to a large city in another part of your country. You request a ride from a local air taxi business to fly across the city for a reasonable price.

It will arrive on the roof of a parking garage next to you and will fly you directly to a landing pad next to your destination. The total time to board, fly, and exit the aircraft will take approximately 30 minutes. The aircraft that arrives is the size of a small passenger car and has four seats.

You are the sole occupant in the aircraft. The aircraft is completely autonomous and will travel by autopilot to your pre-selected destination without further input from you.

The aircraft has a whole-aircraft parachute installed that can be automatically deployed during an emergency.
The aircraft can be remotely flown by a human pilot during an emergency.

2. Please state your level of agreement with the following statements:
Mark only one oval per row.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neither agree nor disagree</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I would be happy to fly in this situation.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I have no fear of flying in this situation.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I would have no problem flying in this situation.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I would feel safe flying in this situation.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I feel confident flying in this situation.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I would be comfortable flying in this situation.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I would be willing to fly in this situation.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Demographics

3. What is your ZIP code?


4. What is your Age?


5. What is your estimated annual household income?
Mark only one oval.

- $25,000 or less
- $25,001 - $50,000
- $50,001 - $80,000
- $80,001 - $130,000
- $130,001 or more

https://docs.google.com/forms/d/1Ge8LVc5Lc912999wYoadrYAuWjA7ZPZUCQM0Q84/edit
6. During a typical week, how many days do you
Mark only one oval per row.

<table>
<thead>
<tr>
<th>Days</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ride a bicycle?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Drive a car?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Ride as a passenger in a car?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Ride in a bus or van?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Ride a train, metro, or other vehicle on rails?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Ride in an aircraft?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

7. Please describe which description best matches the area where you live
Mark only one oval.

☐ Urban. I live in a city, metropolitan area, suburb, or town with a population more than 2,500 people.
☐ Rural. I live in a farm, town, village, or area with less than 2,500 people.

8. Are you male or female?
Mark only one oval.

☐ Female
☐ Male
☐ Other:

Thank you for completing our survey! You are done now.

9. Please input your initials followed by your age.
For example, if your name is John Smith and you are 23 years old, then you would put: JS23

Please return to MTurk and enter this code into the appropriate place so that you can be paid for your time.

Stop filling out this form.

I'm sorry, but you must be 18 years of age and provide informed consent in order to participate. Thank you for your time.
Condition 1 x 0 x 0

Survey Study

Purpose of this research: I am asking you to take part in a research project for the purpose of assessing your willingness to fly in autonomous aircraft. During this study, you will be asked to complete an online survey. You will be presented a hypothetical scenario in which you are flying in a small aircraft in an urban area, and you will be presented 7 statements about your willingness to fly. You will be asked to rate how strongly you agree or disagree with the statements. The survey then closes with a brief section of demographic questions. The completion of the survey is expected to take less than five minutes. Your anonymous responses will be used in multiple analyses to understand air passenger preferences.

Eligibility: To be in this study, you must understand written English, be a resident of the United States or India, a registered user of Amazon Mechanical Turk® with 100 completed tasks and a 98% approval rate, and be at least 18 years of age.

Risks or discomforts: It is anticipated that this study will pose no greater risk than you would experience through normal daily activities.

Benefits: There are no known benefits to your participation other than knowing you have contributed to the advancement of scientific knowledge by helping to improve assessments of cultural orientations.

Confidentiality of records: The data collected during this study will be anonymous and confidential. MTurk does not share any information about your account or identity with us, and we have no way of learning your identity. MTurk may use your IP address to verify your country of origin for eligibility purposes but will not otherwise record the address. The researchers note that by using MTurk, as with any site hosting user information, there is always a small risk of a data breach.

Compensation: You will be compensated 50 cents for your time via Amazon’s Mechanical Turk.

Contact: If you have any questions about this research project, you can contact Kenneth Ward, principal investigator, at wardk1@my.erau.edu, or the faculty member overseeing this project, Dr. Scott Winter, winter2se@erau.edu. For any concerns or questions as a participant in this research, contact the Institutional Review Board (IRB) at 386-226-7179 or via email at terri.gabriel@erau.edu.

Voluntary participation: Your participation in this study is completely voluntary. You may discontinue your participation at any time without penalty or loss of benefits to which you are otherwise entitled. Should you wish to discontinue the research at any time, no information collected will be used.

CONSENT. By checking AGREE below, I certify that I am a resident of the United States or India, understand the information on this form, and voluntarily agree to participate in the study.

If you do not wish to participate in the study, simply close the browser or check DISAGREE which will direct you out of the study.

Please print a copy of this form for your records. A copy of this form can also be requested from Kenneth Ward, wardk1@my.erau.edu.

* Required

1. By selecting AGREE, I certify that I am a resident of the United States or India, 18 years or older, understand the information on this form, and voluntarily agree to participate in the study. *

   Mark only one oval.

   [ ] AGREE

   [ ] DISAGREE Skip to "I'm sorry, but you must be 18 years of age and provide informed consent in order to participate. Thank you for your time. . ."
Scenario
Imagine a situation where your work sent you to a large city in another part of your country. You request a ride from a local air taxi business to fly across the city for a reasonable price.

It will arrive on the roof of a parking garage next to you and will fly you directly to a landing pad next to your destination. The total time to board, fly, and exit the aircraft will take approximately 30 minutes. The aircraft that arrives is the size of a small passenger car and has four seats.

You are the sole occupant in the aircraft. The aircraft is completely autonomous and will travel by autopilot to your pre-selected destination without further input from you.

The aircraft does not have a whole-aircraft parachute installed. The aircraft cannot be remotely flown by a human pilot.

2. Please state your level of agreement with the following statements:
   Mark only one oval per row.

   | Strongly   | Disagree | Neither agree nor disagree | Agree | Strongly agree |
   | disagree   |          |                          |       |               |
   | I would be happy to fly in this situation. |   |   |   |   |
   | I have no fear of flying in this situation. |   |   |   |   |
   | I would have no problem flying in this situation. |   |   |   |   |
   | I would feel safe flying in this situation. |   |   |   |   |
   | I feel confident flying in this situation. |   |   |   |   |
   | I would be comfortable flying in this situation. |   |   |   |   |
   | I would be willing to fly in this situation. |   |   |   |   |

Demographics

3. What is your Postal Index Number (PIN code) for your home?

4. What is your Age?

5. What is your estimated annual household income?
   Mark only one oval.
   - ₹15,000 or less
   - ₹15,001 - ₹30,000
   - ₹30,001 - ₹50,000
   - ₹50,001 - ₹85,000
   - ₹85,001 or more

https://docs.google.com/forms/d/11FEgLLMza4dhXXOV4j5qPlK3O25oMvvaUj6GdH/edit
6. During a typical week, how many days do you
Mark only one oval per row.

<table>
<thead>
<tr>
<th></th>
<th>0 days</th>
<th>1 day</th>
<th>2 days</th>
<th>3 days</th>
<th>4 days</th>
<th>5 days</th>
<th>6 days</th>
<th>7 days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ride a bicycle?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drive a car?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ride as a passenger in a car?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ride in a bus or van?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ride a train, metro, or other vehicle on rails?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ride in an aircraft?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

7. Please describe which description best matches the area where you live
Mark only one oval.

☐ Urban. I live in a city, metropolitan area, suburb, or town with a population more than 2,500 people.
☐ Rural. I live in a farm, town, village, or area with less than 2,500 people.

8. Are you male or female?
Mark only one oval.

☐ Female
☐ Male
☐ Other:

Thank you for completing our survey! You are done now.

9. Please input your initials followed by your age.
   For example, if your name is John Smith and you are 23 years old, then you would put: JS23

Please return to MTurk and enter this code into the appropriate place so that you can be paid for your time.

Stop filling out this form.

I'm sorry, but you must be 18 years of age and provide informed consent in order to participate. Thank you for your time.
**Condition 1 x 0 x 1**

11/12/2019

**Survey Study**

Purpose of this research: I am asking you to take part in a research project for the purpose of assessing your willingness to fly in autonomous aircraft. During this study, you will be asked to complete an online survey. You will be presented a hypothetical scenario in which you are flying in a small aircraft in an urban area, and you will be presented 7 statements about your willingness to fly. You will be asked to rate how strongly you agree or disagree with the statements. The survey then closes with a brief section of demographic questions. The completion of the survey is expected to take less than five minutes. Your anonymous responses will be used in multiple analyses to understand air passenger preferences.

Eligibility: To be in this study, you must understand written English, be a resident of the United States or India, a registered user of Amazon Mechanical Turk® with 100 completed tasks and a 98% approval rate, and be at least 18 years of age.

Risks or discomforts: It is anticipated that this study will pose no greater risk than you would experience through normal daily activities.

Benefits: There are no known benefits to your participation other than knowing you have contributed to the advancement of scientific knowledge by helping to improve assessments of cultural orientations.

Confidentiality of records: The data collected during this study will be anonymous and confidential. MTurk does not share any information about your account or identity with us, and we have no way of learning your identity. MTurk may use your IP address to verify your country of origin for eligibility purposes but will not otherwise record the address. The researchers note that by using MTurk, as with any site hosting user information, there is always a small risk of a data breach.

Compensation: You will be compensated 50 cents for your time via Amazon's Mechanical Turk.

Contact: If you have any questions about this research project, you can contact Kenneth Ward, principal investigator, at wardk1@my.erau.edu, or the faculty member overseeing this project, Dr. Scott Winter, winter25e@erau.edu. For any concerns or questions as a participant in this research, contact the Institutional Review Board (IRB) at 386-226-7179 or via email at terr.gabriel@erau.edu.

Voluntary participation: Your participation in this study is completely voluntary. You may discontinue your participation at any time without penalty or loss of benefits to which you are otherwise entitled. Should you wish to discontinue the research at any time, no information collected will be used.

CONSENT. By checking AGREE below, I certify that I am a resident of the United States or India, understand the information on this form, and voluntarily agree to participate in the study.

If you do not wish to participate in the study, simply close the browser or check DISAGREE which will direct you out of the study.

Please print a copy of this form for your records. A copy of this form can also be requested from Kenneth Ward, wardk1@my.erau.edu.

* Required

1. By selecting AGREE, I certify that I am a resident of the United States or India, 18 years or older, understand the information on this form, and voluntarily agree to participate in the study.*

   [ ] AGREE

   [ ] DISAGREE  *Skip to "I'm sorry, but you must be 18 years of age and provide informed consent in order to participate. Thank you for your time."*

https://docs.google.com/forms/d/1KgSH7gfjgFU_M_UakWUAa1j51Zsu06tYYPwJXoqi4/edit
Scenario
Imagine a situation where your work sent you to a large city in another part of your country. You request a ride from a local air taxi business to fly across the city for a reasonable price.

It will arrive on the roof of a parking garage next to you and will fly you directly to a landing pad next to your destination. The total time to board, fly, and exit the aircraft will take approximately 30 minutes. The aircraft that arrives is the size of a small passenger car and has four seats.

You are the sole occupant in the aircraft. The aircraft is completely autonomous and will travel by autopilot to your pre-selected destination without further input from you.

The aircraft does not have a whole-aircraft parachute installed.
The aircraft can be remotely flown by a human pilot during an emergency.

2. Please state your level of agreement with the following statements:

Mark only one oval per row.

<table>
<thead>
<tr>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neither agree nor disagree</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I would be happy to fly in this situation.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I have no fear of flying in this situation.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I would have no problem flying in this situation.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I would feel safe flying in this situation.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I feel confident flying in this situation.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I would be comfortable flying in this situation.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I would be willing to fly in this situation.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Demographics

3. What is your Postal Index Number (PIN code) for your home?

4. What is your Age?

5. What is your estimated annual household income?

Mark only one oval.

- ₹15,000 or less
- ₹15,001 - ₹30,000
- ₹30,001 - ₹50,000
- ₹50,001 - ₹85,000
- ₹85,001 or more
6. During a typical week, how many days do you ride a bicycle?  Drive a car?  Ride as a passenger in a car?  Ride in a bus or van?  Ride a train, metro, or other vehicle on rails?  Ride in an aircraft?

7. Please describe which description best matches the area where you live
Mark only one oval.

☐ Urban. I live in a city, metropolitan area, suburb, or town with a population more than 2,500 people.

☐ Rural. I live in a farm, town, village, or area with less than 2,500 people.

8. Are you male or female?
Mark only one oval.

☐ Female

☐ Male

☐ Other:

Thank you for completing our survey! You are done now.

9. Please input your initials followed by your age. For example, if your name is John Smith and you are 23 years old, then you would put: JS23

Please return to MTurk and enter this code into the appropriate place so that you can be paid for your time.

Stop filling out this form.

I'm sorry, but you must be 18 years of age and provide informed consent in order to participate. Thank you for your time.
Condition 1 x 1 x 0

Survey Study

Purpose of this research: I am asking you to take part in a research project for the purpose of assessing your willingness to fly in autonomous aircraft. During this study, you will be asked to complete an online survey. You will be presented a hypothetical scenario in which you are flying in a small aircraft in an urban area, and you will be presented 7 statements about your willingness to fly. You will be asked to rate how strongly you agree or disagree with the statements. The survey then closes with a brief section of demographic questions. The completion of the survey is expected to take less than five minutes. Your anonymous responses will be used in multiple analyses to understand air passenger preferences.

Eligibility: To be in this study, you must understand written English, be a resident of the United States or India, a registered user of Amazon Mechanical Turk® with 100 completed tasks and a 96% approval rate, and be at least 18 years of age.

Risks or discomforts: It is anticipated that this study will pose no greater risk than you would experience through normal daily activities.

Benefits: There are no known benefits to your participation other than knowing you have contributed to the advancement of scientific knowledge by helping to improve assessments of cultural orientations.

Confidentiality of records: The data collected during this study will be anonymous and confidential. MTurk does not share any information about your account or identity with us, and we have no way of learning your identity. MTurk may use your IP address to verify your country of origin for eligibility purposes but will not otherwise record the address. The researchers note that by using MTurk, as with any site hosting user information, there is always a small risk of a data breach.

Compensation: You will be compensated 50 cents for your time via Amazon’s Mechanical Turk.

Contact: If you have any questions about this research project, you can contact Kenneth Ward, principal investigator, at wardk1@my.erau.edu, or the faculty member overseeing this project, Dr. Scott Winter, winter25e@erau.edu. For any concerns or questions as a participant in this research, contact the Institutional Review Board (IRB) at 386-226-7179 or via email at test.gabriel@erau.edu.

Voluntary participation: Your participation in this study is completely voluntary. You may discontinue your participation at any time without penalty or loss of benefits to which you are otherwise entitled. Should you wish to discontinue the research at any time, no information collected will be used.

CONSENT. By checking AGREE below, I certify that I am a resident of the United States or India, understand the information on this form, and voluntarily agree to participate in the study.

If you do not wish to participate in the study, simply close the browser or check DISAGREE which will direct you out of the study.

Please print a copy of this form for your records. A copy of this form can also be requested from Kenneth Ward, wardk1@my.erau.edu.

* Required

1. By selecting AGREE, I certify that I am a resident of the United States or India, 18 years or older, understand the information on this form, and voluntarily agree to participate in the study.*

Mark only one oval.

☐ AGREE

☐ DISAGREE Skip to "I'm sorry, but you must be 18 years of age and provide informed consent in order to participate. Thank you for your time. ."
Scenario
Imagine a situation where your work sent you to a large city in another part of your country. You request a ride from a local air taxi business to fly across the city for a reasonable price.

It will arrive on the roof of a parking garage next to you and will fly you directly to a landing pad next to your destination. The total time to board, fly, and exit the aircraft will take approximately 30 minutes. The aircraft that arrives is the size of a small passenger car and has four seats.

You are the sole occupant in the aircraft. The aircraft is completely autonomous and will travel by autopilot to your pre-selected destination without further input from you.

The aircraft has a whole-aircraft parachute installed that can be automatically deployed during an emergency.
The aircraft cannot be remotely flown by a human pilot.

2. Please state your level of agreement with the following statements:
Mark only one oval per row.

<table>
<thead>
<tr>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neither agree nor disagree</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I would be happy to fly in this situation.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>I have no fear of flying in this situation.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>I would have no problem flying in this situation.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>I would feel safe flying in this situation.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>I feel confident flying in this situation.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>I would be comfortable flying in this situation.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>I would be willing to fly in this situation.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

Demographics

3. What is your Postal Index Number (PIN code) for your home?

4. What is your Age?

5. What is your estimated annual household income?
Mark only one oval.

| ₹15,000 or less | ☐ | ₹15,001 - ₹30,000 | ☐ | ₹30,001 - ₹50,000 | ☐ | ₹50,001 - ₹85,000 | ☐ | ₹85,001 or more | ☐ |

https://docs.google.com/forms/d/1wFb7zdBWaqtjJommA84KPEua7FHFL0N8th9HE4U/edit
6. During a typical week, how many days do you
   Mark only one oval per row.

<table>
<thead>
<tr>
<th></th>
<th>0 days</th>
<th>1 day</th>
<th>2 days</th>
<th>3 days</th>
<th>4 days</th>
<th>5 days</th>
<th>6 days</th>
<th>7 days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ride a bicycle?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drive a car?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ride as a passenger in a car?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ride in a bus or van?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ride a train, metro, or other vehicle on rails?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ride in an aircraft?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

7. Please describe which description best matches the area where you live
   Mark only one oval.
   
   [ ] Urban. I live in a city, metropolitan area, suburb, or town with a population more than 2,500 people.
   [ ] Rural. I live in a farm, town, village, or area with less than 2,500 people.

8. Are you male or female?
   Mark only one oval.
   
   [ ] Female
   [ ] Male
   [ ] Other:                             

Thank you for completing our survey! You are done now.

9. Please input your initials followed by your age.
   For example, if your name is John Smith and you are 23 years old, then you would put: JS23

Stop filling out this form.

I'm sorry, but you must be 18 years of age and provide informed consent in order to participate. Thank you for your time.

Powered by Google Forms

https://docs.google.com/forms/d/1wFb77d DwqtfjzommA8sKPeua_hFHLG0N0t99HE4U/edit
Condition 1 x 1 x 1

Survey Study

Purpose of this research: I am asking you to take part in a research project for the purpose of assessing your willingness to fly in autonomous aircraft. During this study, you will be asked to complete an online survey. You will be presented a hypothetical scenario in which you are flying in a small aircraft in an urban area, and you will be presented 7 statements about your willingness to fly. You will be asked to rate how strongly you agree or disagree with the statements. The survey then closes with a brief section of demographic questions. The completion of the survey is expected to take less than five minutes. Your anonymous responses will be used in multiple analyses to understand air passenger preferences.

Eligibility: To be in this study, you must understand written English, be a resident of the United States or India, a registered user of Amazon Mechanical Turk® with 100 completed tasks and a 96% approval rate, and be at least 18 years of age.

Risks or discomforts: It is anticipated that this study will pose no greater risk than you would experience through normal daily activities.

Benefits: There are no known benefits to your participation other than knowing you have contributed to the advancement of scientific knowledge by helping to improve assessments of cultural orientations.

Confidentiality of records: The data collected during this study will be anonymous and confidential. MTurk does not share any information about your account or identity with us, and we have no way of learning your identity. MTurk may use your IP address to verify your country of origin for eligibility purposes but will not otherwise record the address. The researchers note that by using MTurk, as with any site hosting user information, there is always a small risk of a data breach.

Compensation: You will be compensated 50 cents for your time via Amazon's Mechanical Turk.

Contact: If you have any questions about this research project, you can contact Kenneth Ward, principal investigator, at wardk1@my.erau.edu, or the faculty member overseeing this project, Dr. Scott Winter, winter25e@erau.edu. For any concerns or questions as a participant in this research, contact the Institutional Review Board (IRB) at 386-226-7179 or via email at terr gabriel@erau.edu.

Voluntary participation: Your participation in this study is completely voluntary. You may discontinue your participation at any time without penalty or loss of benefits to which you are otherwise entitled. Should you wish to discontinue the research at any time, no information collected will be used.

CONSENT. By checking AGREE below, I certify that I am a resident of the United States or India, understand the information on this form, and voluntarily agree to participate in the study.

If you do not wish to participate in the study, simply close the browser or check DISAGREE which will direct you out of the study.

Please print a copy of this form for your records. A copy of this form can also be requested from Kenneth Ward, wardk1@my.erau.edu.

* Required

1. By selecting AGREE, I certify that I am a resident of the United States or India, 18 years or older, understand the information on this form, and voluntarily agree to participate in the study.
   * Mark only one oval.

   [ ] AGREE

   [ ] DISAGREE  Skip to "I'm sorry, but you must be 18 years of age and provide informed consent in order to participate. Thank you for your time. . *

https://docs.google.com/forms/d/1-ZGKT1fqH10cWCrTTZaj3wo95jL6Kx_N83OjQcsL/pdf/edit
**Scenario**
Imagine a situation where your work sent you to a large city in another part of your country. You request a ride from a local air taxi business to fly across the city for a reasonable price.

It will arrive on the roof of a parking garage next to you and will fly you directly to a landing pad next to your destination. The total time to board, fly, and exit the aircraft will take approximately 30 minutes. The aircraft that arrives is the size of a small passenger car and has four seats.

You are the sole occupant in the aircraft. The aircraft is completely autonomous and will travel by autopilot to your pre-selected destination without further input from you.

The aircraft has a whole-aircraft parachute installed that can be automatically deployed during an emergency.

The aircraft can be remotely flown by a human pilot during an emergency.

2. **Please state your level of agreement with the following statements:**
   *Mark only one oval per row.*

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neither agree nor disagree</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I would be happy to fly in this situation.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I have no fear of flying in this situation.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I would have no problem flying in this situation.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I would feel safe flying in this situation.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I feel confident flying in this situation.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I would be comfortable flying in this situation.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I would be willing to fly in this situation.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

**Demographics**

3. **What is your Postal Index Number (PIN code) for your home?**

   _____________________________

4. **What is your Age?**

   _____________________________

5. **What is your estimated annual household income?**
   *Mark only one oval.*

   - ○ ₹15,000 or less
   - ○ ₹15,001 - ₹30,000
   - ○ ₹30,001 - ₹50,000
   - ○ ₹50,001 - ₹85,000
   - ○ ₹85,001 or more

https://docs.google.com/forms/d/1-ZGKT16qjH0c6WCrRTZajwo99_yL6Kv_N83OjcsLpk/edit
6. During a typical week, how many days do you
   Mark only one oval per row.

<table>
<thead>
<tr>
<th></th>
<th>0 days</th>
<th>1 day</th>
<th>2 days</th>
<th>3 days</th>
<th>4 days</th>
<th>5 days</th>
<th>6 days</th>
<th>7 days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ride a bicycle?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drive a car?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ride as a passenger in a car?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ride in a bus or van?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ride a train, metro, or other vehicle on rails?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ride in an aircraft?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

7. Please describe which description best matches the area where you live
   Mark only one oval.

- [ ] Urban. I live in a city, metropolitan area, suburb, or town with a population more than 2,500 people.
- [ ] Rural. I live in a farm, town, village, or area with less than 2,500 people.

8. Are you male or female?
   Mark only one oval.

- [ ] Female
- [ ] Male
- [ ] Other:

Thank you for completing our survey! You are done now.

9. Please input your initials followed by your age.
   For example, if your name is John Smith and you are 23 years old, then you would put: JS23

Please return to MTurk and enter this code into the appropriate place so that you can be paid for your time.

Stop filling out this form.

I'm sorry, but you must be 18 years of age and provide informed consent in order to participate. Thank you for your time.
Study 2

Study 2 consists of four survey instruments. They are presented in the subsequent pages in the following order of experimental conditions of nationality (United States = 0, India = 1) and safety system availability (not available = 0, available = 1):

<table>
<thead>
<tr>
<th>Nationality</th>
<th>Safety system</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>
Condition 0 x 0

Survey Study

Purpose of this research: I am asking you to take part in a research project for the purpose of assessing how your cultural worldview influences your willingness to fly in autonomous aircraft. During this study, you will be asked to complete an online survey. You will be presented a hypothetical scenario in which you are flying in a small aircraft in an urban area. You will then be presented 12 statements about your cultural worldview and 7 statements about your willingness to fly. You will be asked to rate how strongly you agree or disagree with the statements. The survey then closes with a brief section of demographic questions. The completion of the survey is expected to take less than ten minutes. Your anonymous responses will be used in multiple analyses to understand air passenger preferences.

Eligibility: To be in this study, you must understand written English, be a resident of the United States or India, a registered user of Amazon Mechanical Turk® with 100 completed tasks and a 98% approval rate, and be at least 18 years of age.

Risks or discomforts: It is anticipated that this study will pose no greater risk than you would experience through normal daily activities.

Benefits: There are no known benefits to your participation other than knowing you have contributed to the advancement of scientific knowledge by helping to improve assessments of cultural orientations.

Confidentiality of records: The data collected during this study will be anonymous and confidential. MTurk does not share any information about your account or identity with us, and we have no way of learning your identity. MTurk may use your IP address to verify your country of origin for eligibility purposes but will not otherwise record the address. The researchers note that by using MTurk, as with any site hosting user information, there is always a small risk of a data breach.

Compensation: You will be compensated 50 cents for your time via Amazon's Mechanical Turk.

Contact: If you have any questions about this research project, you can contact Kenneth Ward, principal investigator, at wardk1@my.erau.edu, or the faculty member overseeing this project, Dr. Scott Winter, winter25e@erau.edu. For any concerns or questions as a participant in this research, contact the Institutional Review Board (IRB) at 386-226-7179 or via email at teri.gabriel@erau.edu.

Voluntary participation: Your participation in this study is completely voluntary. You may discontinue your participation at any time without penalty or loss of benefits to which you are otherwise entitled. Should you wish to discontinue the research at any time, no information collected will be used.

CONSENT. By checking AGREE below, I certify that I am a resident of the United States or India, understand the information on this form, and voluntarily agree to participate in the study.

https://docs.google.com/forms/d/1BIqPjFdsNIDD3OfldpVRMBH55UUs5BnA6qA5s1YwZ8/edit
If you do not wish to participate in the study, simply close the browser or check DISAGREE which will direct you out of the study.

Please print a copy of this form for your records. A copy of this form can also be requested from Kenneth Ward, wardk1@my.erau.edu.

* Required

1. By selecting AGREE, I certify that I am a resident of the United States or India, 18 years or older, understand the information on this form, and voluntarily agree to participate in the study. *

Mark only one oval.

☐ AGREE

☐ DISAGREE

Skip to section 7 (I'm sorry, but you must be 18 years of age and provide informed consent in order to participate. Thank you for your time.)

Imagine a situation where your work sent you to a large city in another part of your country. You request a ride from a local air taxi business to fly across the city for a reasonable price.

It will arrive on the roof of a parking garage next to you and will fly you directly to a landing pad next to your destination. The total time to board, fly, and exit the aircraft will take approximately 30 minutes. The aircraft that arrives is the size of a small passenger car and has four seats.

You are the sole occupant in the aircraft. The aircraft is completely autonomous and will travel by autopilot to your pre-selected destination without further input from you.

The aircraft does not have a whole-aircraft parachute installed.

https://docs.google.com/forms/d/1BiqfjAdNjDIDj0Fdpjr3RMBiiHUd58uM6qA5boYwZk/edit
2. People in our society often disagree about how far to let individuals go in making decisions for themselves. How strongly you agree or disagree with each of these statements?

Mark only one oval per row.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly disagree</th>
<th>Moderately disagree</th>
<th>Slightly disagree</th>
<th>Slightly agree</th>
<th>Moderately agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>The government interferes far too much in our everyday lives.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sometimes government needs to make laws that keep people from hurting themselves.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>It’s not the government’s business to try to protect people from themselves.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The government should stop telling people how to live their lives.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The government should do more to advance society’s goals, even if that means limiting the freedom and choices of individuals.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Government should put limits on the choices individuals can make so they don’t get in the way of what’s good for society.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
3. People in our society often disagree about issues of equality and discrimination. How strongly you agree or disagree with each of these statements?

*Mark only one oval per row.*

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly disagree</th>
<th>Moderately disagree</th>
<th>Slightly disagree</th>
<th>Slightly agree</th>
<th>Moderately agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>We have gone too far in pushing equal rights in this country.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Our society would be better off if the distribution of wealth was more</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>equal.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>We need to dramatically reduce inequalities between the rich and the</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>poor, different ethnic and religious groups, and men and women.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discrimination against minorities is still a very serious problem in our</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>society.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>It seems like minority ethnic, religious, and other groups don't want</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>equal rights, they want special rights just for them.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Society as a whole has become too soft and feminine.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Imagine a situation where your work sent you to a large city in another part of your country. You request a ride from a local air taxi business to fly across the city for a reasonable price.

It will arrive on the roof of a parking garage next to you and will fly you directly to a landing pad next to your destination. The total time to board, fly, and exit the aircraft will take approximately 30 minutes. The aircraft that arrives is the size of a small passenger car and has four seats.

You are the sole occupant in the aircraft. The aircraft is completely autonomous and will travel by autopilot to your pre-selected destination without further input from you.

The aircraft does not have a whole-aircraft parachute installed.

4. Please state your level of agreement with the following statements:

Mark only one oval per row.

<table>
<thead>
<tr>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neither agree nor disagree</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I would be willing to fly in this situation.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I would be comfortable flying in this situation.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I would have no problem flying in this situation.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I would be happy to fly in this situation.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I would feel safe flying in this situation.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I have no fear of flying in this situation.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I feel confident flying in this situation.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Demographics
5. Are you male or female?

Mark only one oval.

- Female
- Male
- Other: ____________

6. What is your Age?

- ____________

7. What is your estimated annual household income?

Mark only one oval.

- $25,000 or less
- $25,001 - $50,000
- $50,001 - $80,000
- $80,001 - $130,000
- $130,001 or more

8. Please describe which description best matches the area where you live

Mark only one oval.

- Urban. I live in a city, metropolitan area, suburb, or town with a population more than 2,500 people.
- Rural. I live in a farm, town, village, or area with less than 2,500 people.

9. What is your ZIP code?

- ____________

https://docs.google.com/forms/d/1BlqfjFDxNDID0FdpVRMBIW5UdS5nA6qASb1YwZ9/edit
10. During a typical week, how many days do you

Mark only one oval per row.

<table>
<thead>
<tr>
<th>Days</th>
<th>0 days</th>
<th>1 day</th>
<th>2 days</th>
<th>3 days</th>
<th>4 days</th>
<th>5 days</th>
<th>6 days</th>
<th>7 days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ride a bicycle?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drive a car?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ride as a passenger in a car?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ride in a bus or van?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ride a train, metro, or other vehicle on rails?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ride in an aircraft?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Thank you for completing our survey! You are done now.

11. Please input your initials followed by your age. For example, if your name is John Smith and you are 23 years old, then you would put: JS23

Please return to MTurk and enter this code into the appropriate place so that you can be paid for your time.

I'm sorry, but you must be 18 years of age and provide informed consent in order to participate. Thank you for your time.

https://docs.google.com/forms/d/1Bq9pFDoSNDIE98FLdpVRMBh3SuUsS8a6q5OfSb1YwZK/edit
Survey Study

Purpose of this research: I am asking you to take part in a research project for the purpose of assessing how your cultural worldview influences your willingness to fly in autonomous aircraft. During this study, you will be asked to complete an online survey. You will be presented a hypothetical scenario in which you are flying in a small aircraft in an urban area. You will then be presented 12 statements about your cultural worldview and 7 statements about your willingness to fly. You will be asked to rate how strongly you agree or disagree with the statements. The survey then closes with a brief section of demographic questions. The completion of the survey is expected to take less than ten minutes. Your anonymous responses will be used in multiple analyses to understand air passenger preferences.

Eligibility: To be in this study, you must understand written English, be a resident of the United States or India, a registered user of Amazon Mechanical Turk® with 100 completed tasks and a 98% approval rate, and be at least 18 years of age.

Risks or discomforts: It is anticipated that this study will pose no greater risk than you would experience through normal daily activities.

Benefits: There are no known benefits to your participation other than knowing you have contributed to the advancement of scientific knowledge by helping to improve assessments of cultural orientations.

Confidentiality of records: The data collected during this study will be anonymous and confidential. MTurk does not share any information about your account or identity with us, and we have no way of learning your identity. MTurk may use your IP address to verify your country of origin for eligibility purposes but will not otherwise record the address. The researchers note that by using MTurk, as with any site hosting user information, there is always a small risk of a data breach.

Compensation: You will be compensated 50 cents for your time via Amazon's Mechanical Turk.

Contact: If you have any questions about this research project, you can contact Kenneth Ward, principal investigator, at wardk1@my.erau.edu, or the faculty member overseeing this project, Dr. Scott Winter, winte25e@erau.edu. For any concerns or questions as a participant in this research, contact the Institutional Review Board (IRB) at 386-226-7179 or via email at teri.gabriel@erau.edu.

Voluntary participation: Your participation in this study is completely voluntary. You may discontinue your participation at any time without penalty or loss of benefits to which you are otherwise entitled. Should you wish to discontinue the research at any time, no information collected will be used.

CONSENT. By checking AGREE below, I certify that I am a resident of the United States or India, understand the information on this form, and voluntarily agree to participate in the study.

If you do not wish to participate in the study, simply close the browser or check DISAGREE which will direct you out of the study.

Please print a copy of this form for your records. A copy of this form can also be requested from Kenneth
1. By selecting AGREE, I certify that I am a resident of the United States or India, 18 years or older, understand the information on this form, and voluntarily agree to participate in the study. *

  Mark only one oval.

  ☐ AGREE
  ☐ DISAGREE

  Skip to section 7 (I'm sorry, but you must be 18 years of age and provide informed consent in order to participate. Thank you for your time.)

Scenario

Imagine a situation where your work sent you to a large city in another part of your country. You request a ride from a local air taxi business to fly across the city for a reasonable price.

It will arrive on the roof of a parking garage next to you and will fly you directly to a landing pad next to your destination. The total time to board, fly, and exit the aircraft will take approximately 30 minutes. The aircraft that arrives is the size of a small passenger car and has four seats.

You are the sole occupant in the aircraft. The aircraft is completely autonomous and will travel by autopilot to your pre-selected destination without further input from you.

The aircraft has a whole-aircraft parachute installed that can be automatically deployed during an emergency.

Cultural worldview
2. People in our society often disagree about how far to let individuals go in making decisions for themselves. How strongly you agree or disagree with each of these statements?

*Mark only one oval per row.*

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly disagree</th>
<th>Moderately disagree</th>
<th>Slightly disagree</th>
<th>Slightly agree</th>
<th>Moderately agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>The government interferes far too much in our everyday lives.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sometimes government needs to make laws that keep people from hurting themselves.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>It's not the government's business to try to protect people from themselves.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The government should stop telling people how to live their lives.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The government should do more to advance society's goals, even if that means limiting the freedom and choices of individuals.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Government should put limits on the choices individuals can make so they don't get in the way of what's good for society.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
3. People in our society often disagree about issues of equality and discrimination. How strongly you agree or disagree with each of these statements?

*Mark only one oval per row.*

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly disagree</th>
<th>Moderately disagree</th>
<th>Slightly disagree</th>
<th>Slightly agree</th>
<th>Moderately agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>We have gone too far in pushing equal rights in this country.</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>❌</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Our society would be better off if the distribution of wealth was more equal.</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>❌</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>We need to dramatically reduce inequalities between the rich and the poor, different ethnic and religious groups, and men and women.</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>❌</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Discrimination against minorities is still a very serious problem in our society.</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>❌</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>It seems like minority ethnic, religious, and other groups don’t want equal rights, they want special rights just for them.</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>❌</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Society as a whole has become too soft and feminine.</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>❌</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
Imagine a situation where your work sent you to a large city in another part of your country. You request a ride from a local air taxi business to fly across the city for a reasonable price.

It will arrive on the roof of a parking garage next to you and will fly you directly to a landing pad next to your destination. The total time to board, fly, and exit the aircraft will take approximately 30 minutes. The aircraft that arrives is the size of a small passenger car and has four seats.

You are the sole occupant in the aircraft. The aircraft is completely autonomous and will travel by autopilot to your pre-selected destination without further input from you.

The aircraft has a whole-aircraft parachute installed that can be automatically deployed during an emergency.

4. Please state your level of agreement with the following statements:

   Mark only one oval per row.

<table>
<thead>
<tr>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neither agree nor disagree</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I would be willing to fly in this situation.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I would be comfortable flying in this situation.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I would have no problem flying in this situation.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I would be happy to fly in this situation.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I would feel safe flying in this situation.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I have no fear of flying in this situation.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I feel confident flying in this situation.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Demographics
5. Are you male or female?

Mark only one oval.

☐ Female
☐ Male
☐ Other: ________________________

6. What is your Age?

______________________________

7. What is your estimated annual household income?

Mark only one oval.

☐ $25,000 or less
☐ $25,001 - $50,000
☐ $50,001 - $80,000
☐ $80,001 - $130,000
☐ $130,001 or more

8. Please describe which description best matches the area where you live

Mark only one oval.

☐ Urban. I live in a city, metropolitan area, suburb, or town with a population more than 2,500 people.
☐ Rural. I live in a farm, town, village, or area with less than 2,500 people.

9. What is your ZIP code?

______________________________
10. During a typical week, how many days do you

*Mark only one oval per row.*

<table>
<thead>
<tr>
<th></th>
<th>0 days</th>
<th>1 day</th>
<th>2 days</th>
<th>3 days</th>
<th>4 days</th>
<th>5 days</th>
<th>6 days</th>
<th>7 days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ride a bicycle?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drive a car?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ride as a passenger in a car?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ride in a bus or van?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ride a train, metro, or other vehicle on rails?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ride in an aircraft?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Thank you for completing our survey! You are done now.

11. Please input your initials followed by your age. For example, if your name is John Smith and you are 23 years old, then you would put: JS23 *

Please return to MTurk and enter this code into the appropriate place so that you can be paid for your time.

I'm sorry, but you must be 18 years of age and provide informed consent in order to participate. Thank you for your time.
Survey Study

Purpose of this research: I am asking you to take part in a research project for the purpose of assessing how your cultural worldview influences your willingness to fly in autonomous aircraft. During this study, you will be asked to complete an online survey. You will be presented a hypothetical scenario in which you are flying in a small aircraft in an urban area. You will then be presented 12 statements about your cultural worldview and 7 statements about your willingness to fly. You will be asked to rate how strongly you agree or disagree with the statements. The survey then closes with a brief section of demographic questions. The completion of the survey is expected to take less than ten minutes. Your anonymous responses will be used in multiple analyses to understand air passenger preferences.

Eligibility: To be in this study, you must understand written English, be a resident of the United States or India, a registered user of Amazon Mechanical Turk® with 100 completed tasks and a 98% approval rate, and be at least 18 years of age.

Risks or discomforts: It is anticipated that this study will pose no greater risk than you would experience through normal daily activities.

Benefits: There are no known benefits to your participation other than knowing you have contributed to the advancement of scientific knowledge by helping to improve assessments of cultural orientations.

Confidentiality of records: The data collected during this study will be anonymous and confidential. MTurk does not share any information about your account or identity with us, and we have no way of learning your identity. MTurk may use your IP address to verify your country of origin for eligibility purposes but will not otherwise record the address. The researchers note that by using MTurk, as with any site hosting user information, there is always a small risk of a data breach.

Compensation: You will be compensated 50 cents for your time via Amazon's Mechanical Turk.

Contact: If you have any questions about this research project, you can contact Kenneth Ward, principal investigator, at wardk1@my.erau.edu, or the faculty member overseeing this project, Dr. Scott Winter, wintz25e@erau.edu. For any concerns or questions as a participant in this research, contact the Institutional Review Board (IRB) at 386-226-7179 or via email at teri.gabriel@erau.edu.

Voluntary participation: Your participation in this study is completely voluntary. You may discontinue your participation at any time without penalty or loss of benefits to which you are otherwise entitled. Should you wish to discontinue the research at any time, no information collected will be used.

CONSENT. By checking AGREE below, I certify that I am a resident of the United States or India, understand the information on this form, and voluntarily agree to participate in the study.
If you do not wish to participate in the study, simply close the browser or check DISAGREE which will direct you out of the study.

Please print a copy of this form for your records. A copy of this form can also be requested from Kenneth Ward, wardk1@my.erau.edu.

* Required

1. By selecting AGREE, I certify that I am a resident of the United States or India, 18 years or older, understand the information on this form, and voluntarily agree to participate in the study.*

Mark only one oval.

☐ AGREE

☐ DISAGREE

* Skip to section 7 (I’m sorry, but you must be 18 years of age and provide informed consent in order to participate. Thank you for your time.)

Imagine a situation where your work sent you to a large city in another part of your country. You request a ride from a local air taxi business to fly across the city for a reasonable price.

It will arrive on the roof of a parking garage next to you and will fly you directly to a landing pad next to your destination. The total time to board, fly, and exit the aircraft will take approximately 30 minutes. The aircraft that arrives is the size of a small passenger car and has four seats.

You are the sole occupant in the aircraft. The aircraft is completely autonomous and will travel by autopilot to your pre-selected destination without further input from you.

The aircraft does not have a whole-aircraft parachute installed.

Cultural worldview

https://docs.google.com/forms/d/1eDiV8DDOhBbBv_Rnoexva6wJ5CAWq4tNDMIUIfhmLw/edit
2. People in our society often disagree about how far to let individuals go in making decisions for themselves. How strongly you agree or disagree with each of these statements?

*Mark only one oval per row.*

<table>
<thead>
<tr>
<th>Statement</th>
</tr>
</thead>
<tbody>
<tr>
<td>The government interferes far too much in our everyday lives.</td>
</tr>
<tr>
<td>Sometimes government needs to make laws that keep people from hurting themselves.</td>
</tr>
<tr>
<td>It’s not the government’s business to try to protect people from themselves.</td>
</tr>
<tr>
<td>The government should stop telling people how to live their lives.</td>
</tr>
<tr>
<td>The government should do more to advance society’s goals, even if that means limiting the freedom and choices of individuals.</td>
</tr>
<tr>
<td>Government should put limits on the choices individuals can make so they don’t get in the way of what’s good for society.</td>
</tr>
</tbody>
</table>

---

https://docs.google.com/forms/d/1eDfV8DDibhBv_Rmnoesw8wad5CAWh-q-6ND6UJfwmh/edit
3. People in our society often disagree about issues of equality and discrimination. How strongly you agree or disagree with each of these statements?

*Mark only one oval per row.*

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly disagree</th>
<th>Moderately disagree</th>
<th>Slightly disagree</th>
<th>Slightly agree</th>
<th>Moderately agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>We have gone too far in pushing equal rights in this country.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Our society would be better off if the distribution of wealth was more</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>equal.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>We need to dramatically reduce inequalities between the rich and the</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>poor, different ethnic and religious groups, and men and women.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discrimination against minorities is still a very serious problem in our</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>society.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>It seems like minority ethnic, religious, and other groups don’t want</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>equal rights, they want special rights just for them.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Society as a whole has become too soft and feminine.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Imagine a situation where your work sent you to a large city in another part of your country. You request a ride from a local air taxi business to fly across the city for a reasonable price.

It will arrive on the roof of a parking garage next to you and will fly you directly to a landing pad next to your destination. The total time to board, fly, and exit the aircraft will take approximately 30 minutes. The aircraft that arrives is the size of a small passenger car and has four seats.

You are the sole occupant in the aircraft. The aircraft is completely autonomous and will travel by autopilot to your pre-selected destination without further input from you.

The aircraft does not have a whole-aircraft parachute installed.

4. Please state your level of agreement with the following statements:

Mark only one oval per row.

<table>
<thead>
<tr>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neither agree nor disagree</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I would be willing to fly in this situation.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>I would be comfortable flying in this situation.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>I would have no problem flying in this situation.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>I would be happy to fly in this situation.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>I would feel safe flying in this situation.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>I have no fear of flying in this situation.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>I feel confident flying in this situation.</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

Demographics

https://docs.google.com/forms/d/1eDfV8DDbBv_RmoeQv46wju5CAWq-6NDMUiJfmlh/edit
5. Are you male or female?

Mark only one oval.

☐ Female
☐ Male
☐ Other: ________________________________

6. What is your Age?

_____________________________________

7. What is your estimated annual household income?

Mark only one oval.

☐ ₹15,000 or less
☐ ₹15,001 - ₹30,000
☐ ₹30,001 - ₹50,000
☐ ₹50,001 - ₹85,000
☐ ₹85,001 or more

8. Please describe which description best matches the area where you live

Mark only one oval.

☐ Urban. I live in a city, metropolitan area, suburb, or town with a population more than 2,500 people.
☐ Rural. I live in a farm, town, village, or area with less than 2,500 people.

9. What is your Postal Index Number (PIN code) for your home?

______________________________
10. During a typical week, how many days do you

Mark only one oval per row.

<table>
<thead>
<tr>
<th></th>
<th>0 days</th>
<th>1 day</th>
<th>2 days</th>
<th>3 days</th>
<th>4 days</th>
<th>5 days</th>
<th>6 days</th>
<th>7 days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ride a bicycle?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drive a car?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ride as a passenger in a car?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ride in a bus or van?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ride a train, metro, or other vehicle on rails?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ride in an aircraft?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Thank you for completing our survey! You are done now.

11. Please input your initials followed by your age. For example, if your name is John Smith and you are 23 years old, then you would put: JS23 *

Please return to MTurk and enter this code into the appropriate place so that you can be paid for your time.

I'm sorry, but you must be 18 years of age and provide informed consent in order to participate. Thank you for your time.

https://docs.google.com/forms/d/1eDHeV8DDrbBv_Rmoeuxv6wJd5CAWq-6NDM1UIfwmw/edit
Condition 1 x 1

Survey Study

Purpose of this research: I am asking you to take part in a research project for the purpose of assessing how your cultural worldview influences your willingness to fly in autonomous aircraft. During this study, you will be asked to complete an online survey. You will be presented a hypothetical scenario in which you are flying in a small aircraft in an urban area. You will then be presented 12 statements about your cultural worldview and 7 statements about your willingness to fly. You will be asked to rate how strongly you agree or disagree with the statements. The survey then closes with a brief section of demographic questions. The completion of the survey is expected to take less than ten minutes. Your anonymous responses will be used in multiple analyses to understand air passenger preferences.

Eligibility: To be in this study, you must understand written English, be a resident of the United States or India, a registered user of Amazon Mechanical Turk® with 100 completed tasks and a 98% approval rate, and be at least 18 years of age.

Risks or discomforts: It is anticipated that this study will pose no greater risk than you would experience through normal daily activities.

Benefits: There are no known benefits to your participation other than knowing you have contributed to the advancement of scientific knowledge by helping to improve assessments of cultural orientations.

Confidentiality of records: The data collected during this study will be anonymous and confidential. MTurk does not share any information about your account or identity with us, and we have no way of linking your identity. MTurk may use your IP address to verify your country of origin for eligibility purposes but will not otherwise record the address. The researchers note that by using MTurk, as with any site hosting user information, there is always a small risk of a data breach.

Compensation: You will be compensated 50 cents for your time via Amazon’s Mechanical Turk.

Contact: If you have any questions about this research project, you can contact Kenneth Ward, principal investigator, at wardk1@my.erau.edu, or the faculty member overseeing this project, Dr. Scott Winter, winte25e@erau.edu. For any concerns or questions as a participant in this research, contact the Institutional Review Board (IRB) at 386-226-7179 or via email at teri.gabriel@erau.edu.

Voluntary participation: Your participation in this study is completely voluntary. You may discontinue your participation at any time without penalty or loss of benefits to which you are otherwise entitled. Should you wish to discontinue the research at any time, no information collected will be used.

CONSENT. By checking AGREE below, I certify that I am a resident of the United States or India, understand the information on this form, and voluntarily agree to participate in the study.

If you do not wish to participate in the study, simply close the browser or check DISAGREE which will direct you out of the study.

Please print a copy of this form for your records. A copy of this form can also be requested from Kenneth
1. By selecting AGREE, I certify that I am a resident of the United States or India, 18 years or older understand the information on this form, and voluntarily agree to participate in the study. *

* Mark only one oval.

☐ AGREE

☐ DISAGREE

Skip to section 7 (I'm sorry, but you must be 18 years of age and provide informed consent in order to participate. Thank you for your time.)

Imagine a situation where your work sent you to a large city in another part of your country. You request a ride from a local air taxi business to fly across the city for a reasonable price.

It will arrive on the roof of a parking garage next to you and will fly you directly to a landing pad next to your destination. The total time to board, fly, and exit the aircraft will take approximately 30 minutes. The aircraft that arrives is the size of a small passenger car and has four seats.

You are the sole occupant in the aircraft. The aircraft is completely autonomous and will travel by autopilot to your pre-selected destination without further input from you.

The aircraft has a whole-aircraft parachute installed that can be automatically deployed during an emergency.

Cultural worldview
2. People in our society often disagree about how far to let individuals go in making decisions for themselves. How strongly you agree or disagree with each of these statements?

*Mark only one oval per row.*

<table>
<thead>
<tr>
<th>The government interferes far too much in our everyday lives.</th>
<th>Strongly disagree</th>
<th>Moderately disagree</th>
<th>Slightly disagree</th>
<th>Slightly agree</th>
<th>Moderately agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sometimes government needs to make laws that keep people from hurting themselves.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>It's not the government's business to try to protect people from themselves.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>The government should stop telling people how to live their lives.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>The government should do more to advance society's goals, even if that means limiting the freedom and choices of individuals.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Government should put limits on the choices individuals can make so they don't get in the way of what's good for society.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>
3. People in our society often disagree about issues of equality and discrimination. How strongly you agree or disagree with each of these statements?

*Mark only one oval per row.*

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly disagree</th>
<th>Moderately disagree</th>
<th>Slightly disagree</th>
<th>Slightly agree</th>
<th>Moderately agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>We have gone too far in pushing equal rights in this country.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Our society would be better off if the distribution of wealth was more equal.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>We need to dramatically reduce inequalities between the rich and the poor, different ethnic and religious groups, and men and women.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discrimination against minorities is still a very serious problem in our society.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>It seems like minority ethnic, religious, and other groups don't want equal rights, they want special rights just for them.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Society as a whole has become too soft and feminine.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Imagine a situation where your work sent you to a large city in another part of your country. You request a ride from a local air taxi business to fly across the city for a reasonable price.

It will arrive on the roof of a parking garage next to you and will fly you directly to a landing pad next to your destination. The total time to board, fly, and exit the aircraft will take approximately 30 minutes. The aircraft that arrives is the size of a small passenger car and has four seats.

You are the sole occupant in the aircraft. The aircraft is completely autonomous and will travel by autopilot to your pre-selected destination without further input from you.

The aircraft has a whole-aircraft parachute installed that can be automatically deployed during an emergency.

4. Please state your level of agreement with the following statements:

*Mark only one oval per row.*

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neither agree nor disagree</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I would be willing to fly in this situation.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I would be comfortable flying in this situation.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I would have no problem flying in this situation.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I would be happy to fly in this situation.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I would feel safe flying in this situation.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I have no fear of flying in this situation.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>I feel confident flying in this situation.</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

Demographics
5. Are you male or female?

*Mark only one oval.*

- Female
- Male
- Other: ______________________

6. What is your Age?

______________________________

7. What is your estimated annual household income?

*Mark only one oval.*

- ₹15,000 or less
- ₹15,001 - ₹30,000
- ₹30,001 - ₹50,000
- ₹50,001 - ₹85,000
- ₹85,001 or more

8. Please describe which description best matches the area where you live

*Mark only one oval.*

- Urban. I live in a city, metropolitan area, suburb, or town with a population more than 2,500 people.
- Rural. I live in a farm, town, village, or area with less than 2,500 people.

9. What is your Postal Index Number (PIN code) for your home?

______________________________
10. During a typical week, how many days do you

*Mark only one oval per row.*

<table>
<thead>
<tr>
<th></th>
<th>0 days</th>
<th>1 day</th>
<th>2 days</th>
<th>3 days</th>
<th>4 days</th>
<th>5 days</th>
<th>6 days</th>
<th>7 days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ride a bicycle?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drive a car?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ride as a passenger in a car?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ride in a bus or van?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ride a train, metro, or other vehicle on rails?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ride in an aircraft?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Thank you for completing our survey! You are done now.

11. Please input your initials followed by your age. For example, if your name is John Smith and you are 23 years old, then you would put: JS23

---

Please return to MTurk and enter this code into the appropriate place so that you can be paid for your time.

I'm sorry, but you must be 18 years of age and provide informed consent in order to participate. Thank you for your time.