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# Factors that predict passengers willingness to fly during and after the COVID-19 pandemic

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## ABSTRACT

**Background:** Prior research has examined consumer willingness to fly in a variety of situations, including during disease outbreaks. However, to date, no study that we know of has identified what type of person is willing to fly during the COVID-19 pandemic.

**Methods:** Six hundred and thirty-two participants from the United States were asked to complete a survey designed to capture demographics, personality measures, emotional states and travel purposes. The data were collected in two stages in order to both develop a descriptive regression equation and a predictive model.

**Results:** Regression equations were created for both business and pleasure travel, and the following predictors were significant for both scenarios: perceived threat from COVID-19, agreeableness, affect, and fear. These models accounted for 66–67% of the variance in willingness to fly.

**Conclusion:** Airlines and governments could use these findings to help control the message to potential passengers on actions being taken to provide a safe flying experience, such as mask wearing policies and aircraft disinfectant procedures.

## 1. Introduction

The perceived threat from COVID-19 is very real, and people are afraid for various reasons including losing their employment, becoming seriously ill, transmitting the disease to family or friends, being responsible for their death and suffering, and general financial loss associated with the virus (Conway et al., 2020; Spitzmuller et al., 2020). There has been considerable research examining consumer willingness to fly in a variety of situations (Anania et al., 2018a,b; Bergstrom and McCaul, 2004; Ragbir et al. 2018; Rice and Winter 2015; Rice et al., 2015; Winter et al., 2017). However, to date, no study that we know of has identified the factors that predict what type of person is willing to fly during the COVID-19 pandemic.

The global aviation industry has enjoyed decades of steady growth, even in the face of previous global catastrophes such as the 9/11 terrorist attacks in 2001 and the global financial crisis of 2008. Aviation has been largely resilient with passenger travel demands increasing at a steady pace of approximately 4.5% annually (International Air Transportation Association (IATA), 2019a; Olsthoorn, 2001). However, aviation has never been impacted by a global pandemic of the current

proportion, which novel coronavirus officially known as COVID-19, has pervaded over 46 countries, infecting over 3.7 million people and causing 230,000 deaths since December 2019 (Smidt, 2020; World Health Organization, 2020a). Sevilla (2018) identified that infections similar to COVID-19 (H1N1 and SARS) had the potential to be nationally and internationally from air travel as has appeared to be the case in the current pandemic.

Within the past three months, the global aviation industry has experienced a 70%–95% reduction in passenger demand (Shepardson et al., 2020; Whitely et al., 2020). Aviation experts and aviation executives concur that increasing passengers' confidence in their personal safety is a complex challenge that must be overcome before commercial aviation can move on to what will likely be a new era that is vastly different than what passengers have become accustomed to (Shepardson et al., 2020). Given the novelty of this severe decrease in air travel, the purpose of the current study was to produce two predictive statistical models that would identify the significant factors related to the types of individuals who would be willing to fly for both business and pleasure given the current pandemic.

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## 2. Background and literature review

### 2.1. Passenger perceptions

A survey conducted by IATA in April 2020 concluded that 30% of respondents would wait six months or more before they considered commercial airline travel and an additional 10% stated that they would not travel before a year or more had passed. This survey suggests that the willingness to travel by air will be significantly decreased for the near future (IATA, 2020). In response to this marked decrease in passenger loads, airlines are communicating directly with their customers, most commonly by email, to reassure passengers about the safety precautions they are undertaking including robust cleaning, disinfecting, and social distancing procedures (Shepardson et al., 2020). Delta Airlines CEO, Ed Bastian stated in a letter to employees "... We should be prepared for a choppy, sluggish recovery even after the virus is contained, ... I estimate the recovery period could take two to three years" (Whitely et al., 2020, n.p.). When passenger confidence and willingness does increase, IATA speculates that people will prefer to fly on domestic routes as opposed to international routes.

#### 2.1.1. Passenger centric operations

Passengers are the primary revenue generator for most airlines; freight and cargo are usually secondary revenue generators (Sinha, 2019; Wells, 2007). In order for a given flight to break even, most airlines need to operate at least 67% load factor (Sinha, 2019), which is the relationship between available seat miles and revenue passenger seat miles realized (i.e., the percentage of seats available filled with paying customers). The load factor has a critical impact on the cost and quality of the service that an airline is able to provide (Wells, 2007). In anticipation of the anticipated growth in demand, commercial airlines were scheduled to take delivery of over 2206 new aircraft, which would increase the global fleet to over 31,000 aircraft. These new orders represent an investment of around \$123 billion U.S Dollars.

### 2.2. Predictors explored in this study

This study explored a total of 23 possible predictors that may influence a passenger's willingness to fly for either business or pleasure. The predictors are discussed under five categories: a) personality predictors, b) demographic predictors c), affect or emotional predictors, d) health predictors, and, e) air travel predictors. Previous research has indicated that some of these predictors may affect a passenger's willingness to fly (Rice et al., 2019; Winter et al., 2018; Winter, Thropp and Rice et al., 2019).

#### 2.2.1. Personality predictors

Personality type has been shown to affect an individual's behavior, attitude and decision-making processes in many situations, including consumer purchasing, investing in the stock market, taking risks, and decisions made in professional and personal environments (Miller and Dollard, 1941; Scott and Bruce, 1995; Riaz et al., 2012). There are five main categories of personality traits that have been modeled into useful and widely accepted measures to explore and classify behavior and predict outcomes. Many of these scales have their foundational roots in the "five-factor" model, also described as the "big Five" (Costa and McCrae, 1992; McCrae and Costa, 1997; Nicholson, Soane, Fenton-O'Creevy and Willman, 2005). The five-factor model includes: neuroticism, extraversion, openness, agreeableness, and conscientiousness (John and Srivastava, 1999).

Neuroticism is an individual's tendency towards a nervous and insecure disposition. They tend to suffer anxiety, emotional instability, and frequently sadness and hostility. It is possible that this personality type may be less willing to fly given the COVID-19 pandemic, and thus was included in the model. Extraversion tends towards an outward facing emotionally positive disposition, generally energetic, socially

focused, and usually exhibits assertiveness. Due to their outgoing nature, it is possible that those participants who rate high in extraversion may be more willing to fly. Openness is a general description of an individual who has a broad and original depth and complexity of both mental and lived experiences. A prior study related to willingness to undergo robotic surgery found openness to be a significant predictor (Anania et al. 2020). Agreeableness is described as a quality focused disposition on personal interactions and relationships, a general tendency towards altruism, and compassion. Individuals who score high in agreeableness are often friendly, helpful, considerate of others, generous, and trustworthy (Germine et al., 2012; Rahafar et al., 2017). Studies have also indicated that personality traits scoring high on agreeableness is a predictor of behavior that minimizes conflict and disagreements with others in both personal and professional environments (Germine et al., 2012). It is possible that these traits may serve as a significant predictor of willingness, and thus, it was included in the model as a potential predictor. Conscientiousness is a trait often described as intellect and imagination (Donnellan et al., 2006), and represents characteristics of persistence and motivation. Individuals who are predominantly rated as conscientious are usually highly organized and exhibit self-control in social forums. The traits related to conscientiousness may serve as a predictor of willingness. Personality was assessed in this study by utilizing the 20-item Mini-IPIP scale (Donnellan et al., 2006). The 20-item Mini-IPIP includes the following personality traits: neuroticism, extraversion, openness, agreeableness, intellect/imagination (conscientiousness).

This study also explores the propensity for risk taking as possible predictors of willingness to fly during the presence of the novel coronavirus. Risk taking was measured by the General Risk Propensity Scale (GriPS) (Zhang et al., 2018), which is an eight-item assessment measured using a five-point Likert scale. Its primary purpose is to measure an individual's risk-taking behaviors and inclinations toward certain activities, such as gambling and extreme sports. This scale can be utilized to determine a risk-taking threshold. All of these previously validated scales can be found in Appendix A1.

#### 2.2.2. Demographic predictors

Demographic questions in the survey included age, gender, ethnicity, education level, annual income, political view, if they had lost their job due to COVID-19, and their religiosity level. The study also asked participant about their income to explore whether higher income individuals would be more willing to fly than those of low incomes.

Current research indicates significant division between democrats and republicans when it comes to opinions on risk and messages associated with the novel coronavirus (Mitchell and Oliphant, 2020). Previous research has also indicated political views to be a factor in other 'willingness' research related to community wellbeing and protection (Winter et al., 2016; Winter et al., 2018).

#### 2.2.3. Affect (emotional) predictors

Emotions or, 'affect' have been found to play a significant role in decision making in both work and personal settings and plays a role in a person's attitudes and behavior (Sayegh et al., 2004). The terms 'affect' and 'feelings' are often used interchangeably (Isen, 2000); however, they are also described as very distinct from each other (Barrett, 1999; Fowles, 1980). The value of general affect is an aggregate of affect complex independent values and are bipolar in nature, describing a tending towards positive affect value or tending towards negative affect value. Previous studies have indicated that 'affect' can have a significant effect on willingness to fly (Anania et al., 2018; Mehta et al., 2014; Rice et al., 2015; Winter et al., 2017), and thus affect was selected as a possible predictor for the current study.

Related to affect is the work conducted by Ekman and Friesen (1971) who developed a methodology for researching the theory of using a graphical representation of six universal emotions. This scale is often referred to as the 'universal emotion scale' (Ajzen and Fishbein, 2005; Sayegh et al., 2004). The six universal emotions are anger, disgust, fear,

happiness, sadness, and surprise (Ajzen and Fishbein, 2005). As humans it is a natural evolutionary response to experience disgust and/or fear to a potentially dangerous situation, object, animal or another person, this affect response plays a significant role in human learning and evolution (Cloninger, 1987; Fowles, 1980; Millard and Dollard, 1941; Plutchik, 2001). Fear can be responsible for decision making rational or otherwise, and fear can support bias and misjudgments (Tversky and Kahneman, 1979). Prior studies have shown that these six expressions are recognized irrespective of an individual's culture, ethnicity, language or other background factors. As they relate to willingness, previous studies have found that disgust (Winter and Trombley, 2019) and fear (Anania et al. 2020; Rice et al., 2019) are significant predictor variables of willingness and thus this grounding was used to include them in the current study.

The Flight Anxiety Situations Questionnaire (FAS) (Van Gerwen, Spinhoven, Van Dyck and Diekstra, 1999), was used in this study to determine if participants had a fear or an immense anticipatory anxiety of flying. This scale is a thirty-two item, three-factor scale that shares a similar five-point Likert scale measurement with many of the scales utilized for this study. The three factors are general flight anxiety, anticipatory flight anxiety, and in-flight anxiety. Given that most people have been precautious and fearful of contracting the COVID-19 virus recently, there may be a certain level of anxiety that may be present when examining people's willingness toward any scenario, including their willingness to fly in an enclosed aircraft. As a result, we only selected the anticipatory flight anxiety scale for use in the current study. The scale can be found in [Appendix A1](#).

#### 2.2.4. Health predictors

Approximately 25% of adults under the age of 65 in the United States have comorbidities that increase their risk of becoming seriously ill from COVID-19 (Nania & AARP, 2020). Medical experts suggest that people who have any underlying medical conditions including heart disease, obesity, asthma, and diabetes may explain higher rates of illness and death due to COVID-19 (Nania & AARP, 2020). Paying for health insurance and health care is an expense that may lead even the average income earner to sacrifice other basic needs or abandon certain treatments altogether (Morisako, Tauali'i, Ambrose and Withy, 2017; Russell, 1996). Those who have a lower ability to maintain a satisfactory level of health care are likely not willing to expose themselves to higher risk of requiring additional medical expense. Families who have children or at-risk people at home may also be less willing to risk exposing a family member to the novel coronavirus. This study therefore explored three possible predictors under the category of health-related predictors: a) the perception of their current health, b) satisfaction with their current health care provider, and c) how many children they have.

The Perceived COVID-19 Threat Questionnaire (Conway et al., 2020) was developed for the CDC to collect information on an individual's perception of the current threat of COVID-19 pandemic. The version of the questionnaire implemented for this study lists six items that are measured with seven-point Likert scale where 1 represented "not true at all" and 7 represents "very true of me." The Perceived COVID-19 Threat Questionnaire is an important scale for use in this study as it provides a measure of how participant's perception of the pandemic could affect their actions in varying scenarios including that of flight willingness. The scale can be found in [Appendix A1](#).

#### 2.2.5. Air travel predictors

This study also examines frequency of air travel in order to determine whether frequent travelers for business would indicate different willingness to fly than those who travel less or travel purely for pleasure. The Willingness to Fly scale (Rice et al., 2015, 2020) is a scale developed, and subsequently validated in numerous studies analyzing participant's desire to fly in various scenarios (Rice and Winter 2015; Rice et al., 2015; Rice et al., 2015a,b; Winter et al., 2017). Therefore, the willingness to fly scale was selected as a valid measure of the outcome variable

in the current study. The scale includes seven items that are measured using a strongly disagree to strongly agree bipolar rating system. Furthermore, we used the scale given two scenarios, whether the reason to fly was for business or pleasure. This scale can be found in [Appendix A1](#). We hypothesize that leisure travelers who only fly to vacation destinations or to see family and friends may be less likely to risk contracting and spreading the novel coronavirus, while, those who frequently travel, may perceive less risk, possibly due to more familiarity of exposure to traveling by air (Sönmez and Graefe, 1998).

#### 2.3. Current study

Our model was developed using 23 possible predictors: ethnicity, education level, age, gender, number of at-risk COVID-19 family members, current health level, level of religiousness, number of children, primary purpose of travel pre-coronavirus, pre-COVID-19 flight anxiety, perceived threat from COVID-19, satisfactions with health insurance, anticipatory flight anxiety, annual frequency of travel, extraversion, agreeableness, conscientiousness, neuroticism, intellect/imagination, risk taking, affect, level of disgust, and level of fear.

### 3. Methods

#### 3.1. Participants

Six Hundred and thirty-two participants from the United States were recruited for the study. In order to conduct the statistical analysis, these participants were randomly divided into two samples. The Stage 1 sample was selected to develop the regression model, and the separate Stage 2 sample was used to assess model fit. The dataset for Stage 1 consisted of 316 participants (147 males, 168 females, 1 no response). An initial data analysis found no participants with significant missing data, and for reflective items, known value replacement was used to impute values (Hair et al., 2016). Independence of observations was observed through the Durbin-Watson statistic of 1.876 and 1.891 for the willingness to fly for business and willingness to fly for pleasure models, respectively. A review of the interitem correlations of the independent variables found all values were less than 0.5, except for the relationships between fear and affect and fear and disgust,  $-0.53$  and  $0.66$ , respectively. However, these values are well below the suggested cutoff of 0.9 by Hair et al. (2016). There were no issues with multicollinearity as all tolerance values were above 0.1 and VIF values were below 10. Mahalanobis distances revealed no cases were considered outliers, all leverage values were less than 0.2, and all Cook's distance values were less than 1, suggesting no influential points in the data. For scaled items, skewness and kurtosis values were all within  $\pm 1.4$  as shown in [Appendix B1](#). Additionally, Cronbach's Alpha values and Guttman Split Half coefficients were assessed for all scaled items. All were above the minimum cutoff threshold of 0.7, with many above 0.8 and 0.9. Thus, these scaled items were averaged prior to data analysis to produce one score for each scale. The reporting of these coefficients can be found in [Appendix B1](#). Linearity was established through a visual inspection of partial regression plots between the dependent and independent variables, and normality through a visual assessment of the standardized residuals of each dependent variable. The histograms for each dependent variable can be found in [Appendix C](#). All other assumptions of regression were verified. Therefore, all 316 cases were deemed eligible for inclusion in the data analysis. The average age of participants from Stage 1 was 39.85 ( $SD = 13.50$ ) years old. For the Stage 2 data, there were 316 participants. An initial data screening found two participants who had excessive missing data, and thus were removed from the dataset, resulting in 314 eligible cases (150 males, 164 females) for data analysis and model fit. The Stage 2 average age was 39.92 ( $SD = 13.40$ ) years old.

Participants for the study were recruited using the crowdsourcing platform Amazon's <sup>®</sup> Mechanical Turk <sup>®</sup> (MTurk). This platform



provides a connection between willing participants and researchers. Previous studies (Buhrmester et al., 2011; Germine et al., 2012; Rice and Winter 2020; Rice et al., 2017) have demonstrated that data collected via MTurk is as reliable as traditional laboratory data. An a priori sample size estimate was calculated using the software program G\*Power. Using the parameters of an estimated medium effect size of 0.15, alpha level of significance of 0.05, power of 0.95, and 23 predictors indicated a minimum of 234 participants were needed for each stage of the data analysis. This minimum was exceeded with 316 participants in Stage 1 and 314 participants in Stage 2.

### 3.2. Materials and stimuli

The electronic instrument was deployed via the use of Google Forms® (Alphabet Corp., Mountain View, CA, USA). Participants were first presented with an electronic consent form. After consenting to the study, participants received instructions for completing the survey. The survey instrument took approximately 10 min to complete. Participants were first asked questions related to their demographics such as their ethnicity; highest education level; age; gender; number of at risk COVID-19 family members; current health status using a scale from 1 = extremely unhealthy to 10 = extremely healthy; level of religiousness using a scale from 1 = not at all religious to 5 = extremely religious; and number of children. Questions were randomized on the page and rows, where appropriate, to prevent order effects.

Participants were then asked to provide information about their air travel history. This section included their primary purpose of air travel before COVID-19, either for work or pleasure; their pre-COVID flight anxiety on a scale from 1 = no flight anxiety at all to 5 = extreme flight anxiety; the anticipatory flight anxiety scale (Van Gerwen, Spinhoven, Van Dyck and Diekstra, 1999); satisfaction with their current health insurance from 1 = non-existent to 5 = extremely satisfied with my health insurance; perceived threat from COVID-19 (Conway et al., 2020); and average annual number of round trip flights completed.

Next, participants responded to the 20-item Mini-IPIP scale (Donnellan et al., 2006) to assess their levels of extraversion, agreeableness, conscientiousness, neuroticism, and intellect/imagination. Participants then completed the General Risk Propensity Scale (GriPS) (Zhang et al., 2018). Participants were then presented with the following situation, "Imagine a scenario where you would have to fly between two major cities within the next one to two weeks." They were asked to respond to an affect scale and pictures of two faces from Ekman and Friesen's (1971) universal facial expressions that indicated disgust and fear. This was followed by the same situation above, and they were asked to respond to the willingness to fly scale (Rice et al., 2020) for two situations: a) If the purpose of your trip was for BUSINESS/WORK; and b) If the purpose of your trip was for PLEASURE/LEISURE. Lastly, participants were thanked, compensated, and dismissed.

### 3.3. Design and statistical analysis

The current study followed a quantitative correlational design and two stages for data analysis. Multiple linear regression was used for statistical processing. Stage 1 developed the regression equations for the two statistical models, and Stage 2 was conducted to verify the predictive capabilities and validate the model fit of willingness to fly for business and pleasure.

## 4. Results

### 4.1. Stage 1 – regression equation development

Due to the exploratory nature of the study, a backward stepwise regression was conducted using the 316 participants from Stage 1. The results indicated two statistically significant models were produced for willing to fly for business and willingness to fly for pleasure.

#### 4.1.1. Willingness to fly for business

The following five predictors were significant for willingness to fly for business model: perceived threat from COVID-19, agreeableness, propensity of risk taking, affect, and fear. These predictors indicate that as a person's perceived threat from COVID-19, agreeableness, and fear increase, their willingness to fly for business decreases. Meanwhile, as their propensity of risk taking, and affect increase, so does their willingness to fly for business. The model resulted in an  $R^2$  of 0.677 (adjusted  $R^2$  of 0.672) which accounted for approximately 67% of the variance in participant's willingness to fly for business. The model was statistically significant,  $F(5, 306) = 128.41, p < .001$ . A summary of the analysis of regression is found in Table 1, and a summary of the significant coefficients is found in Table 2.

#### 4.1.2. Willingness to fly for pleasure

The following five predictors were significant for willingness to fly for pleasure model: primary purpose of travel before COVID-19, perceived threat from COVID-19, agreeableness, affect, and fear. These predictors indicate that as a person's perceived threat from COVID-19, agreeableness, and fear increase, their willingness to fly for pleasure decreases. Meanwhile, as their affect increases, so does their willingness to fly for pleasure. Lastly, if participants primarily travelled for business before COVID-19, they were more willing to fly for pleasure now. The model resulted in an  $R^2$  of 0.665 (adjusted  $R^2$  of 0.659) which accounted for approximately 66% of the variance in participant's willingness to fly for pleasure. The model was statistically significant,  $F(5, 306) = 121.36, p < .001$ . A summary of the analysis of regression is found in Table 1, and a summary of the significant coefficients is found in Tables 2a and 2b.

### 4.2. Stage 2 – model fit

The purpose of Stage 2 was to assess the model fit and predictive capabilities of the two regression models, using a separate sample of participants. For each participant, their actual willingness to fly scores for business and pleasure were collected, and these scores were compared to their predicted willingness to fly for business and pleasure scores calculated using the Stage 1 regression equations. Model fit was examined through the use of three metrics: a  $t$ -Test, correlation, and cross validated  $R^2$ .

#### 4.2.1. Willingness to fly for business

An independent samples  $t$ -test found no significant differences between the predicted stage 2 willingness to fly for business scores ( $M = -0.62, SD = 1.01$ ) and the actual stage 2 willingness to fly for business scores ( $M = -0.61, SD = 1.25$ ),  $t(626) = 0.142, p = .887$ . Since the predicted scores do not significantly vary from actual scores, it appears the original equation is a valid model to predict willingness to fly for business.

Second, a Pearson's correlation was conducted between the predicted stage 2 willingness to fly for business scores and actual stage 2 willingness to fly for business scores. The data suggest a statistically significant relationship exists,  $r(314) = 0.765, p < .001$ . The significance of this cross-validity coefficient provides further evidence of model fit.

In the final step, cross validated  $R^2$  was used to test model fit of the willingness to fly for business statistical equation. The cross validated

**Table 1**  
Analysis of regression model summaries from stage 1.

	Willingness to Fly Business	Willingness to Fly Pleasure
$R^2$	.677	.665
Adj. $R^2$	.672	.659
$F$	128.41	121.36
df	5, 306	5, 306
$p$	<.001	<.001

**Table 2a**  
Statistically significant regression coefficients from Stage 1 for Willingness to Fly Business.

	M(SD)	Beta	t	SE	Sig.	β
Constant	–	1.437	7.47	0.192	<.001	–
Perceived COVID Threat	4.63 (1.55)	–0.159	–5.24	0.030	<.001	–0.202
Agreeableness	3.75 (0.89)	–0.156	–3.34	0.047	.001	–0.114
Fear	5.63 (3.25)	–0.050	–3.19	0.016	.002	–0.135
Affect	–0.68 (1.20)	0.594	14.17	0.042	<.001	0.588
Propensity of Risk Taking	–0.52 (0.97)	0.095	2.13	0.045	.034	0.076

**Table 2b**  
Statistically significant regression coefficients from Stage 1 for Willingness to Fly Pleasure.

	M(SD)	Beta	t	SE	Sig.	β
Constant	–	1.451	7.04	.206	<.001	–
Perceived COVID Threat	4.63 (1.55)	–0.172	–5.36	0.032	<.001	–0.211
Agreeableness	3.75 (0.89)	–0.150	–3.05	0.049	.002	–0.106
Fear	5.63 (3.25)	–0.063	–3.77	0.017	<.001	–0.161
Affect	–0.68 (1.20)	0.599	14.31	0.042	<.001	0.571
Pre-COVID Travel Purpose	N/A	0.242	2.28	0.106	.023	0.077

Note: Pre-COVID Travel Purpose was nominal and thus no mean or standard deviation was calculated.

$R^2 = 1 - (1 - R^2)[(n + k)/(n - k)]$ , where  $R^2$  is the overall  $R^2$  from the stage 1 model, n is the sample size of the stage 1 sample, and k is the degrees of freedom. The analysis revealed a cross validated  $R^2 = 0.667$ , and this suggests how well the preliminary model would apply to other samples from the population. Based on the closeness of the overall  $R^2$  and the cross validated  $R^2$ , the presence of model fit is supported. Table 3 provides a summary of the model fit statistics for the willingness to fly for business model.

4.2.2. Willingness to fly for pleasure

An independent samples t-test found no significant differences between the predicted stage 2 willingness to fly for pleasure scores ( $M = -0.63, SD = 1.03$ ) and the actual stage 2 willingness to fly for pleasure scores ( $M = -0.60, SD = 1.30$ ),  $t(626) = 0.327, p = .744$ . Since the predicted scores do not significantly vary from actual scores, it appears the original equation is a valid model to predict willingness to fly for pleasure.

Pearson’s correlation was next conducted between the predicted stage 2 willingness to fly for pleasure scores and actual stage 2 willingness to fly for pleasure scores. The data was found to be statistically significant,  $r(314) = 0.768, p < .001$ . The significance of this cross-validity coefficient provides further evidence of model fit.

In the final step, cross validated  $R^2$  was used to test model fit of the willingness to fly for pleasure statistical equation. The analysis revealed a cross validated  $R^2 = 0.654$ , and this suggests how well the preliminary

**Table 3**  
Model Fit Summaries using Actual vs. Predicted Scores (Stage 2).

	t-Test			Correlation		Original $R^2$	Cross-Validated $R^2$
	t	df	Sig.	r	Sig.		
WTF- Business	0.142	626	.887	.765	<.001	.677	.667
WTF – Pleasure	0.327	626	.744	.768	<.001	.665	.654

model would apply to other samples from the population. Based on the closeness of the overall  $R^2$  and the cross validated  $R^2$ , the presence of model fit is supported. Table 3 provides a summary of the model fit statistics for the willingness to fly for pleasure model.

5. Discussion

The purpose of the current study was to identify the factors which predict what type of airline passenger would be willing to fly during and after the COVID-19 pandemic. We also developed a descriptive and predictive model that could be used by future agencies to identify potential passengers. During Stage 1, we generated a descriptive regression equation that successfully identified five significant predictors for business travelers. These predictors were perceived threat from COVID-19, agreeableness, risk taking propensity, affect, and fear.

This equation accounted for 67% of the variance in willingness to fly. In addition, a second equation for pleasure flights identified the following predictors: primary purpose of travel before COVID-19, perceived threat from COVID-19, agreeableness, affect, and fear. This equation accounted for 66% of the variance in WTF.

Perceived threat from COVID-19, agreeableness, affect and fear are significant predictors for both business and pleasure flights. Perceived threat from COVID-19 is an obvious reason for potential passengers to want to avoid flying. Although COVID-19 can be transmitted between airline passengers, humans often make decisions based on perceived threats which have not necessarily materialized, or even completely understood (Tversky and Kahneman, 1979).

Individuals who score high in agreeableness are often friendly, helpful, considerate, generous and trustworthy (Germiné et al., 2012; Rahafar et al., 2017), but are not necessarily conformists (Rahafar et al., 2017). People who fall into this category might not want to fly because they believe that they will endanger others, including family and friends.

Fear often intercorrelates with perceived threat, so it is not surprising to see that people who fear flying with COVID-19 are less willing to fly. Although fear may impair rational decision-making and promote an emotional response (Plutchik, 2001; Tversky and Kahneman, 1979), fear of COVID-19 transmission on public transportation is realistic. Passengers who weigh the costs and benefits of flying, may decide that it is rational to stay home.

General affect measures a complex number of individual emotions, but in general, it covers the positive and negative ones (Watson and Clark, 1992). In this case, the more positive one feels about flying with COVID-19, the more likely they are to be willing to do so. This is not surprising and falls in line with the findings about perceived threat and fear. In fact, it is not a stretch to assume that a person who sees a perceived threat will have negative emotions about it, and one of the emotions would very likely be fear.

5.1. Practical applications and recommendations

The economic impact of current pandemic is widespread and has especially affected travel and hospitality. Before people begin traveling freely, several conditions must be met, including the development of an effective vaccine or herd immunity and the availability of therapeutic options if a person becomes infected. Although some countries (e.g., New Zealand) have begun the process of re-starting their economies,

many others are still seeing exponential increases in the number of infections. Even after the virus begins to subside, however, airlines will have the difficult job of convincing passengers that it is safe to travel.

Because multiple factors may prevent people from flying, airlines will probably need to develop a comprehensive strategy to protect their passengers and then to explain why these steps will be effective. The first, obvious step, is to require that passengers and crew wear face coverings in accordance with CDC guidelines. In one study of respiratory diseases that are spread by droplets, the probability of direct transmission to passengers not seated in close proximity to an infectious passenger was found to be low (Hertzberg et al., 2018). Although no data currently exist on the feasibility of disinfection of whole aircraft, protocols that minimize the risk of transmission in operating rooms include disinfection and deep cleaning of surfaces with a quaternary ammonium compound (Dexter et al., 2020). There is evidence that ultraviolet light (UV-C) may also help to inactivate SARS-CoV-2 (Pavia et al., 2018). These steps may be required in order to ensure passenger safety for the foreseeable future, as will repeated messaging about the practical steps that are taken to minimize the risk of flying. In addition to disinfection, airlines will need to maintain social distancing on their aircraft in order to minimize the risk of spread. This may also help to signal the airlines' concern for their passengers.

### 5.2. Limitations

This study was confined by several limitations, primarily by the use of a convenience sample which tends to limit the generalizability of the results. MTurk is an efficient method that has been used to capture survey results from the general public to support cross-sectional studies. MTurk data represents a snapshot in time while the pandemic is rapidly evolving. MTurk is used by people who are willing and know how to complete online assessments. This study included participants from the United States only, and considering this is a global pandemic, future studies might query people of other nationalities who are also affected by the disease. Lastly, the researchers were required to trust that participants gave answers that truly reflected their beliefs.

Although the current study found five significant predictors for each model, there may be other factors that we did not evaluate. Continued research may also evaluate willingness to fly for business or pleasure from a longitudinal perspective, especially as advancements towards

making a vaccine and medical preparedness increases around the world.

## 6. Conclusions

The purpose of the current study was to identify what type of person would be willing to fly during and after the COVID-19 pandemic. Through the use of two stages, regression models were developed and shown to have predictive capabilities. In stage 1, models were created identifying significant variables that predicted at least 67% and 66% of the variance in willingness to fly for both business and pleasure travel models, respectively. Each model had five significant predictors, four of which were present in both models. These four predictors were perceived threat from COVID-19, agreeableness, affect, and fear. Model fit was assessed through the use of the three metrics and was found to be very strong indicating that both models had strong predictive capabilities. Airlines and government agencies could use the findings from the current study to help identify the messaging presented to customers to educate about actions being taken to provide a safe environment for commercial aviation. Policies on mask wearing or disinfecting procedures of aircraft could help work to alleviate fear and worry about resuming commercial flights, potentially increase willingness to fly, and assist the industry in providing clear messaging to passengers.

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### CRediT authorship contribution statement

**Tracy L. Lamb:** Conceptualization, Writing - original draft, Resources, Project administration. **Scott R. Winter:** Conceptualization, Writing - original draft, Formal analysis, Supervision. **Stephen Rice:** Conceptualization, Writing - original draft, Writing - review & editing. **Keith J. Ruskin:** Writing - original draft, Writing - review & editing. **Austin Vaughn:** Writing - original draft.

### Declaration of competing interest

No conflicts with any of the authors exist.

## Appendix D. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jairtraman.2020.101897>.

## Appendix A1

### Scales Used in This Study

1. Am the life of the party	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
2. Sympathize with others feelings	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
3. Get chores done right away	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
4. Have frequent mood swings	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
5. Have a vivid imagination	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
6. Don't talk a lot	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
7. Am not interested in other people's problems	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
8. Often forget to put things back in their proper place	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
9. Am relaxed most of the time	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
10. Am not interested in abstract ideas	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
11. Talk to a lot of different people at parties	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
12. Feel others emotions	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
13. Like order	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
14. Get upset easily	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
15. Have difficulty understanding ideas	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
16. Keep in the background	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
17. Am not really Interested in others	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
18. Make a mess of things	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
19. Seldom feel blue	Strongly disagree	Disagree	Neutral	Agree	Strongly agree

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Appendix A1 (continued)

20. Do not have a good imagination	Strongly disagree	Disagree	Neutral	Agree	Strongly agree				
1) Taking risks makes life more fun	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree				
2) My friends would say that I am a risk taker	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree				
3) I enjoy taking risks in most aspects of my life	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree				
4) I would take a risk even if it meant I might get hurt	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree				
5) Taking risks is an important part of my life	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree				
6) I commonly make risky decisions	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree				
7) I am a believer of taking chances	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree				
8) I am attracted, rather than scared by risk	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree				
You decide to take a plane	No anxiety	Slight anxiety	Moderate anxiety	Considerable anxiety	Overwhelming anxiety				
You buy a ticket	No anxiety	Slight anxiety	Moderate anxiety	Considerable anxiety	Overwhelming anxiety				
You enter the departure hall	No anxiety	Slight anxiety	Moderate anxiety	Considerable anxiety	Overwhelming anxiety				
You are waiting for the boarding call	No anxiety	Slight anxiety	Moderate anxiety	Considerable anxiety	Overwhelming anxiety				
You are walking in the direction of the gate	No anxiety	Slight anxiety	Moderate anxiety	Considerable anxiety	Overwhelming anxiety				
You are going through the gate	No anxiety	Slight anxiety	Moderate anxiety	Considerable anxiety	Overwhelming anxiety				
You enter the flight cabin	No anxiety	Slight anxiety	Moderate anxiety	Considerable anxiety	Overwhelming anxiety				
The doors are being closed	No anxiety	Slight anxiety	Moderate anxiety	Considerable anxiety	Overwhelming anxiety				
The takeoff is announced	No anxiety	Slight anxiety	Moderate anxiety	Considerable anxiety	Overwhelming anxiety				
Thinking about the coronavirus (COVID-19) makes me feel threatened			1. Not true of me at all	2.	3.	4.	5.	6.	7. Very true of me
I am afraid of the coronavirus (COVID-19)			1. Not true of me at all	2.	3.	4.	5.	6.	Very true of me
I am not worried about the coronavirus (COVID-19)			1. Not true of me at all	2.	3.	4.	5.	6.	7. Very true of me
I am worried that I or people I love will get sick from coronavirus (COVID-19)			1. Very true of me	2.	3.	4.	5.	6.	7. Very true of me
I am stressed around other people because I worry, I'll catch the coronavirus (COVID-19)			1. Not true of me at all	2.	3.	4.	5.	6.	7. Very true of me
I have tried hard to avoid other people because I don't want to get sick			1. Not true of me at all	2.	3.	4.	5.	6.	7. Very true of me
1) I would be happy to fly in this situation	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree				
2) I would be willing to fly in this situation	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree				
3) I have no fears of flying in this situation	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree				
4) I would be comfortable flying in this situation	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree				
5) I would have no problem flying in this situation	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree				
6) I feel confident flying in this situation	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree				
7) I would feel safe flying in this situation	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree				

Personality Scale (Donnellan et al., 2006), Risk Taking Scale (Zhang et al., 2018), Anticipatory Flight Anxiety Scale (adapted from Van Gerwen, Spinhoven, Van Dyck and Diekstra, 1999), Threat of Coronavirus scale (Conway et al., 2020), Willingness to Fly scale (Rice et al., 2020).

Appendix B1

Scaled Items Statistics

Item	Mean	Standard Deviation	Skewness	Kurtosis	Cronbach's Alpha	Guttman's Split Half
COVID1	4.0571	2.01978	-0.095	-1.273	0.90	0.90
COVID2	4.2476	1.94567	-0.125	-1.173		
COVID3R	5.0759	1.99378	-0.671	-0.869		
COVID4	4.819	1.8483	-0.518	-0.822		
COVID5	4.1551	1.91519	-0.078	-1.179		
COVID6	5.4127	1.66296	-0.950	0.127		
AFA1	2.0863	1.22823	0.837	-0.413	0.97	0.95
AFA2	1.8481	1.1474	1.240	0.512		
AFA3	2.1524	1.26023	0.796	-0.525		
AFA4	2.2077	1.21357	0.689	-0.570		
AFA5	2.0981	1.22663	0.850	-0.432		
AFA6	2.2152	1.26412	0.689	-0.684		
AFA7	2.449	1.29349	0.456	-0.864		
AFA8	2.3397	1.29802	0.618	-0.76		
AFA9	2.4254	1.28811	0.481	-0.897		
Risk1	-0.3217	1.17551	0.112	-0.999	0.95	0.95
Risk2	-0.6592	1.14805	0.529	-0.715		
Risk3	-0.6083	1.12596	0.455	-0.703		
Risk4	-0.6835	1.14136	0.478	-0.751		
Risk5	-0.5778	1.13267	0.399	-0.827		
Risk6	-0.727	1.09213	0.593	-0.533		
Risk7	0.0222	1.14664	-0.222	-0.931		
Risk8	-0.6422	1.1064	0.399	-0.824		
Affect1	-0.6424	1.26063	0.602	-0.759	0.98	0.96
Affect2	-0.6127	1.26535	0.464	-0.983		
Affect3	-0.6019	1.27552	0.513	-0.923		
Affect4	-0.7152	1.23747	0.658	-0.619		
Affect5	-0.7048	1.25371	0.647	-0.702		
Affect6	-0.6762	1.27316	0.641	-0.722		
Affect7	-0.7746	1.25556	0.723	-0.593		
WTF_BUS1	-0.3714	1.3609	0.238	-1.295	0.97	0.95
WTF_BUS2	-0.654	1.31052	0.595	-0.861		
WTF_BUS3	-0.5905	1.33804	0.512	-1.059		
WTF_BUS4	-0.6361	1.31312	0.549	-0.963		
WTF_BUS5	-0.6646	1.27297	0.633	-0.77		

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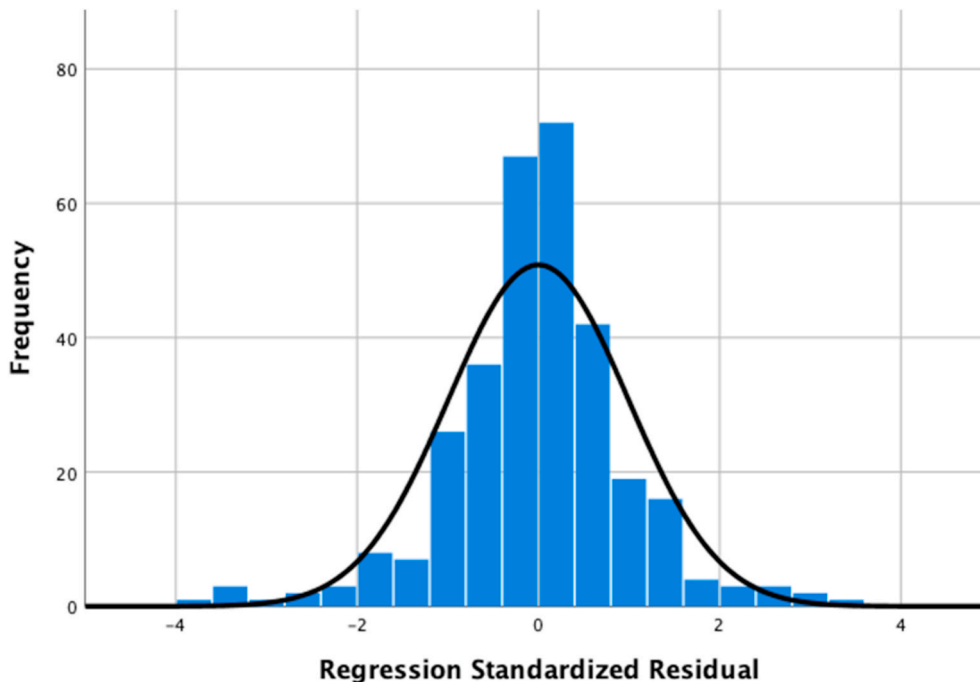
Appendix B1 (continued)

Item	Mean	Standard Deviation	Skewness	Kurtosis	Cronbach's Alpha	Guttman's Split Half
WTF_BUS6	-0.6266	1.27483	0.521	-0.955		
WTF_BUS7	-0.7732	1.25179	0.688	-0.733		
WTF_PLES1	-0.4952	1.39921	0.348	-1.313	0.98	0.96
WTF_PLES2	-0.6361	1.32515	0.535	-1.037		
WTF_PLES3	-0.6424	1.33879	0.563	-1.017		
WTF_PLES4	-0.6519	1.31621	0.514	-1.080		
WTF_PLES5	-0.6835	1.31458	0.665	-0.837		
WTF_PLES6	-0.6108	1.31309	0.497	-1.033		
WTF_PLES7	-0.5886	1.33157	0.496	-1.019		
E1	2.3185	1.16957	0.625	-0.473	0.81	0.85
E2R	2.9082	1.29999	0.163	-1.115		
E3	2.7707	1.30309	0.162	-1.143		
E4R	2.75	1.2127	0.382	-0.812		
A1	3.8814	1.04036	-0.864	0.200	0.80	0.88
A2R	3.6741	1.19712	-0.724	-0.403		
A3	3.731	1.03607	-0.753	0.079		
A4R	3.7278	1.18535	-0.634	-0.623		
C1	3.5191	1.17534	-0.492	-0.717	0.71	0.75
C2R	3.8386	1.21468	-0.821	-0.343		
C3	3.981	0.91874	-0.729	0.241		
C4R	4.0285	1.0642	-1.059	0.434		
I1	3.6698	1.15055	-0.692	-0.31	0.80	0.83
I2R	3.7595	1.20807	-0.725	-0.470		
I3R	3.8418	1.15757	-0.751	-0.449		
I4R	3.9114	1.15679	-0.866	-0.182		
N1	2.2405	1.1815	0.535	-0.873	0.70	0.79
N2R	2.3671	1.08587	0.547	-0.455		
N3	2.4241	1.17267	0.362	-0.992		
N4R	2.8639	1.28625	0.103	-1.139		

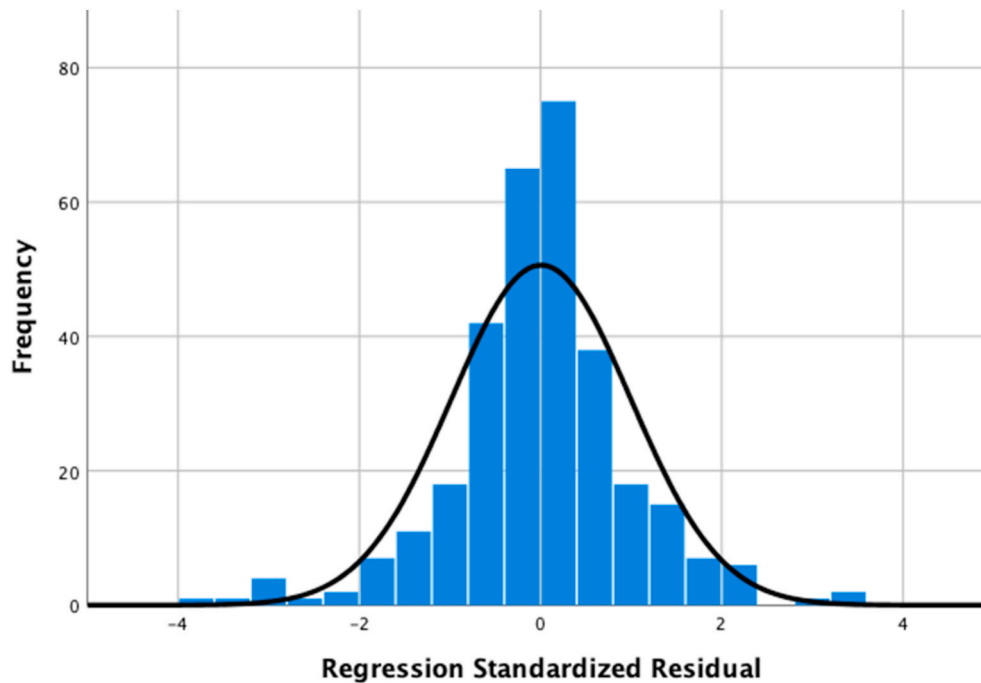
Notes: AFA = Anticipatory Flight Anxiety; WTF\_BUS = Willingness to fly for business; WTF\_PLES = Willingness to fly for pleasure; E = Extraversion; A = Agreeableness; C = Conscientiousness; I = Intellect/Imagination; N = Neuroticism.

Appendix C. Normality Assessment of Dependent Variable Standardized Residuals

Dependent Variable: Willingness to Fly for Business.



Dependent Variable: Willingness to Fly for Pleasure.



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